NorthConnex M1-M2 Water Quality Plan and Monitoring Program

NorthConnex & M2 Integration Project

Lendlease Bouygues Joint Venture

	Name	Position	Date	Signed/Authorised
Originator(s)	John Wiggers de Vries	Environment and Sustainability Manager	11 Oct 2018	[signature]
Authorised	Damien Hertslet	Executive Project Director	11 Oct 2018	[signature]

Document Number:
ALL-LLB-01-001-QA-PL-0062

Revision: 10

lendlease | BOUYGUES CONSTRUCTION AUSTRALIA

Document Control

Title:	Plan Title	Document No/Ref: ALL-LLB-01-0001-QA-PL-0062
General Description:	Water Quality Plan and Monitoring Program	
Document Path:		
Document Template:	Plan /Procedure: Version 25 July, 2016	

Revision

Revision	Date	Description	Section/Page No.	Approved
Revision 01	11-11-2014	Draft		Liz Webb (EMM)
Revision 02	28-01-2015	Draft		Liz Webb (EMM)
Revision 03	23-02-2015	Draft		Liz Webb (EMM)
Revision 04	25-02-2015	Draft		Liz Webb (EMM)
Revision 05	26-02-2015	Draft		Liz Webb (EMM)
Revision 06	27-02-0215	Draft		Liz Webb (EMM)
Revision 07	26-03-2015	Draft		Philip Towler (EMM)
Revision 08	30-03-2015	Draft		-
Revision 09	02-04-2015	Draft		Duncan Peak (EMM)

Revision	Date	Description	Section/Page No.	Approved
Revision 10	01-05-2015	Draft		Philip Towler (EMM)
Revision 11	06-05-2015	Draft		Philip Towler (EMM)
Revision 12 TeamBinder Revision 04	29-05-2015	For DP&E Approval		Philip Towler (EMM)
Revision 13 TeamBinder Revision 5	13-04-2017	Updates: · Revised groundwater drawdown zone · Inclusion of additional groundwater users · Inclusion of details of groundwater monitoring bores added to the monitoring network · Amendment to analytical suite and frequency of sampling / monitoring · Addition of operational aspects throughout document	Section1 Section 2 Section 3 Section 4 Section 5 Section 6 Section 7 Section 8 Section 9	Philip Towler (EMM) & Grant Sainsbery (LLBJV)
Revision 14 TeamBinder Revision 6	15-06-2017	Updates following Client comment		Grant Sainsbery
Revision 15 TeamBinder Revision 7	30-10-2017	Incorporation of GHD Operational Phase Water Assessment outcomes.	Section 4.1.2 Section 6.3.5 Section 7.7	Grant Sainsbery

Revision	Date	Description	Section/Page No.	Approved
Revision 16 TeamBinder Revision 8	27-11-2017	Close out of client comments - Office of Water references changes to Crown Lands & Water Division`	Various	Grant Sainsbery
Revision 17 TeamBinder Revision 9	24-05-2018	Amendments following Agency Comment	Key Changes: Section 4.12 Table 6.2 Table 6.3 Section 6.3.3 Section 6.3.5 Figure 6.4 Section 6.3.6 Figure 6.5 Section 7.4 Tables 7.2, 7.3, 7.4 Section 7.6.2 Section 7.7 Section 7.7.2 Tables 7.7, 7.8, 7.9 Table 7.10, 7.11 Section 7.7.3 Section 7.7.6 Tables 7.12 – 7.17 Section 8.2.1 Table 8.1 Section 8.3.1 Table 8.4 Section 8.5.1 Table 8.5	Grant Sainsbery GHD EMM

Revision	Date	Description	Section/Page No.	Approved
			Section 9.1.2 Section 9.4.1 Table 10.1 Section 11 Section 12 Appendix B (Removal of Lab certificates only)	
Revision 18 TeamBinder Revision 10	11/10/2018	Various update to address DPE and EPA comments.	Inclusion of section 6.3.7 Water Balance and WTP Capacity Details Update to footnote 5 of Table 7.9 Removal of Footnote 8 under Table 7.9.	John Wiggers de Vries Ashkun Jalili Damien Hertslet

Table of Contents

Terms and Definitions

Term	Definition
AIP	Aquifer Interference Policy
AHD	Australian Height Datum
BoM	Bureau of Meteorology
CEMP	Construction Environmental Management Plan
CLWD	Crown Lands & Water Division (formally Office of Water)
CSWMP	Construction Soil & Water Management Plan
D&C	Design and construction
Deed	As appropriate to the defined scope of the NorthConnex D&C Deed OR the M2 Integration D&C Deed
DGRs	Director General's Requirements
DPE	Department of Planning and Environment
ECC	Endangered ecological community
EIS	Environmental Impact Statement
EPA	Environment Protection Agency
EPL	Environment Protection Licence 20570
IC	Independent Certifier - APP Corporation Pty Limited engaged in accordance with either the NCX OR M2I Independent Certifier Deeds.
IFC	Issued for construction
GDE	Groundwater dependant ecosystem
LLBJV	Lend Lease Bouygues Joint Venture (Contractor)
LPS	Low Point Sump
LLEMS	Lend Lease Engineering Management System
MCoA	Minister's Conditions of Approval
MOC	Motorway Operations Complex
M2I	M2 Integration
NCX	NorthConnex
NSW	New South Wales

OEMP	Operational Environmental Management Plan
PMP	Project Management Plan
PMS	Project Management System
Project	NorthConnex and M2 Integration Projects
Project Company	NorthConnex Company Pty Ltd, which acts on behalf of the Client's under both the NCX D&C Deed and the M2I D&C Deed.
Project Company Group	NorthConnex Company Pty Ltd (Project Company) and NorthConnex State Works Contractor Pty Ltd
QP	Quality Plan
REMM	Revised Environmental Management Measure
RMS	Roads and Maritime Services
SPIR	Submissions of Preferred Infrastructure Report
SSI	State Significant Infrastructure
Sub IC	Sub Independent Certifier - APP Corporation Pty Limited engaged in accordance with either the NCX OR M2I Sub Deed of Appointment of Independent Certifier.
SWTC	As appropriate to the defined scope of the Scope of Works & Technical Criteria defined as Exhibit A under the individual NorthConnex D&C Deed OR the M2 Integration D&C Deed
WQO	Water Quality Objectives
WQPMP	Water Quality Plan and Monitoring Program
WSP	Water Sharing Plan
WTP	Water treatment plant
WSUD	Water Sensitive Urban Design

1. Introduction

1.1. Purpose and objectives

The purpose of this document is to detail the Water Quality Plan and Monitoring Program (WQPMP) for the NorthConnex Project (the Project) in accordance with the Minister's Conditions of Approval (MCoA), specifically in conditions B15 and B16.

Water quality and level data measured as part of the Project and, where available, historic data (data measured by third parties, eg Council derived data) is presented within this report to establish natural baseline conditions.

The baseline water quality data collected has facilitated setting discharge criteria for the construction and operational Water Treatment Plants (WTP) and setting trigger levels to identify and monitor any changes in surface and groundwater quality, groundwater levels and groundwater dependant ecosystems (GDEs) during construction and operation of the Project.

The objective of the WQPMP is to observe and assess the potential for impacts from the Project on surface and groundwater quality, water resources and groundwater dependent ecosystems. No water discharge will occur from WTP before each plant has been adequately commissioned to meet catchment-specific discharge criteria and goals to ensure compliance with the proposed discharge criteria in accordance with the Project Environmental Protection Licence (EPL 20570) requirements consistent with catchment-specific criteria developed in accordance with the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* guidelines (ANZECC/ARMCANZ 2000a). This plan provides a testing and monitoring regime to detect any impacts of the Project on the wider receiving environment.

The WQPMP will guide monitoring prior to and during construction and operation of the Project and form part of the Construction Soil & Water Management Plan (CSWMP), a subplan of the Construction Environmental Management Plan (CEMP). In the operational phase of the Project component of this plan will for parts of the Operational Environmental Management Plan (OEMP) as required MCoAE30 .The information collected as part of the WQPMP monitoring program will be used to inform management responses to manage any potential impacts indicated by the monitoring results during construction and operation of the Project.

1.2. Project background

The Project is within Greater Sydney, a built up, urban environment. The local water resources have therefore been subject to varying levels of disturbance for over a century prior to the initiation of the Project.

The Project corridor generally follows the alignment of Pennant Hills Road, along a ridge line forming the boundary of several local drainage catchments, notably the Hawkesbury-Nepean River Catchment and Sydney Metropolitan Catchment.

A map of the Project area is provided in Figure 1.1.

The general features of the Project are:

- twin motorway tunnels approximately nine kilometres in length with two lanes in each direction. The tunnels will be constructed wide enough for a third lane in each direction if required in the future;
- a northern interchange with the M1 Pacific Motorway and Pennant Hills Road, including sections of tunnel for on-ramps and off-ramps, which also facilitate access to and from the Pacific Highway;
- a southern interchange with the Hills M2 Motorway and Pennant Hills Road, including sections of tunnel for on-ramps and off-ramps;
- integration works with the Hills M2 Motorway including alterations to the eastbound carriageway to accommodate traffic leaving the Hills M2 Motorway to connect to the Project travelling northbound, and

the provision of a new westbound lane on the Hills M2 Motorway extending through to the Windsor Road off-ramp;

- tie-in works with the M1 Pacific Motorway extending to the north of Edgeworth David Avenue;
- a motorway operations complex located near the southern interchange on the corner of Eaton Road and Pennant Hills Road that includes operation and maintenance facilities;
- two tunnel support facilities incorporating emergency smoke extraction outlets and substations;
- ancillary facilities for motorway operation, such as electronic tolling facilities, signage, ventilation systems and fire and life safety systems including emergency evacuation infrastructure;
- modifications to service utilities and associated works at surface roads near the two interchanges and operational ancillary facilities;
- modifications to local roads as described in the Environmental Impact Statement (EIS) (AECOM 2014) and the Submissions of Preferred Infrastructure Report (SPIR); and
- ancillary facilities and temporary works to facilitate the construction of the Project.

As part of the Project, modifications to the Hills M2 Motorway will be undertaken west of Pennant Hills Road to enable southbound traffic from the Project to merge safely with existing westbound traffic on the motorway. These works would extend for a distance of around 3.5 kilometres (km) west of the Pennant Hills Road interchange to the existing Windsor Road off-ramp. This will include:

- an additional westbound lane on the Hills M2 Motorway;
- widening of Yale Close bridge and Darling Mill Creek viaduct; and
- lengthening of Barclay Road overbridge.

Minor alterations will also be required to allow eastbound traffic from the Hills M2 Motorway to leave the motorway and join the northbound carriageway of the Project.

1.3. Operational elements

The MCoAB15 requires that the operational elements of the WQPMP be submitted to the Secretary for approval one year prior to the commencement of operation of the Project.

This WQPMP revision addresses both the construction and operational phases of MCoAB15 and B16 and responds to this requirement.

Commitments relating to monitoring periods required by MCoAB15(h) are acknowledged and the detailed approach to monitoring will also be incorporated within the Operational Environmental Management Plan (OEMP) as required.

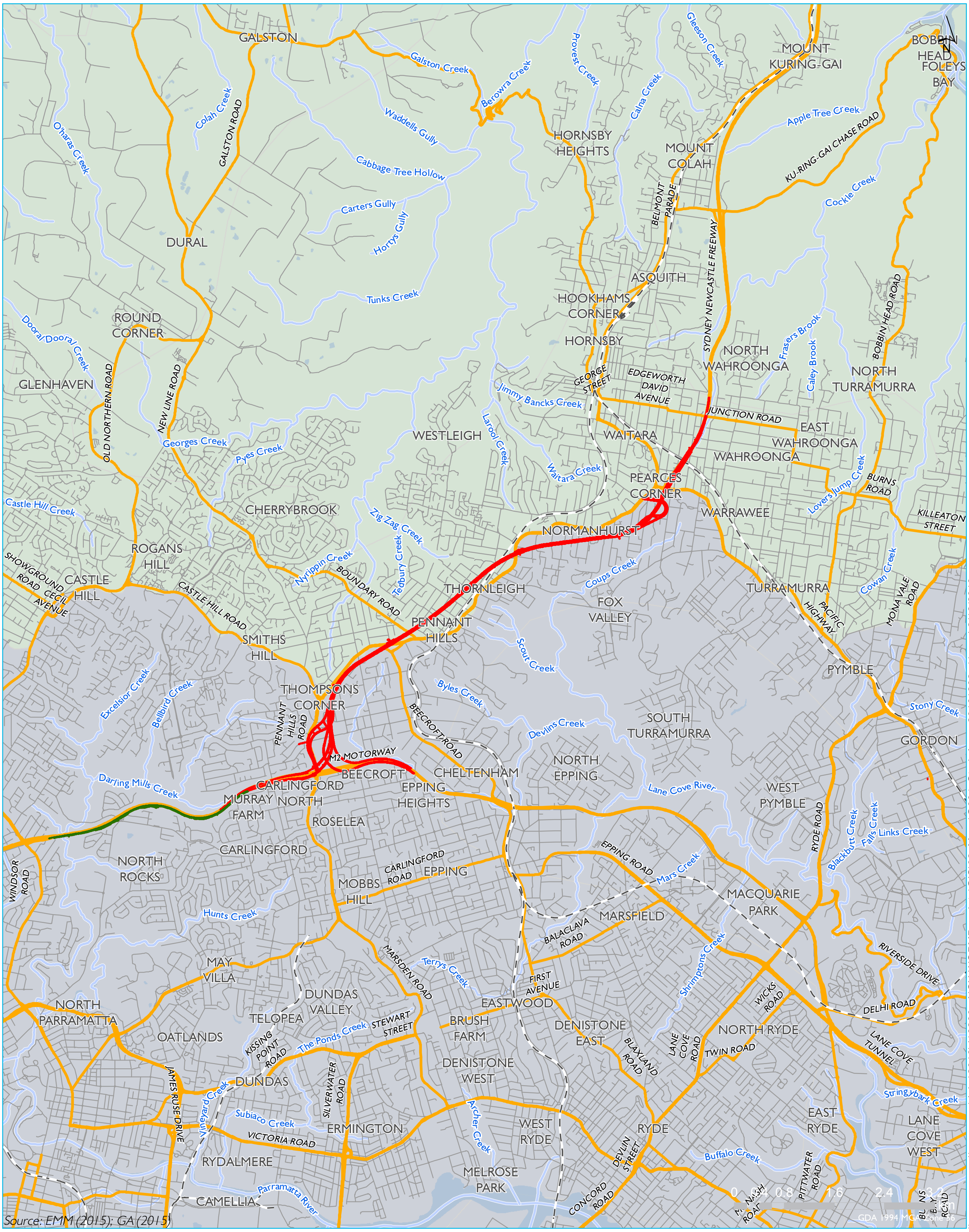
One WTP will be used during the operation phase of the NorthConnex tunnel. This will be located at the intersection of Pennant Hills Road and the M2 motorway at the Motorway Operations Complex (MOC). Treated water from this WTP will be discharged to the stormwater system which discharges to Blue Gum Creek as outlined in Sections 7.8 and 7.9 of the EIS and Section 8.17.4 of the SPIR or to Trade Waste under agreement with Sydney Water Corporation.

Ongoing operational phase surface water quality monitoring of receiving waters will be conducted in accordance with this WQPMP (Section 8). The receiving water from the operational phase will be Blue Gum Creek.

With regard to the surface roads the following applies:

- Existing basins along the Hills M2 Motorway remain unaltered;

- The existing stormwater detention basin serving Pennant Hills Rd and located in the Motorway Operations Complex compound is retained and increased in volume, plus a proprietary Gross Pollutant Trap (GPT) installed;
- Where modification of existing roads is requires the project will also incorporate:
  - A new GPT will be installed in Hewitt Ave to serve the M1 Motorway at the intersection with Pennant Hills Rd; and
  - A new GPT will be installed on M1 Motorway to serve surface drainage of the M1, north of the rail bridge to just north of Edgeworth David Rd bridge.



\\emgammsvr1\emgamm\Jobs\2016\J16200 - NCX WQPMP update\GIS\02_Maps\G004_StudyArea_20161202_11.mxd 2/12/2016

KEY

- NorthConnex tunnel
- M2 integration works
- Major road
- Minor road
- Rail line
- Watercourse
- Waterbody
- Hawkesbury/Nepean catchment
- Sydney Metro catchment

Project area
NorthConnex
Water Quality Plan and Monitoring Program
Figure 1.1

EMM

2. Regulatory context

2.1. Environmental assessment

The Project has been approved as a state significant infrastructure (SSI) project under Part 5.1 of the Environmental Planning & Assessment Act 1979 (EP&A Act). The initial Director General's Requirements (DGRs) were issued in October 2013 and the revised DGRs to incorporate the M2 integration works were issued on 11 April 2014.

The DGRs for surface water and groundwater required:

> The assessment of water quality impacts is to have reference to relevant public health and environmental water quality criteria, including those specified in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ 2000a), and any applicable regional, local or site-specific guidelines;
>
> and
>
> the assessment of groundwater impacts as a result of the project (including ancillary facilities such as the tunnel control centre and any deluge systems), considering local impacts along the length of the tunnels and impacts on local and regional hydrology. The assessment must consider: extent of drawdown; impacts to groundwater quality; discharge requirements; location and details of groundwater management and implications for groundwater-dependent surface flows, groundwater dependent ecological communities, and groundwater users. The assessment should be prepared having consideration to the requirements of the NSW Aquifer Interference Policy.

The assessment of groundwater and surface water impacts presented in the EIS (AECOM 2014) was prepared in accordance with the DGRs. The EIS was subsequently exhibited for consultation and a SPIR (AECOM 2014) was prepared in response to matters raised. The EIS identified Project-specific mitigation and management measures; and a groundwater and surface water monitoring program. The program was designed to monitor the baseline conditions and monitor the effectiveness of the management and mitigation measures with an overall aim of minimising adverse impacts to water resources.

Approval for the Project was issued by the Minister for Planning on 13 January 2015.

2.1.1. Proposed monitoring

Section 7.8 of the EIS states that:

> A surface water quality monitoring program for the construction period would be implemented to monitor water quality upstream and downstream of the construction areas. The monitoring program would commence prior to commencement of any construction works and would build on available water quality data.
>
> Inspection of water quality mitigation controls (eg sediment fences, sediment basins) would be carried out regularly and following significant rainfall to detect any breach in performance.
>
> A groundwater monitoring plan would be prepared for the duration of the construction period. Parameters to be monitored would include groundwater levels and groundwater quality with field parameters, laboratory parameters and sample frequency to be developed prior to tunnelling.
>
> A groundwater monitoring network to monitor groundwater levels and groundwater quality would be established during the construction phase. The groundwater monitoring network would contain monitoring wells along the project corridor intersecting groundwater in both Ashfield Shale and Hawkesbury Sandstone.

Groundwater captured during construction would be tested, treated and discharged to meet the requirements of the project EPL.

Where available, and of appropriate chemical and biological quality, subject to a health risk assessment, stormwater, recycled water, groundwater inflows to tunnels or other water sources would be used in preference to potable water for construction activities, including concrete mixing and dust control.

Compliance records of groundwater monitoring undertaken would be retained.

The EIS states that, although impacts were unlikely, licensees of existing groundwater bores identified in Table 7-170 of the EIS would be consulted in addressing any impact from the Project during construction and operation.

The SPIR issued in December 2014 confirmed the proposed surface and ground water monitoring outlined in the EIS.

2.1.2. Minister's Conditions of Approval

The Project Approval included the MCoA for surface and ground water monitoring, among other construction and groundwater management requirements. MCoAB15 specify that:

A Water Quality Plan and Monitoring Program shall be prepared and implemented to ensure that the Project monitor and avoids or mitigates impacts on surface and groundwater quality and resources, during construction and operation.

The WQPMP is required to be developed in consultation with the EPA, DPI (Fisheries NSW), NSW Crown Lands & Water Division (CLWD)) and relevant Councils. Table 2.1 outlines the specific requirements of MCoAB15 and B16 and provides section references where each condition is addressed within this plan.

The MCoA relate to a broad range of environmental, social and economic factors. The conditions relevant to the WQPMP are reproduced in Table 2.1

Table 2.1 Minister's conditions of approval relevant to WQPMP

Reference	Condition	Detailed report reference
B15	A **Water Quality Plan and Monitoring Program** shall be prepared and implemented to ensure that the project monitor and avoids or mitigates impacts on surface and groundwater quality and resources, during construction and operation. The Plan and Program shall be developed in consultation with the EPA, DPI (Fisheries), Crown Lands & Water Division, and relevant Councils, for the approval of the Secretary, and shall include but not necessarily be limited to:	This WQPMP has been updated to incorporate both the construction and operational phases of the Project. The monitoring program and management actions are addressed in Sections 8 and 9. This WQPMP revision was prepared in consultation with EPA, DPI (Fisheries), Crown Lands & Water Division, and relevant Councils and has been approved by the Secretary.
B15(a)	Identification of works and activities during construction and operation of the SSI, including tunnel discharge, runoff, emergencies and spill events, that have the potential to impact on surface water quality of potentially affected watercourses and riparian land;	Identification of construction and operation phase works activities provided in Section 4.1. Description of potential impacts to receptors during construction and operation of the Project provided in Sections 4.2.
B15(b)	A risk management framework for evaluation of the risks to groundwater and surface water resources and dependent ecosystems as a result of groundwater inflows to the tunnels, including definition of impacts that trigger contingency and ameliorative measures;	Risk management framework described in Section 5 and detailed in Table 5.4. Control measures for each risk is detailed in Table 6.2. Ambient water quality trigger values that are used to determine when additional management measures are required are described in Section 7. Management response triggers for each risk are detailed in Table 6.2. Ameliorative management measures are provided in Section 9.
B15(c)	The identification of environmental management measures relating to surface and groundwater during construction and operation, including water treatment, erosion and sediment control plans and stormwater management measures consistent with Water Sensitive Urban Design measures, where relevant, and consistent with the measures detailed in the documents listed in condition A2, including the specifications and design	Identification of environmental management measures provided in Table 6.1. Specifications and design details of the water treatment plants and stormwater management measures are provided in Sections 6.3. Erosion and sediment control plans and stormwater management measures consistent with Water Sensitive Urban Design (WSUD)

Table 2.1 Minister's conditions of approval relevant to WQPMP

Reference	Condition	Detailed report reference
	details of the Water Treatment Plants;	measures are addressed in the CSWMP and the Flood Mitigation Strategy.
B15(d)	Commitment to designing discharge points into watercourses affected by the proposal to emulate a natural stream system, where feasible and reasonable;	Section 6.3.6 responds to this condition.
B15(e)	The presentation of water quality objectives, standards and parameters, having regard to the *Australian and New Zealand guidelines for fresh and marine water quality* (Agriculture and Resource Management Council of Australia and New Zealand and the Australian and New Zealand Environment and Conservation Council 2000) developed in accordance with condition B16 and endorsed by EPA;	Water quality objectives are detailed in Section 2.4.2. Monitoring parameters presented in Section 8.3, specifically in Table 8.4.
B15(f)	Representative background monitoring data (including but not necessarily limited to representative data collected by the relevant Council, and considering seasonality) for surface and groundwater quality parameters, to establish baseline water conditions prior to the commencement of construction;	Analysis of Council data is presented in Section 3.7. Baseline monitoring data summarised in Section 3.8. Results are provided in Appendices A, B, C and D.
B15(g)	Identification of construction and operational phase surface and groundwater quality monitoring locations (including watercourses, water bodies and wetlands) which are representative of the potential extent of impacts from the SSI, including the relevant analytes and frequency of monitoring;	Construction and operational phase surface and groundwater monitoring locations are provided in Section 8.2, specifically Tables 8.1 and 8.2. The relevant analytes are provided in Section 8.3, specifically in Table 8.5. The sampling frequency is provided in Section 8.5, specifically in Table 8.5 and Section 8.5.2.
B15(h)	Commitment to a minimum monitoring period of three years following the completion of construction or until the affected waterways and/ or groundwater resources are certified	The commitment for the Project is presented in Section 8.4 The Flood Mitigation Strategy has established the operational water

Table 2.1 Minister's conditions of approval relevant to WQPMP

Reference	Condition	Detailed report reference
	by a suitably qualified and experienced independent expert as being rehabilitated to an acceptable condition. The monitoring shall also confirm the establishment of operational water control measures (such as sedimentation basins and vegetation swales);	control measure requirements.
B15(i)	Contingency and ameliorative measures in the event that adverse impacts to water quality are identified, with reference to the impact triggers defined in accordance with (b);	Contingency and ameliorative measures provided in Table 6.1 and Section 6.2 and in Section 9 in accordance with condition B15(b).
B15(j)	Identification of and commitment to 'make good' provisions for groundwater users to be implemented in the event of a decline in water supply levels from existing bores associated with groundwater changes from either construction and ongoing operational dewatering caused by the SSI; and	Groundwater users are listed in Section 3.5.2 and specifically in Table 3.3. Commitment to 'make good' provisions are provided in Table 6.1 and further detailed in Section 9.4.
B15(k)	Reporting of the monitoring results to the Secretary, EPA, OEH, Crown Lands & Water Division, DPI (Fisheries) and the relevant Council;	Reporting commitments are provided in Section 10. The reporting schedule of reporting is detailed in Table 10.1.
	The construction elements of the Plan and Program shall be submitted to the Secretary for approval prior to the commencement of construction of the SSI, as part of the Construction Soil and Water Management Plan required by condition D57(f). The operational elements of the Plan and Program shall be detailed in principle as part of the Construction Soil and Water Management Plan. The final operational elements of the Plan and Program shall be submitted to the Secretary for approval one year prior to the commencement of operation of the SSI, unless otherwise agreed by the Secretary. A copy of the Plan and Program shall be submitted to the EPA, DPI (Fisheries), Crown Lands & Water Division and relevant Councils prior to its implementation.	This plan forms Appendix D of the Construction Soil & Water Management Plan and was submitted to the Secretary for approval prior to the commencement of construction as required by condition D57(f). The approved Plan and Program was provided to the EPA, DPI (Fisheries), Crown Lands & Water Division and relevant Councils prior to implementation. The operational elements of the Project have been incorporated into this revision of the WQPMP. This WQPMP was submitted to the Secretary for approval more than one year prior to the commencement of operation.

Table 2.1 Minister's conditions of approval relevant to WQPMP

Reference	Condition	Detailed report reference
B16	As part of the Water Quality Plan and Monitoring Program, the Proponent shall provide details of how the potential impact of discharges on receiving waters would be avoided or minimised, which shall include but not necessarily be limited to:	Details of how the potential impacts of discharges on receiving waters would be avoided or minimised are outlined throughout this document.
B16(a)	Characterisation of current water quality in any receiving waters that could be affected by the proposal;	Characterisation of receiving environment has been provided in background and baseline data analysis in Sections 3.3, 3.7 and 3.8
B16(b)	A statement of the ambient water quality objectives and the environmental values for the receiving waters relevant to the proposal;	The ambient water quality objectives and the environmental values for the receiving environment are detailed in Section 2.4.2.
B16(c)	A statement of the indicators and associated trigger values or criteria for the identified environmental values;	A statement of indicators and associated trigger values are presented in Section 4 and Section 7.
B16(d)	Details of the significance of any identified impacts on surface waters including consideration of the relevant water quality outcomes;	A risk management framework has been presented in Section 5 and specifically in Table 5.4.
B16(e)	Demonstration of how the proposal will be designed and operated to: i. protect the water quality objectives for receiving waters, where they are currently being achieved, and ii. contribute towards achievement of the water quality objectives over time, where they are not currently being achieved.	Commitment relevant to the construction and operational phase have been provided in Sections 6.3. Catchment-specific water quality design specifications for the WTP are described in Sections 7.6.2 & 7.7. These will contribute to maintaining and improving water quality objectives where ANZECC/ARMCANZ (2000a) default trigger values for slightly to moderately disturbed ecosystems are not currently achieved.
B16(f)	Demonstration that any groundwater discharge water quality is consistent with supporting a slightly to moderately disturbed level of aquatic ecosystem protection for receiving waters as defined by the *Australian and New Zealand guidelines for fresh and*	Discharge criteria and WTP water quality design specifications have been developed to maintain and improve water quality in the receiving

Table 2.1 Minister's conditions of approval relevant to WQPMP

Reference	Condition	Detailed report reference
	marine water quality (Agriculture and Resource Management Council of Australia and New Zealand and the Australian and New Zealand Environment and Conservation Council 2000).	environment as described in Sections 7.2 and 7.7. Discharge criteria have been selected to protect the environment and to meet the commitment to maintain and improving water quality by meeting trigger values applicable to slightly to moderately disturbed aquatic ecosystems (demonstrated in Sections 6 and 7).

2.2. Other NSW Legislation

Section 115ZG of the EP&A Act details the approvals under NSW legislation that are not required for a SSI project approved under Part 5.1 of the EP&A Act (see Table 2-1 of Section 2.4 in the EIS (AECOM 2014)). A summary of relevant legislation is provided below.

2.2.1. Water Act 1912

The Water Act 1912 (WA 1912) has historically been the main legislation for the management of NSW water resources. The WA 1912 is progressively being replaced by the Water Management Act 2000 (WMA 2000) as water sharing plans commence.

Groundwater within the Project area is mostly governed under the WMA 2000 within the Water Sharing Plan (WSP) for the Greater Metropolitan Region Groundwater Sources, which commenced in 2011 (Metro GW WSP). However, some aspects of the WA 1912 are still operational within the project area, such as licenses for monitoring bores, and reinjection activities.

2.2.2. Water Management Act 2000

i. Water Sharing Plans

The WMA 2000 applies to those areas where a WSP has commenced. WSPs are statutory plans under the WMA 2000 which contain the rules for sharing and managing individual or groups of water resources.

Water sharing plans aim to ensure sustainable and integrated management of NSW water by providing clear arrangements for activities that affect water quality and quantity. The plans set management rules for water access licences, water allocation accounts, dealings in licences and water allocations, water supply works approvals, and the extraction of water. Water sharing plans also define the water management rules for trading water and granting of access licences.

The provisions in the surface water WSPs include the protection of water to support the ecological processes and environmental needs of rivers, and directions on how surface water that is available for extraction is to be shared. The provisions in the groundwater WSPs provide for groundwater to support the ecological processes and environmental needs of high priority GDEs and rivers, and direct how the water that is available for extraction is to be shared.

ii. The project and water sharing plans

The Project area is within the Metro groundwater WSP which consists of several groundwater sources. The Project area overlies the Sydney Basin Central Groundwater Source. The groundwater WSP covers all water occurring naturally below the surface of the ground, including water in alluvial sediments, coastal sands, porous rock aquifers and fractured rock aquifers (CLWD 2011a).

The management of the surface water resource in the project area is governed by the WSP for the Greater Metropolitan Region Unregulated River Water Sources, which commenced in July 2011 (CLWD 2011b).

2.2.3. Project legislative exemptions

Groundwater will be taken incidentally via dewatering as part of the Project, to allow effective and safe construction and operation of the tunnels.

The taking of groundwater or surface water during tunnel construction is exempt from requiring an access licence. The NOW's position on this exemption is as follows:

By virtue of clause 18 and Schedule 5, clause 2 of the Water Management (General) Regulation 2011 roads authorities are currently exempt from the requirement to hold a water access licence to account for water taken for road construction and maintenance.

Ongoing licensing arrangements for road infrastructure are currently under development in consultation with the Roads and Maritime Services. The NOW will not currently require licensing for water taken by a roads authority for the Project, however requests a commitment from Roads and Maritime to liaise with the NOW and ensure any necessary licences are held once these arrangements are finalised (NOW 2015).

2.2.4. Protection of the Environment Operations Act 1997

An Environmental Protection Licence (EPL) # 20570 is in place for the construction phase of the Project. Discharges from the site and WTP are made in accordance with the requirements of this EPL. An EPL is not required for the Operational Phase of the Project

2.3. Relevant policies

2.3.1. Aquifer Interference Policy

The NOW released the Aquifer Interference Policy (AIP) in 2012 to address the assessment of potential impacts, and water licensing of aquifer interference activities within NSW. The AIP defines the regime for protecting and managing the impacts of aquifer interference activities on NSW's water resources. Approval for aquifer interference activities will not be granted unless the Minister is satisfied that adequate arrangements are in place to ensure that no more than minimal harm will be done to any water source, or its dependent ecosystems as a consequence of the interference.

Assessment criteria, the 'minimal impact considerations' are employed to assess impacts to water table levels, water pressure levels and water quality in different groundwater systems. The policy divides groundwater sources into 'highly productive' as opposed to 'less productive' based on the following criteria:

- has total dissolved solids of less than 1,500 mg/L; and
- contains water supply works that can yield water at a rate greater than 5 L/sec.

Thresholds are set in the AIP for the different groundwater sources where minimal impact considerations are stipulated.

The Project will intercept groundwater during construction and is therefore defined as an aquifer interference activity under the AIP. The groundwater source in this area is relatively low yielding and is considered to be in the 'less productive' groundwater source category as defined in the AIP. The AIP also considers a range of minimal impact activities, one of which is defined as "caverns, tunnels, cuttings, trenches and pipelines (intersecting the water table) if a water licence is not required". The Project is therefore considered to be defined as having a minimal impact under the AIP. Section 2.2 outlines the water licence requirements and exemptions as defined in the legislation and confirmed by the NOW as it applies to the Project.

The AIP also provides impact considerations to further define 'minimal impact'. The potential impacts of the Project have been assessed against the categories of 'less productive groundwater sources'. This category classifies the Project area as 'porous and fractured rock water sources'. The criteria and impacts for the Project are listed in Table 2.2.

Table 2.2 Consideration of Aquifer Interference Policy

No	Consideration	Potential impact
	Water table	
1	Less than or equal to 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40 m from any: (a) high priority groundwater dependent ecosystem; or (b) high priority culturally significant site; and (c) listed in the schedule of the relevant water sharing plan. A maximum of a 2 m decline cumulatively at any water supply work.	The Project would not be within 40 m of any high priority groundwater dependent ecosystems or high priority culturally significant sites. The Project may potentially result in a decline of the water table at existing bores in the vicinity of the Project, however the impacts are considered to be limited.
2	If more than ten per cent cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40 m from any: (a) high priority groundwater dependent ecosystem; or (b) high priority culturally significant site; Listed in the schedule of the relevant water sharing plan if appropriate studies demonstrate to the Minister's satisfaction that the variation will not prevent the long-term viability of the dependent ecosystem or significant site. If more than a two metre decline cumulatively at any water supply work then make good provisions should apply.	In the event that drawdown of the water table does impact on the viability of existing bores, consultation would be undertaken with the bore owner to develop appropriate mitigation measures which may include development of a new, deeper bore (see Section 9.4).
	Water pressure	
1	A cumulative pressure head decline of not more than a 2 m decline, at any water supply work.	The Project may potentially result in a decline in head pressure at existing bores in the vicinity of the Project, however the likelihood is considered low.
2	If the predicted pressure head decline is greater than requirement 1. above, then appropriate studies are required to demonstrate to the Minister's satisfaction that the decline will not prevent the long-term viability of the affected water supply works unless make good provisions apply.	In the event that drawdown of the water table does impact on the viability of existing bores, including a decline in head pressure, consultation would be undertaken with the bore owner to develop appropriate mitigation measures which may include development of a new, deeper bore (see Section 9.4).

Table 2.2 Consideration of Aquifer Interference Policy

No	Consideration	Potential impact
	Water quality	
1	Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity.	The Project is not anticipated to result in impacts to groundwater quality.
2	If condition 1 is not met then appropriate studies will need to demonstrate to the Minister's satisfaction that the change in groundwater quality will not prevent the long-term viability of the dependent ecosystem, significant site or affected water supply works.	Not applicable.

As indicated by the CLWD in their submission (9 September 2014), the Project is explicitly defined in the AIP as a minimal impact aquifer interference activity. The Project meets the minimal impact considerations under the AIP.

2.3.2. RMS Water Policy

The Roads and Maritime Services (RMS) (formerly RTA) has developed a water policy document which considers the environmental management and efficient use of groundwater and surface water during all phases of a project (RTA undated).

The policy states:

> The RTA will use the most appropriate water management practices in the planning, design, construction, operation, and maintenance of the roads and traffic systems in order to:
>
> - conserve water;
> - protect the quality of water resources; and
> - preserve ecosystems.

The policy identifies that during the construction phase of a project there is potential for uncontrolled erosion and sedimentation, potential for contamination from accidental spills of leaks of fuels and lubricants and potential for contamination from wash off areas. The policy defines the action to address this potential risk as:

> Appropriate best management control measures are to be implemented to mitigate potential deleterious effects on both water quality and quantity in all areas of construction sites. RTA's policy is to implement effective water management practices and procedures as an integral part of on-site construction management to ensure that water quality and quantity impacts on the environment are minimised.

The policy identifies that during the operational phase of the project there is potential for build up on contaminants along roadside corridors which can run off during rain events. The policy defines the action to address this potential risk as:

> Structural measures such as detention basins, gross pollutant traps, grass channels and created wetlands need to be maintained. Non-structural measures such as community involvement in reducing roadside litter and developing an ownership for good vehicle maintenance practices need to be encouraged and implemented to prevent pollution at the source. RTA's policy is to develop and maintain both structural and non-structural measures to minimise water pollution during operation of roads.

The policy identifies that during maintenance there is a potential to discharge pollutants, and the policy defines the action to address this potential risk as:

> On-site control measures together with adherence to good work practices need to be developed and implemented to ensure minimum discharge of pollutants originating from all maintenance works. RTA's policy is to identify potential water pollution issues related to all RTA maintenance activities and to ensure that those activities are performed in an environmentally responsible manner to avoid and/or minimise impacts on receiving water bodies and associated aquatic ecosystems.

The WQPMP has been developed in accordance with the RMS Water Policy to ensure that the Project is appropriately designed and operated to promote water conservation, protect water quality and resources and preserve surrounding ecosystems. This will be achieved through the implementation of best management control measures so as to mitigate potential risks.

2.3.3. RMS Code of Practice for Water Management

The RMS Code of Practice of Water Management: Road Development and Management (the Code) (RTA 1999) outlines the principles by which RMS works to achieve the goals of the RMS water policy. The Code states that its prime objective:

> ...aims to guide staff to the principles that need to be maintained for effective management of water quality during the various stages of road development and management.

The Code acknowledges that water management is a key responsibility for projects from planning through construction to operation and ongoing maintenance. Principles of ecologically sustainable development have guided the development of the Code. The WQPMP has been developed in accordance with the Code, and enable adaptive management.

2.4. Relevant guidelines and objectives

2.4.1. Australian and New Zealand Guidelines for Fresh and Marine Water Quality

The Agriculture and Resource Management Council of Australia and New Zealand and the Australian and New Zealand Environment and Conservation Council (ANZECC/ARMCANZ) developed the Australian and New Zealand Guidelines for Fresh and Marine Water Quality in 2000 (the ANZECC/ARMCANZ (2000a) guidelines). These guidelines were prepared as part of the Australian National Water Quality Management Strategy (NWQMS), which aims to achieve the sustainable use of Australia's and New Zealand's water resources by protecting and enhancing their quality while maintaining economic and social development. The ANZECC/ARMCANZ (2000a) guidelines include water quality guideline values that aim to protect and manage the environmental values supported by a water resource(s).

The ANZECC/ARMCANZ (2000a) guidelines for fresh and marine water quality for south-east Australian lowland rivers and NSW coastal rivers have been used throughout this document in accordance with MCoAB15(e) and MCoA B16(b) so as to inform ongoing assessments of potential impacts on water quality.

2.4.2. Surface water quality objectives

For each catchment in NSW, the state government has endorsed the community's environmental values for water, known as 'Water Quality Objectives' (WQOs) (NSW Government 2006). The NSW WQOs are the environmental values and long-term goals for consideration when assessing and managing the likely impact of activities on waterways.

Environmental values are particular values or uses of the environment that are important to maintain for a healthy ecosystem, to provide a public benefit, and improve or maintain safety or health from the effects of pollution, waste discharges and deposits. The environmental values included in the ANZECC/ARMCANZ (2000a) guidelines are:

- aquatic ecosystems;
- aquatic foods (cooked before eating);
- drinking water at point of supply;
- homestead water supply;
- irrigation water supply;
- livestock water supply;
- primary contact recreation;
- secondary contact recreation; and
- visual amenity.

The ANZECC/ARMCANZ (2000a) guidelines provide value specific assessment criteria for each environmental value.

The environmental values expressed as WQOs provide goals that help in the selection of the most appropriate management options. The guiding principles are that:

- where the environmental values are being achieved in a waterway, they should be protected, and
- where the environmental values are not being achieved in a waterway, all activities should work towards their achievement over time.

The creeks within the surface water catchments intercepted by the Project support aquatic ecosystems. 'Aquatic ecosystems' is the primary environmental value to be protected.

There is likely to be 'secondary contact recreation' (eg boating) and 'primary contact recreation' (eg swimming) in the lower reaches of the surface water catchments; and there are urban and conservation area viewpoints to the creeks with attendant 'visual amenity'. Therefore, these environmental values need to be protected. However, the protection of aquatic ecosystems will protect these environmental values as aquatic ecosystems are generally more sensitive to changes to the aquatic environment.

The environmental values of 'aquatic foods (cook before eating)', 'drinking water at point of supply', 'homestead water supply', 'irrigation water supply' and 'livestock water supply' are less applicable in the catchments.

The identification of water quality objectives has been completed in accordance with the requirements of MCoAB15(e) and B16(b).

2.4.3. Groundwater monitoring and modelling plans

The Groundwater Monitoring and Modelling plans – Information for Prospective Mining and Petroleum Exploration Activities (CLWD 2014) is an advisory guidance document that provides guidance for proponents to ensure that their monitoring network will provide sufficient baseline data to inform an impact assessment that meets the criteria of the AIP. This document has been considered in the designing of the Project's groundwater and surface water monitoring programme.

The guideline defines the purpose of the monitoring network as identifying hydrogeological strata and their depths and thicknesses; hydraulic behaviours; interaction between layers; and connection to surface waters. It states that both quality and levels must be obtained and that prediction of impacts on sensitive receptors (users) should be established.

The document recommends that data loggers be used to monitor water levels, and advises that monitoring of groundwater quality considers major ions along with field parameters such as salinity, and that chemistry sampling is undertaken quarterly. The guideline also comments on aquifer testing methods, and states that isotopes can be used to more accurately determine system characteristics, particularly surface and groundwater connectivity.

The Project monitoring network complies with this guideline, in that monitoring bores selected ensure that all groundwater system types (ie both shale and sandstone) are being monitored. Installation of groundwater data loggers and chemistry sampling are also aligned with this guideline.

3. Existing environment

3.1. Topography

The Project corridor extends along a broad north to north-east trending ridgeline. The terrain along the corridor rises from an elevation of approximately 144 m (Australian Height Datum (AHD) at the southern end, near the M2 motorway, to an elevation of approximately 180 m AHD at the northern end, near the F3 motorway. Generally, the terrain dips to the south-east and to the north-west away from the Pennant Hills ridgeline (AECOM 2014).

3.2. Climate

The Metro Sydney Basin bioregion is characterised by a temperate climate, with warm summers and mild winters.

Historic rainfall and temperature data for the site was acquired from the Bureau of Meteorology (BoM), and included:

- Parramatta North (Masons Drive) weather station (BoM: 066124) is south–west of the study area. The rainfall dataset extends from 1965 to current, and the temperature dataset extends from 1967 to current.
- Turramurra (Kissing Point Road) weather station (BoM: 066158) is north–east of the study area. The rainfall dataset extends from September 1934 to current. Temperature is not recorded at this weather station.

3.2.1. Temperature

The temperature recorded at Parramatta North fluctuates throughout the year. January is generally the warmest month with a mean maximum temperature of 28.4°C and July is generally the coldest month with a mean maximum temperature of 17.4°C (Figure 3.1).

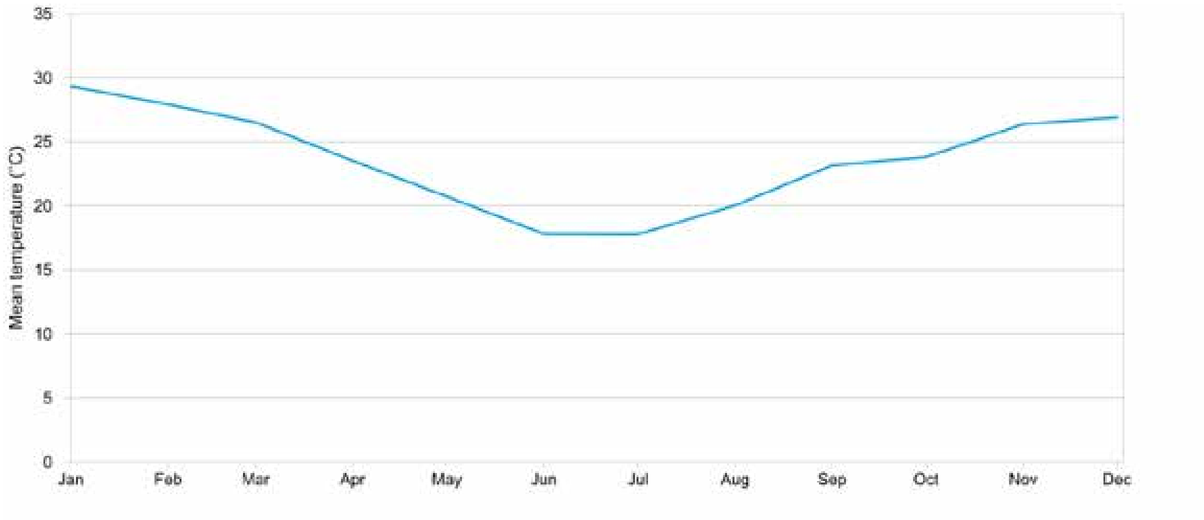


Figure 3.1 Monthly mean temperature variation at Parramatta North (Masons Drive)

3.2.2. Rainfall

Analysis of wet and dry periods is important for designing and undertaking monitoring programs, particularly for surface water monitoring. Understanding the natural magnitude and frequency of climatic events informs both the baseline and ongoing monitoring.

The average annual rainfall at the Parramatta North and Turramurra BoM weather stations over the period January 1966 – December 2014 is 969 and 1,350 mm/year, respectively. The Turramurra monitoring station experiences relatively higher rainfall compared with the Parramatta monitoring station.

Analysis of dry and wet periods can be completed using the statistical technique “cumulative deviation from the mean” (CDFM). The CDFM is commonly used to relate groundwater level fluctuations to trends in rainfall but can also be used to assess trends in long-term monthly and annual rainfall fluctuations and allows comparison of rainfall and groundwater trends over time. The CDFM method subtracts the actual rainfall over a defined period from the long-term mean rainfall of the same period (Ferdowsian and McCarron 2001; Yesertener 2007). Figure 3.2 presents the CDFMs for Parramatta North and Turramurra weather stations. The upwards or downward trend in the curve indicates a period of above or below average rainfall, respectively.These are marked on the graph as wet or dry periods.

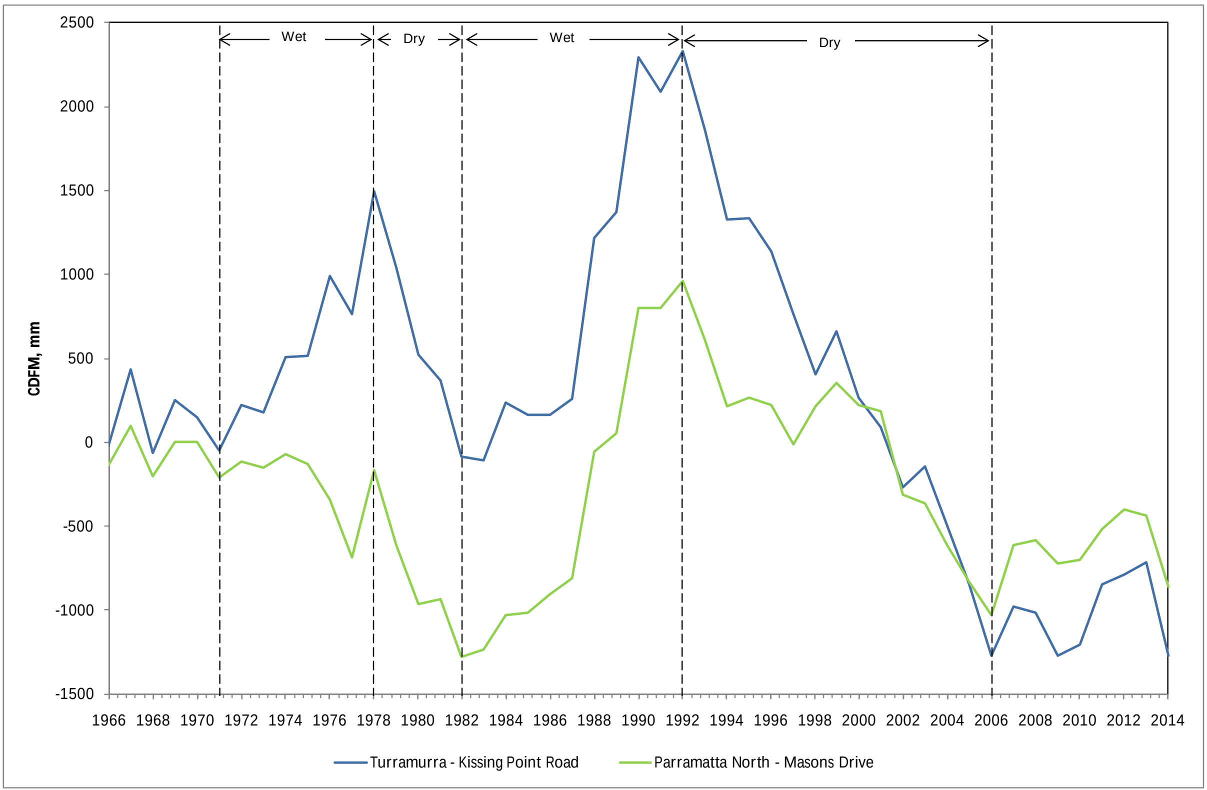


Figure 3.2 Rainfall: Cumulative deviation from mean

There are cyclical periods of wet and dry average rainfall (Figure 3.2). The periods 1978 to 1982 and 1992 to 2006 generally exhibit below average rainfall. The periods 1971 to 1978 and 1982 to 1992 generally exhibit above average rainfall with the exception of rainfall recorded at the Parramatta North gauging station between 1971 and 1978.

Trends since 2006, show oscillating rainfall with overall wet conditions observed in 2014. In August 2014, some significant rainfall events were experienced, specifically 185 mm of rainfall was recorded at Parramatta (monthly average of 56.1 mm) and 270.2 mm was recorded at Turramurra (monthly average of 86.9 mm).

3.3. Surface water

3.3.1. Catchments

The topography typically controls the flow of surface water within the catchment. Drainages and creeks, which form a common hydrological feature of the study area, are represented as trellis-type systems, typical of structurally-controlled drainages and are formed through sub-vertical jointing and fractures (Hydro Tasmania Consulting 2010). The north to north-east trending ridgeline forming the Project area is dissected by a number of local drainage catchments, represented by steep-sided V-shaped valleys, including several ‘drowned valleys’ which are now partly inundated tidal estuarine waters.

The Project area drains through a number of tributaries that eventually discharge to the Cowan Creek, Pittwater, Berowra Creek, Parramatta River and Lane Cove River.

Catchments and sub-catchments that are in or adjacent to the Project area are tabulated in Table 3.1.

Table 3.1 Identified watercourses crossed or adjacent to the Project

Catchment	Sub-catchment	Watercourse	Project area	Proximity to works	Suburb
Sydney Metropolitan	Parramatta River	Stevenson Creek	Hills M2 Motorway integration works	Crossed	Baulkham Hills
		Darling Mills Creek	Hills M2 Motorway integration works	Crossed	Baulkham Hills/North Rocks
		Blue Gum Creek	Hills M2 Motorway integration works	Adjacent (<20 m)	West Pennant Hills
		Bellamys Creek	Southern interchange	Adjacent (250 m)	West Pennant Hills
		Unnamed creek (Darling Mills Creek tributary)	Main alignment tunnels	Adjacent (400 m)	West Pennant Hills
	Lane Cove River	Unnamed creek (Devlins Creek tributary)	Main alignment tunnels	Adjacent (<800 m)	Beecroft
		Devlins Creek	Main alignment tunnels	Adjacent (250 m)	Beecroft
		Unnamed creek (Byles Creek tributary)	Main alignment tunnels	Adjacent (650 m)	Pennant Hills
		Terra Ulong Creek	Main alignment tunnels	Adjacent (450 m)	Pennant Hills
		Camp Creek	Main alignment tunnels	Adjacent (500 m)	Pennant Hills

Table 3.1 Identified watercourses crossed or adjacent to the Project

Catchment	Sub-catchment	Watercourse	Project area	Proximity to works	Suburb
		Scout Creek	Main alignment tunnels	Adjacent (500 m)	Thornleigh/Pennant Hills
		Unnamed creek (Lane Cove River tributary)	Main alignment tunnels	Adjacent (550 m)	Thornleigh
		Unnamed creek (Lane Cove River tributary)	Main alignment tunnels	Adjacent (300 m)	Normanhurst
		Coups Creek	Main alignment tunnels	Adjacent (<200 m)	Wahroonga
Hawkesbury-Nepean River	Berowra Creek	Unnamed creek (Berowra Creek tributary)	Main alignment tunnels	Adjacent (200 m)	West Pennant Hills
		Tedbury Creek	Main alignment tunnels	Adjacent (450 m)	Pennant Hills
		Unnamed creek (Waitara Creek tributary)	Main alignment tunnels	Adjacent (450 m)	Normanhurst
		Unnamed creek (Waitara Creek tributary)	Main alignment tunnels	Adjacent (550 m)	Normanhurst
	Cowan Creek/Pittwater	Cockle Creek	Main alignment tunnels	Adjacent (<10 m)	Wahroonga

3.3.2. Water quality

The Hornsby Shire Council, The Hills Shire Council and the Ku-ring-gai Council areas cover the majority of the Project area and the receiving watercourses downstream of the Project. These three local governments undertake water quality monitoring programs. The results of these monitoring programs were used in the EIS (AECOM 2014).

Water quality data sets obtained by local councils are generally limited to physical parameters, microbiology and nutrients. Despite the limited range of analysis, an assessment of ecosystem health across the surface water catchments, and particularly the Project area as determined by the surface water quality, determined the water quality to be poor. In many cases the ANZECC/ARMCANZ (2000a) guideline values for bacterial contamination and nutrients were exceeded. Further discussion of surface water background monitoring data is provided in Section 3.7.

Many of the surface water features downstream of the Project area support aquatic and riparian environments, including aquatic ecosystems and fish habitats. The receiving environments identified in the EIS (AECOM 2014) are listed in Table 3.2.

Table 3.2 Receiving environments in and adjacent to the Project area

Project area	Receiving watercourse	Description	Receiving environment
Hills M2 Motorway integration works	Stevenson Creek (tributary of Darling Mills Creek) Darling Mills Creek Blue Gum Creek	Watercourses are freshwater systems	Bidjigal Reserve
Southern interchange	Blue Gum Creek	Watercourse is a small freshwater system	Bidjigal Reserve
Main alignment tunnels	Blue Gum Creek	Watercourses are small freshwater systems	Bidjigal Reserve
	Coups Creek		Lane Cove National Park
Northern interchange	Cockle Creek	Watercourses are small freshwater systems	Ku-ring-gai Chase National Park

3.4. Geological setting

The Project area is within the Permo-Triassic Sydney Basin. The geology of the Sydney basin comprises thick stratigraphical sequences of Permian and Triassic sedimentary rocks including sandstone, siltstone and shale formations with interbedded coal seams in the lower Permian sequence with deposition occurring between 210 and 290 million years ago.

The study area is in the central region of the basin complex, commonly referred to as the Hornsby Plateau, where the upper Triassic section of the sedimentary sequence is exposed. The Triassic sequence within the Project area comprises predominantly Hawkesbury Sandstone and overlying Ashfield Shale, a formation belonging to the Wianamatta Group of Shales. These shale exposures remain as erosional remnants above the older Hawkesbury sandstone sequences and are discontinuous where they outcrop across the plateau. The two geological units are separated intermittently by the Mittagong Formation, which is typically a thin transitional unit.

The Ashfield Shale is present across the majority of the Project area with the unit reaching a maximum thickness of 60 to 70 m. The shale consists of siltstone and laminate subgroup units.

The Hawkesbury Sandstone underlies the shale and occurs along the entire extent of the alignment. The sandstone is typically composed of medium to coarse grained quartz sandstone. Beds of sandstone are typically stratified by intermittent bands of shale breccia.

The transitional Mittagong Formation is composed of a thin, very fine grained sandstone and siltstone band, typically m to 2 m , but not more than 12 m in thick.

Igneous dykes and breccia diatremes of Jurassic Age are sparsely distributed throughout the Sydney Region, and occur in the central region of the Project area. The dykes are understood to range in age from approximately

50 to 170 million years and pre-date many of the major faults within the basin. Dykes have been identified during drilling across the northern extent of the Project area approximately 500 m north of the tunnel alignment.

Conceptualised geological long sections were provided as part of the EIS (AECOM 2014). The sections show the local geological thicknesses of the transitional units that are intercepted by the proposed tunnel (Figures 3.3). The inferred geological thicknesses are based on widely spaced boreholes and local variations in these thicknesses are expected.

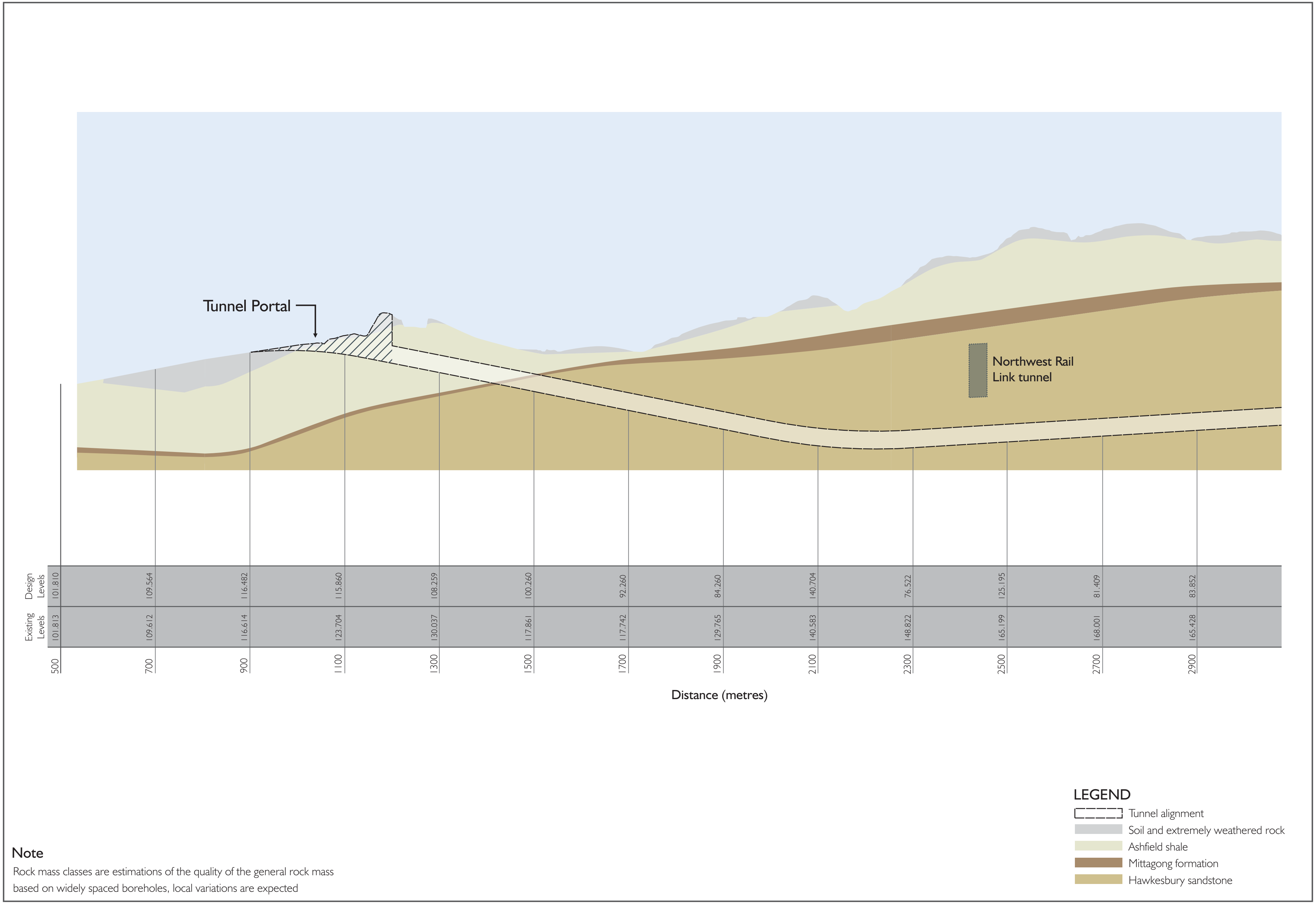
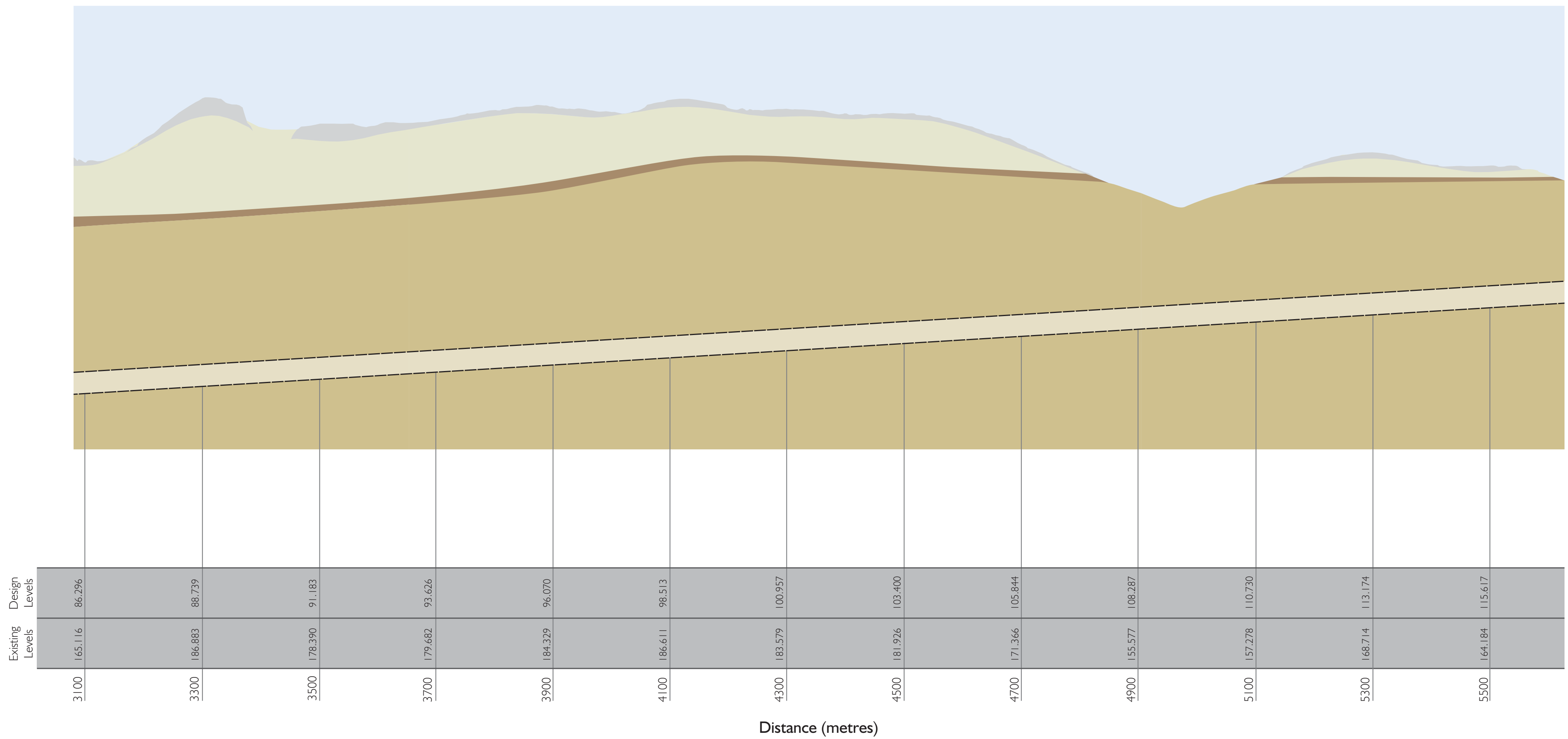


Figure 3.3 Geological long section - Map 1 (AECOM)



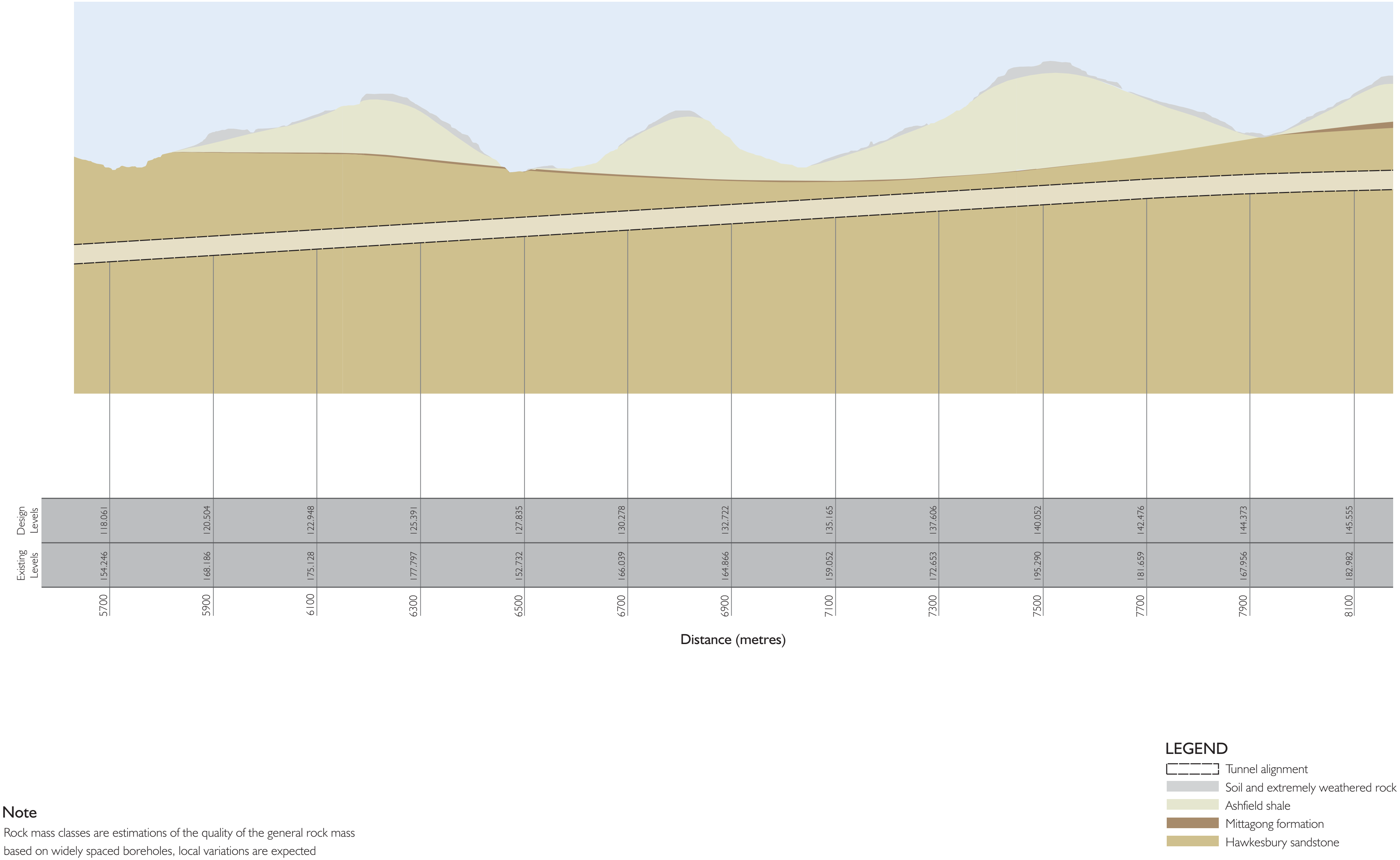
LEGEND

- Tunnel alignment
- Soil and extremely weathered rock
- Ashfield shale
- Mittagong formation
- Hawkesbury sandstone

Note

Rock mass classes are estimations of the quality of the general rock mass based on widely spaced boreholes, local variations are expected

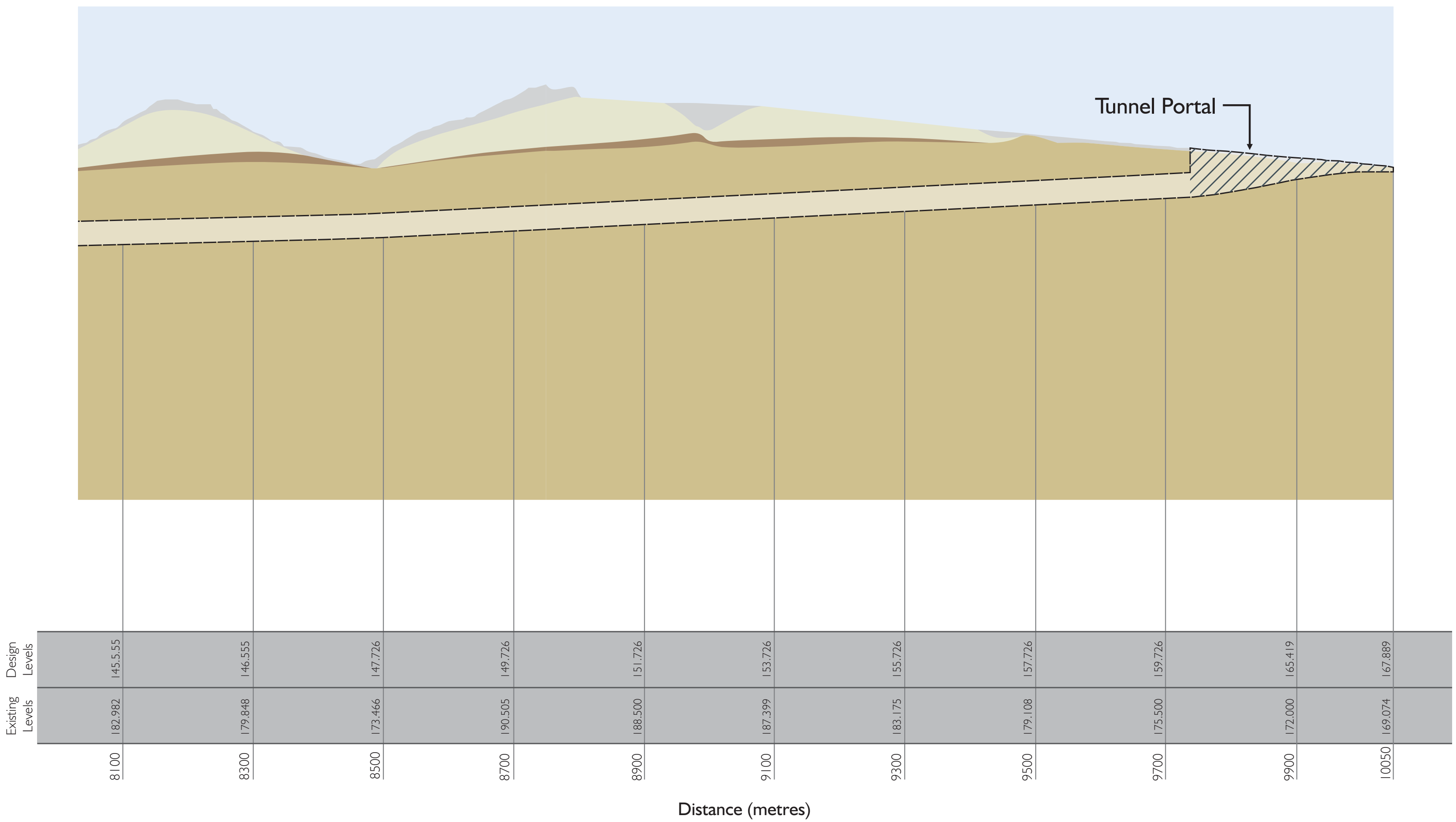
Figure 3.3 Geological long section - Map 2 (AECOM)



Note

Rock mass classes are estimations of the quality of the general rock mass based on widely spaced boreholes, local variations are expected

Figure 3-3 Geological long section - Map 3 (AECOM)



LEGEND
- Tunnel alignment
- Soil and extremely weathered rock
- Ashfield shale
- Mittagong formation
- Hawkesbury sandstone

Note

Rock mass classes are estimations of the quality of the general rock mass based on widely spaced boreholes, local variations are expected

Figure 3.3 Geological long section - Map 4 (AECOM)

3.5. Hydrogeological setting

3.5.1. Groundwater systems

There are three identified groundwater systems in the region:

- an unconsolidated shallow alluvial system;
- a fractured rock system associated with the Ashfield Shale; and
- a porous rock system associated with the Hawkesbury Sandstone.

The Hawkesbury Sandstone is the main water bearing groundwater system in the region and forms a confined to semi–confined/leaky aquifer. The Ashfield Shale is also typically semi-confined or confined system with a much lower hydraulic conductivity (ie is less permeable) than the underlying Hawkesbury Sandstone, and in parts, acts as a confining layer to the underlying Hawkesbury Sandstone.

The sedimentary Sydney Basin geological units have dual porosity, ie both intergranular (primary porosity) and fractured (secondary porosity) groundwater storage. Water bearing zones are often associated with bedding plane joints, sub-vertical joints and faults, as groundwater flow is largely via secondary porosity.

Groundwater within the Hawkesbury Sandstone and Ashfield Shale is derived from recharge by rainfall infiltration through the shallow weathered rock zone in topographically higher areas. Groundwater discharge predominantly occurs via seeps and springs located along major gullies, gorges and cliffs, and to local creeks and rivers.

Groundwater flow rates are likely to have localised fluctuations and be largely determined by weathered and fractured zones, and the presence of bedding planes. Yields from bores vary significantly depending on the depth and the number of localised fractures within the sequences. Typically, high yielding bores intersect fractures, as the primary porosity is low.

The water quality of the Permo-Triassic rocks ranges from fresh in recharge areas, to slightly saline in down gradient areas. Groundwater quality within the Hawkesbury Sandstone is generally fresh and slightly acidic. Salinity increases in the upper horizons of the aquifer where the sandstone receives downwards vertical leakage from the overlying Ashfield Shale. The Hawkesbury Sandstone is also characterised by elevated manganese and iron concentrations. The dissolved heavy metal concentrations in the project area are typical of background levels present in the Sydney basin (AECOM 2014).

Groundwater within the Ashfield Shale is typically brackish with a higher pH (ie more basic). The Ashfield Shale groundwater quality is largely influenced by the depositional environment, low permeability and recharge characteristics.

The Project tunnels will be predominantly within saturated rock below the water table. Site specific information suggests the hydraulic conductivity of the Ashfield Shale and Hawkesbury Sandstone to be relatively low in the Project area, with the majority of groundwater flowing through secondary structural features such as fractures, joints and faults rather than the primary rock matrix.

3.5.2. Groundwater users

A spatial search for groundwater users was undertaken to identify bores listed within the predicted zone of drawdown provided by AECOM during the development of the tender baseline model (AECOM 2014). The model was developed using the Perrochet and Musy (1992) method, an empirical assessment that considers the lateral extent of predictive groundwater drawdown. The model calculated the extent of drawdown using a number of assumptions including a constant groundwater head and a bulk hydraulic conductivity value and is therefore considered useful as an indicative model of predictive groundwater drawdown. The modelled zone extends to a 2 m reduction in groundwater levels and is therefore relevant to assessment against the requirements of the AIP.

In accordance with the Revised Environmental Management Measure (REMM) OpHs5, a three dimensional numerical groundwater model has been developed during the detailed design phase to verify that the extent of groundwater drawdown against the predictions presented in the EIS. The three dimension modelling was completed by Golder Associates (2016) (Appendix E).

The Golder Associates (2016) three dimensional numerical groundwater model identified that the extent of the 2 m predicted drawdown is slightly larger than that identified by the two dimensional empirical model developed as part of the EIS (Figure 3.5)

There are no additional registered groundwater bores utilised for water supply within the revised predicted zone of drawdown, however there are seven registered groundwater users in proximity of the revised predicted zone of drawdown (Table 3.3 and Figure 3.5). Total depths of the bores vary from shallow (24 m) to deep (195 m), with no data available on the screened formation.

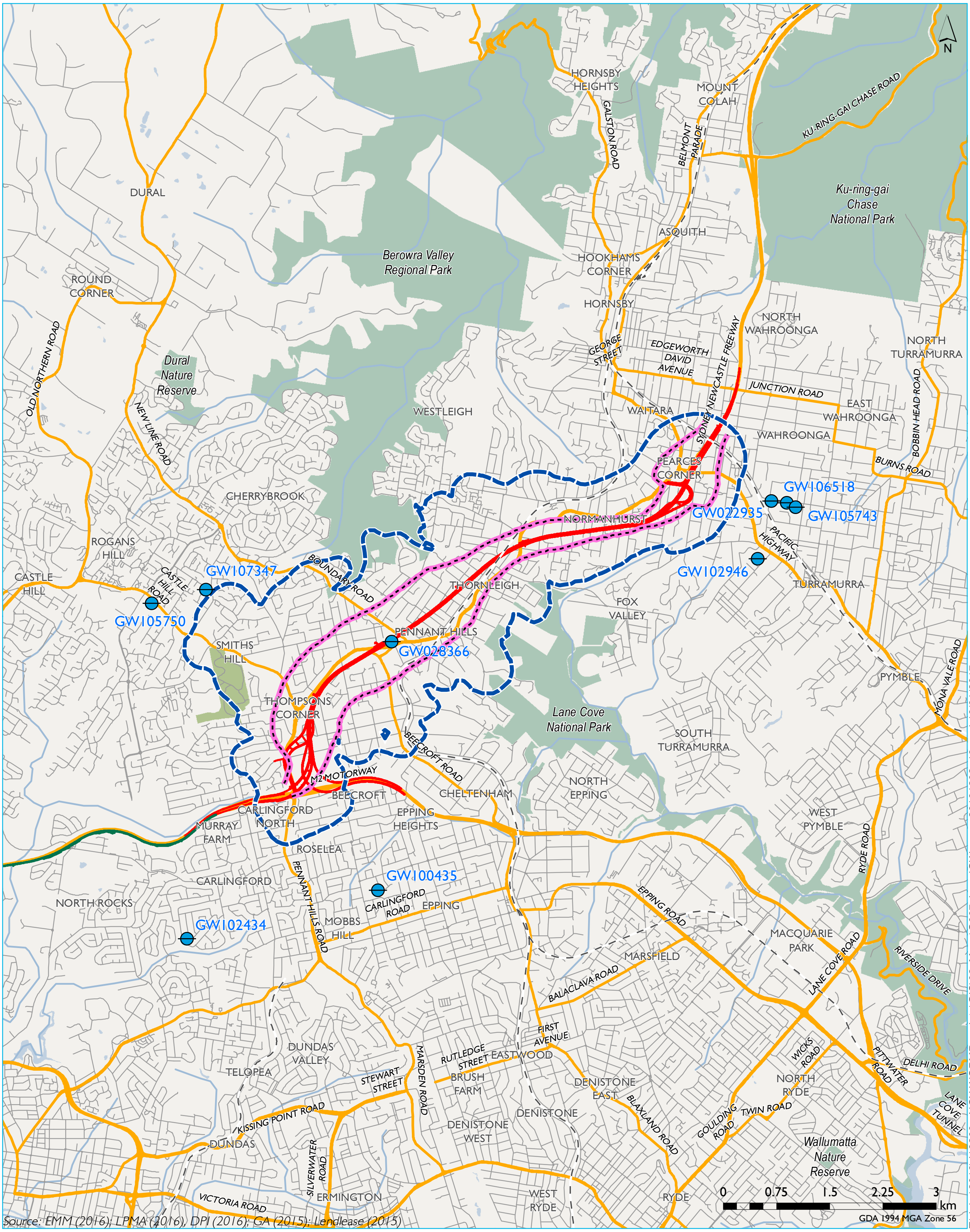
One registered bore with an active licence being utilised for water supply was identified within the revised predicted zone of 2 m drawdown. In addition, seven registered active bores were identified in proximity of the revised predicted zone of drawdown.

Table 3.3 Groundwater users within and in the vicinity of the predicted zone of drawdown

Works number	Licence number	Easting	Northing	Depth below surface (m)	Screened formation[1]	Authorised purpose	Date completed
Groundwater users in original drawdown prediction							
GW028366	10BL021374	320677	6265040	4.2	Alluvium	Domestic	NA
Groundwater users in proximity of revised drawdown prediction							
GW022935	10BL016416	326022	6267019	26.8	unknown	Domestic	12/01/1965
GW100435	10BL157898	320484	6261537	24.0	unknown	Domestic, stock	16/01/1997
GW102434	10BL158966	317796	6260856	146.0	unknown	Domestic, stock	31/05/1999
GW102946	10BL159554	325829	6266208	186.5	unknown	Stock, domestic	15/03/2000
GW105750	10BL162105	317299	6265582	126.5	unknown	Domestic	23/01/2004
GW106518	10BL164098	326237	6266992	150.0	unknown	Domestic	23/09/2004
GW107347	10BL163095	318062	6265774	195.0	unknown	Domestic	04/08/2004

Note: 1. Screened formation interpreted from drillers logs.

The Golder Associates (2016) assessment (Appendix E) found that it is unlikely that the water level within any bores will be reduced by more than 2 m, which is within the defined minimal impact criteria of the AIP and discuss in Section 2.3.1.



T:\Jobs\2016\J16200 - NCX WQPMP update\GIS\02_Maps\G007_LocalGWusers_20161202_13.mxd 19/01/2017

KEY

- Groundwater users
- Revised 2 m predicted drawdown countour
- Original 2 m predicted drawdown contour
- NorthConnex tunnel
- M2 integration works
- Major road
- Minor road
- Rail line
- Watercourse
- Waterbody
- NPWS reserve
- State forest

Local groundwater users

NorthConnex

Water Quality Plan and Monitoring Program

Figure 3.5

EMM

3.6. Ecosystems that potentially use groundwater

There is no defined high priority GDEs within the WSP for the Greater Metropolitan Region Groundwater Sources (CLWD 2011a) that are likely to be impacted by the Project.

There is some vegetation within the Berowra Valley Regional/National Park and the Lane Cove National Park that is reliant on groundwater to some extent. However, there is no vegetation specifically reliant on the surface expression of groundwater identified in the Groundwater Dependent Ecosystem Atlas or the WSP for the Greater Metropolitan Region Groundwater Sources for the Project area (AECOM 2014).

A potential low priority GDE and spring survey was completed between 19 and 21 November 2014 (EMM 2014). The study was designed to assess the surface expression of groundwater, specifically groundwater springs within the Project area to understand whether there are GDEs in the Project area and if there are, their level of dependence on groundwater contributions from the Ashfield Shale and Hawkesbury Sandstone aquifers.

Twenty seven individual sites were assessed in the field within a 2 km buffer of the Project's tunnel alignment (see Table 3.4 and Figure 3.6). Thirteen groundwater springs were identified as follows:

- ten were observed at the geological contact between the Ashfield Shale and Hawkesbury Sandstone;
- two were observed discharging from discrete fractures within the sandstone immediately below the contact of the overlying shale; and
- one was observed to be discharging from the weathered shale deposits.

Table 3.4 Spring locations

Site ID	GDE?	Easting	Northing	Elevation (mAHD)
DEV-01	No	320589	6263727	129.6
COU-02	Yes	324446	6266331	145.6
COU-03	Yes	324427	6266303	144.6
COU-01	Yes	324482	6266376	146.4
WAI-03	No	323377	6267330	139.6
SCO-02	Yes	320896	6264620	133.7
SCO-01	Yes	320918	6264461	126.1
WAI-01	No	323130	6268249	137.9
WAI-02	No	323860	6267770	146.2
TED-04	No	320637	6266220	145.0
TED-03	No	320631	6266301	141.8
TED-02	No	320608	6266398	138.0
TED-01	No	320604	6266471	133.5

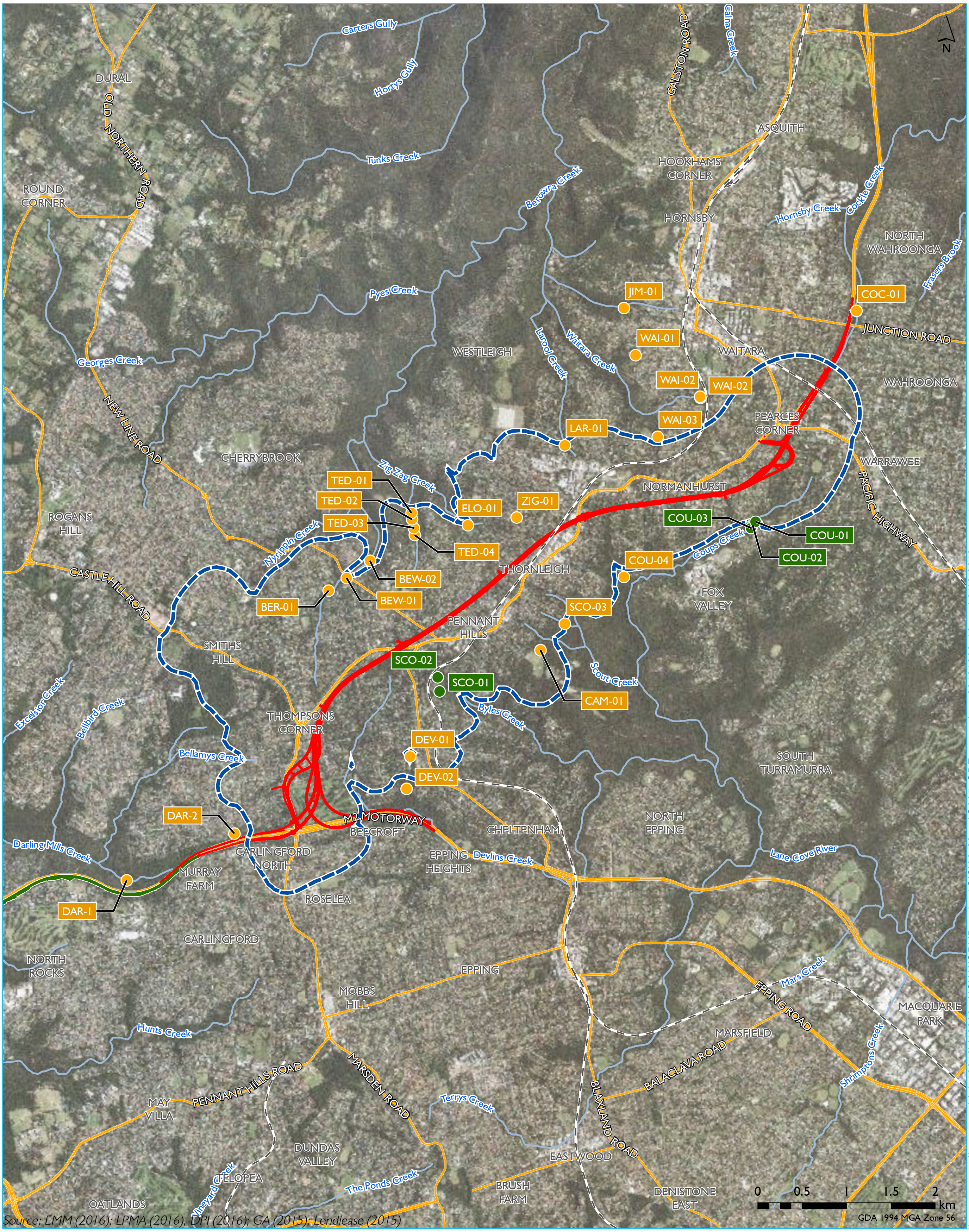
Two sites are located within the revised drawdown zone with the remaining three on the edge of that boundary. Of the thirteen springs or GDEs identified, seven of these are located within the the revised predicted zone of drawdown and three are located on the boundary.

Two GDEs (Blue Gum High Forest and Sydney Turpentine-Ironbark Forest) were identified during the surveys at five of the 13 spring sites (Figure 3.6). These two GDEs are both listed as endangered ecological communities (EECs) under the NSW Threatened Species Conservation Act 1995 (TSC Act) and the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The Blue Gum High Forest is listed as critically endangered under the TSC and EPBC Acts, whilst the Sydney-Turpentine Ironbark Forest is listed as endangered under the TSC Act and critically endangered under the EPBC Act.

Spring discharge is often observed above areas where the rock is massive with frequent fracturing. The relative impermeability of the underlying rock can impede downward infiltration of groundwater in the unsaturated zone and will therefore result in the seepage of groundwater along incised valleys. The source of groundwater to the identified GDEs is considered to be through rainfall fed shallow local springs. The seepage of groundwater from these springs is likely to be influenced by zones of higher permeability, created by the weathering of the rock, and discharge associated with incised valleys.

The Golder Associates (2016) assessment (Appendix E) found that there will be no change in the computed pre-tunnel discharge rates of the springs at either the commencement of operations or in the long term based on the revised groundwater model estimates.

Survey report on the groundwater spring census has been provided in Appendix D.



\\emgammsvr1\emgamm\Jobs\2016\J16200 - NCX WQPMP update\GIS\02_Maps\G005_GDEsurveysites_20161202_12.mxd 2/12/2016

KEY

- Groundwater dependant ecosystems
- Survey locations
- Lateral limit of drawdown of groundwater
- NorthConnex tunnel
- M2 integration works
- Major road
- Rail line
- Transport facility
- Watercourse

Potential groundwater dependent ecosystems

NorthConnex

Water quality sampling

Figure 3.6

EMM

3.7. Historic data

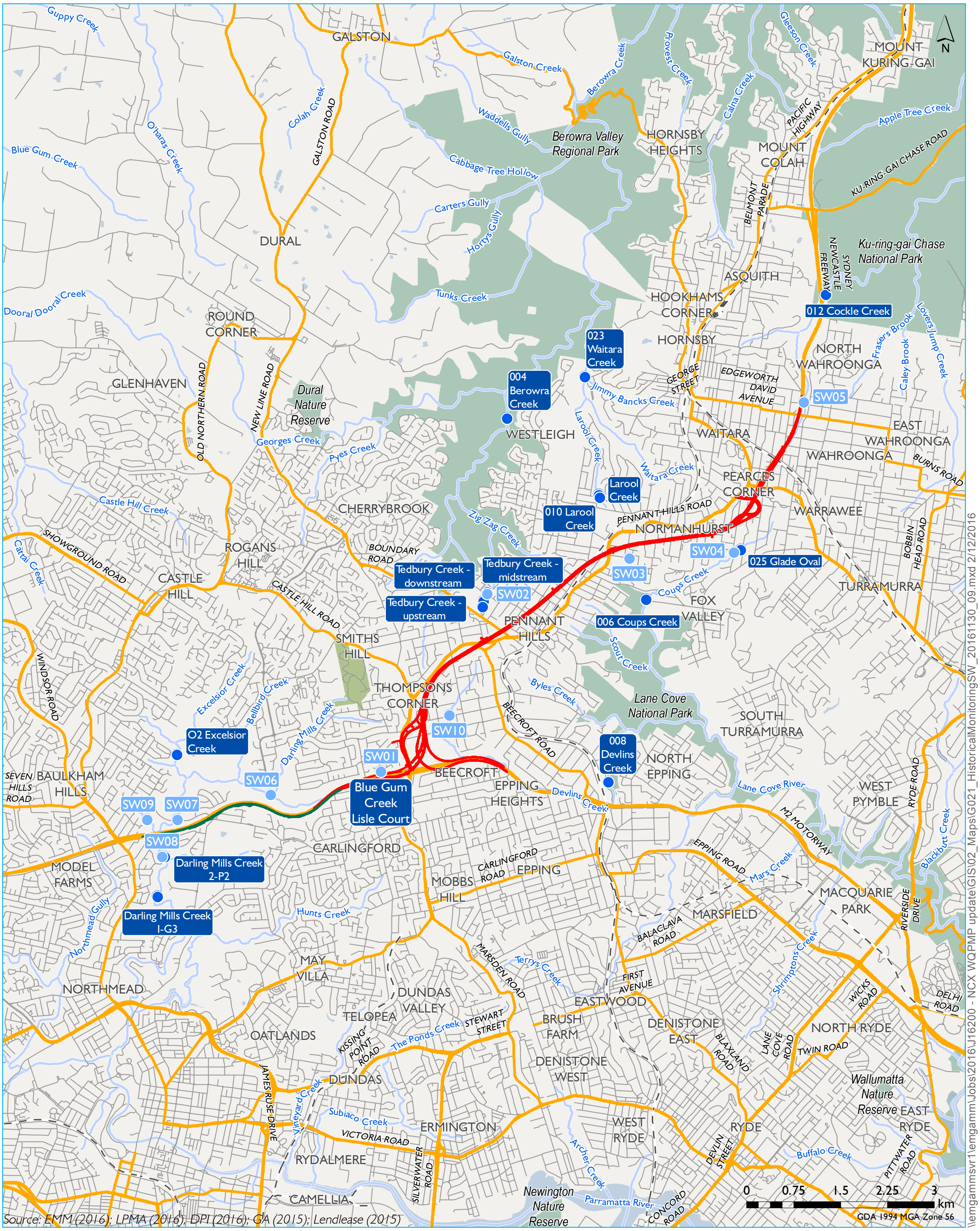
3.7.1. Sampling locations and monitoring periods

A desktop study was undertaken of publically available historic water data (in accordance with MCoAB15(f) and B16(a)) from: Hornsby Shire Council, Hills Shire Council, Ku-ring-gai Council; and the Streamwatch database. Sites proximate to the Project specific monitoring locations were selected for analysis. The selected surface water and groundwater sites are presented in Table 3.5 and Table 3.6 and shown on Figure 3.7 and Figure 3.8 respectively.

Table 3.5 Historic surface water sampling locations

Monitoring location	Monitoring period	Source
006 Coups Creek	1998-2005	Ku-ring-gai Council
012 Cockles Creek	1998-1999	Ku-ring-gai Council
025 Glade Oval	2004-2005	Ku-ring-gai Council
004 Berowra Creek	1994-2015	Hornsby Shire Council
008 Devlins Creek	1994-2015	Hornsby Shire Council
010 Larool Creek	1994-2015	Hornsby Shire Council
023 Waitara Creek	1994-2015	Hornsby Shire Council
Darling Mills Creek 1-G3	24/01/14-07/02/14	Hills Shire Council
Darling Mills Creek 2-P2	24/01/14-07/02/14	Hills Shire Council
O2 Excelsior Creek	2006-2014	Hills Shire Council
Blue Gum Creek Lisle Court	22/04/09-28/04/11	Streamwatch
Larool Creek	24/07/04-01/08/14	Streamwatch
Tedbury Creek - behind Pennant Hills High	1992-2012	Streamwatch
Tedbury Creek - downstream Pennant Hills High	21/02/05-23/11/05	Streamwatch
Tedbury Creek - upstream Pennant Hills High	01/02/05-23/11/05	Streamwatch

Table 3.6 Historic groundwater sampling locations		
Monitoring location	Monitoring period	Source
BH001	2013	AECOM (2014)
BH002	2013	AECOM (2014)
BH004	2013	AECOM (2014)
BH006	2013	AECOM (2014)
BH008	2013	AECOM (2014)
BH012	2013	AECOM (2014)
BH014	2013	AECOM (2014)
BH016	2013	AECOM (2014)
BH018	2013	AECOM (2014)
BH021	2013	AECOM (2014)
BH023	2013	AECOM (2014)
BH025	2013	AECOM (2014)



KEY

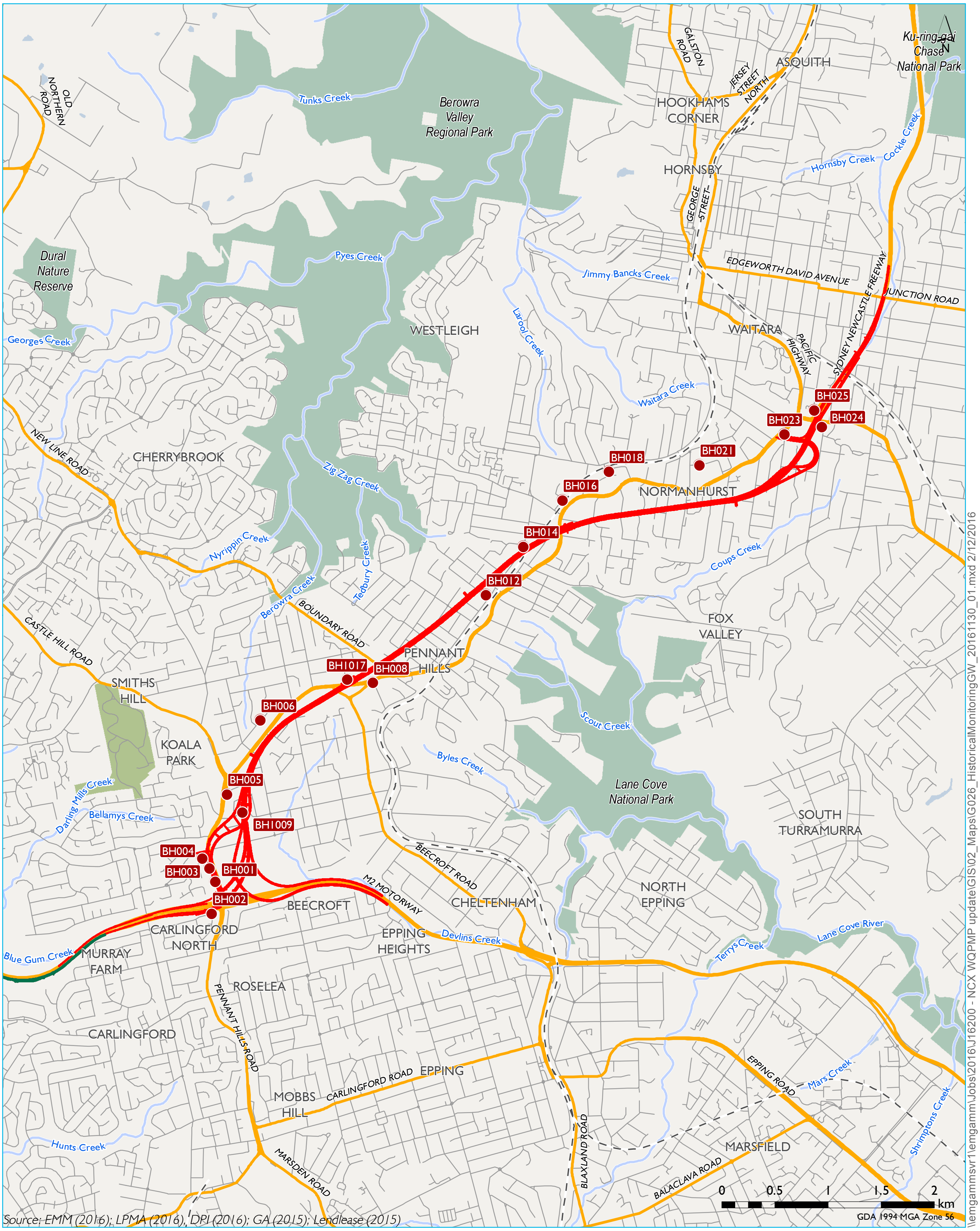
- Baseline surface water monitoring locations
- Historic surface water monitoring locations
- NorthConnex tunnel
- M2 integration works
- Rail line
- Major road
- Minor road
- Watercourse
- Waterbody
- NPWS reserve
- State forest

Historic and baseline surface water monitoring locations

NorthConnex

Water Quality and Monitoring Plan

Figure 3.7



KEY

- Groundwater monitoring locations
- NorthConnex tunnel
- M2 integration works
- Rail line
- Major road
- Minor road
- Watercourse
- Waterbody
- NPWS reserve
- State forest

Historic and baseline groundwater monitoring locations

NorthConnex

Water Quality and Monitoring Program

Figure 3.8

3.7.2. Surface water

Surface water data were tabulated and assessed against the ANZECC/ARMCANZ (2000a) guideline criteria for slightly to moderately disturbed aquatic ecosystems as per the baseline data. The tabulated data is provided in Appendix A.

Overall, historic monitoring indicates the surface water conditions are mostly “fresh”, ie <800 μS/cm, in accordance with the classification system reported by the Australian Water Resources Council (1998). There were a small number of exceedances of the water quality electrical conductivity (EC) guideline value (>2,220 μS/cm) amongst the Hornsby Council monitoring locations. Assessment of the EC trends indicated that EC increases during periods of above average rainfall, ie from January 2011 onwards (Figure 3.9). This EC trend suggests relatively greater groundwater discharge to surface water systems following wetter periods as the EC of groundwater is typically one order of magnitude higher than that of surface water. It should be noted that stormwater runoff typically has elevated EC which will contribute to this trend.

The pH in surface water fluctuates and while overall conditions are neutral, there are a number of minor exceedances outside the water quality guideline (6.5–7.5 pH units, ANZECC/ARMCANZ 2000a). The overall average was 7.3 pH units, and this is consistent across the monitoring period (Figure 3.10). The average pH conditions reported for Larool Creek (Hornsby Shire Council) are slightly alkaline (7.7 pH units) at Thornleigh, but are neutral (7.03 pH units) at Wareemba Avenue (Streamwatch).

A large range of turbidity measurements were recorded, with a number of exceedances of the ANZECC/ARMCANZ (2000a) guideline (25 nephelometric turbidity units (NTU)). Elevated turbidity concentrations are likely to be associated with rainfall events and the subsequent mobilisation of sediments in surface runoff. The highest turbidity measurements, ranging from 400 NTU to 725 NTU, were typically recorded during the relatively wetter summer months, late spring and early autumn. Concentrations of total suspend solids (TSS) fluctuate, and although TSS concentrations and turbidity were not measured at the same time, TSS concentrations elevated when turbidity concentrations spike (Figure 3.11).

During events where total nitrogen was sampled, the concentration always exceeded the ANZECC/ARMCANZ (2000a) guideline value (0.015 mg/L). The total phosphorous concentration also exceed the guideline value (0.02 mg/L) during a majority of the sampling events. While surface water nutrient levels are predominantly above the guideline values, the results are expected given the surrounding land uses types. Total nitrogen concentrations show minor spikes associated with rainfall events, typically around summer. Thus the total nitrogen concentrations show a seasonal pattern. It can be assumed that the other nutrients that are mobilised in a similar fashion.

The numbers of colony forming units (CFU) and Escherichia coli (E. coli), representing faecal coliforms are typically low, but always present in the surface water sampled (Appendix A). Overall faecal coliforms are generally highest at Excelsior Creek and Larool Creek, although sampling for faecal coliforms is less frequent at the other sites reviewed. The faecal coliform counts are typically further elevated following rainfall, most frequently in summer. The maximum CFU reading detected at the Excelsior Creek site was 72,000 CFU/100 mL (Hills Shire Council), and the maximum CFU reading at Larool Creek was 9,300,000 CFU/100 mL, possibly indicating a sewage overflow event (Figure 3.12).

In summary, the review of the historic surface water data within the Project area and surrounds indicates that the water is fresh and mostly neutral, and is representative of surface water in a predominantly urban catchment. Nutrient and coliform concentrations are elevated, and along with turbidity, are typically highest following rainfall events, where they are mobilised in runoff. Seasonal increases in nutrient loads, coliforms and turbidity are noted during the summer and shoulder months. pH measurements do not reflect a similar trend with minimal variation across the monitoring period. EC concentrations show a longer term trend, possibly associated with groundwater discharges, evident in periods of higher than average rainfall.

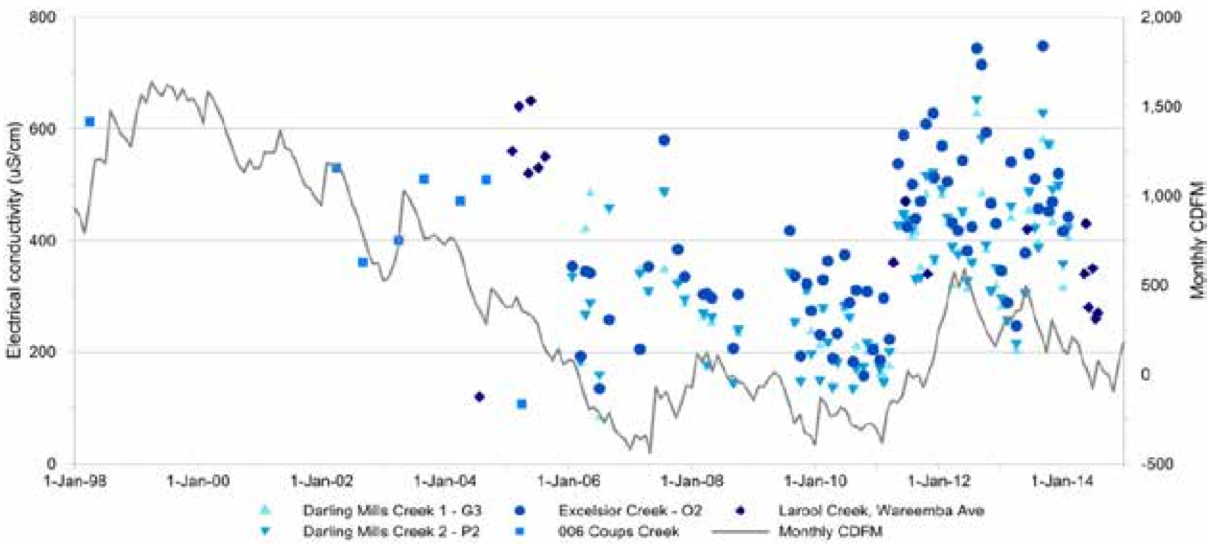


Figure 3.9 Historic surface water data – electrical conductivity and CDFM

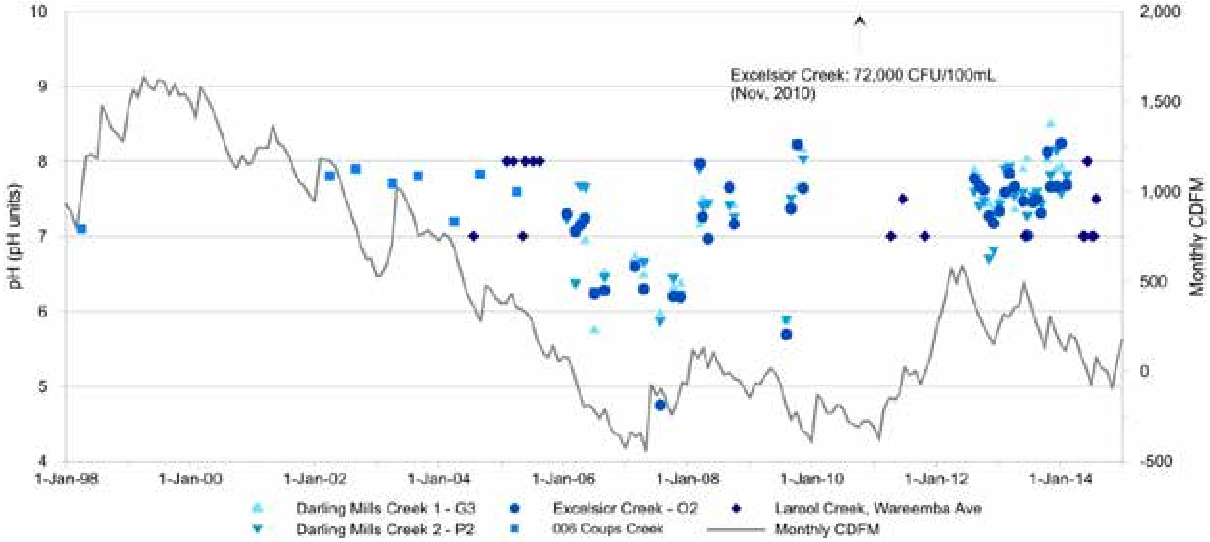


Figure 3.10 Historic surface water data – pH and CDFM

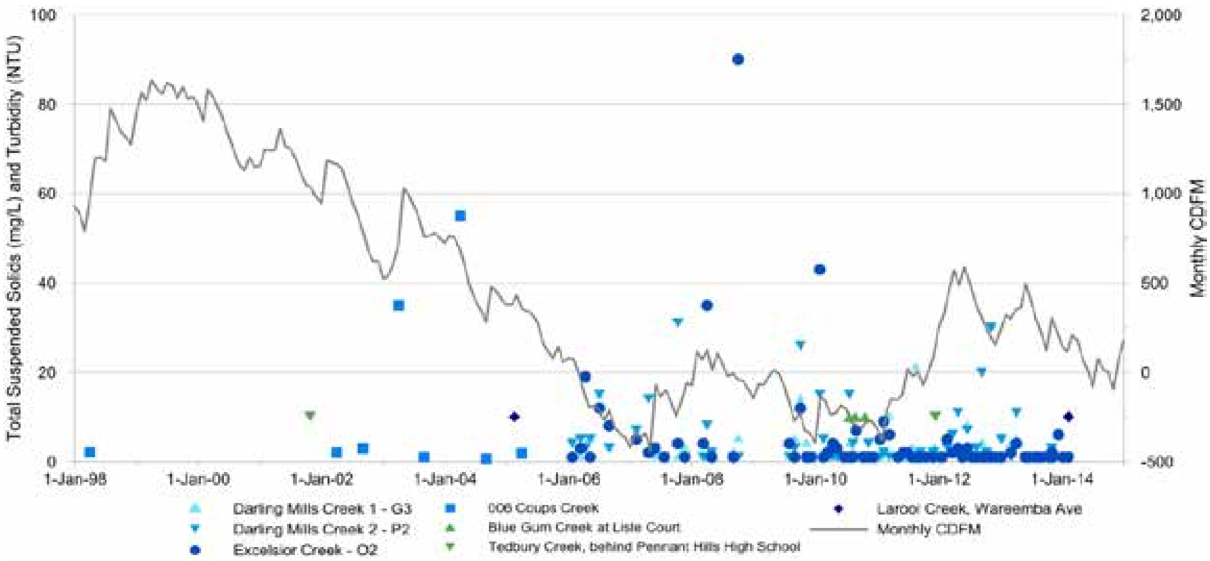


Figure 3.11 Historic surface water data – TSS/turbidity and CDFM

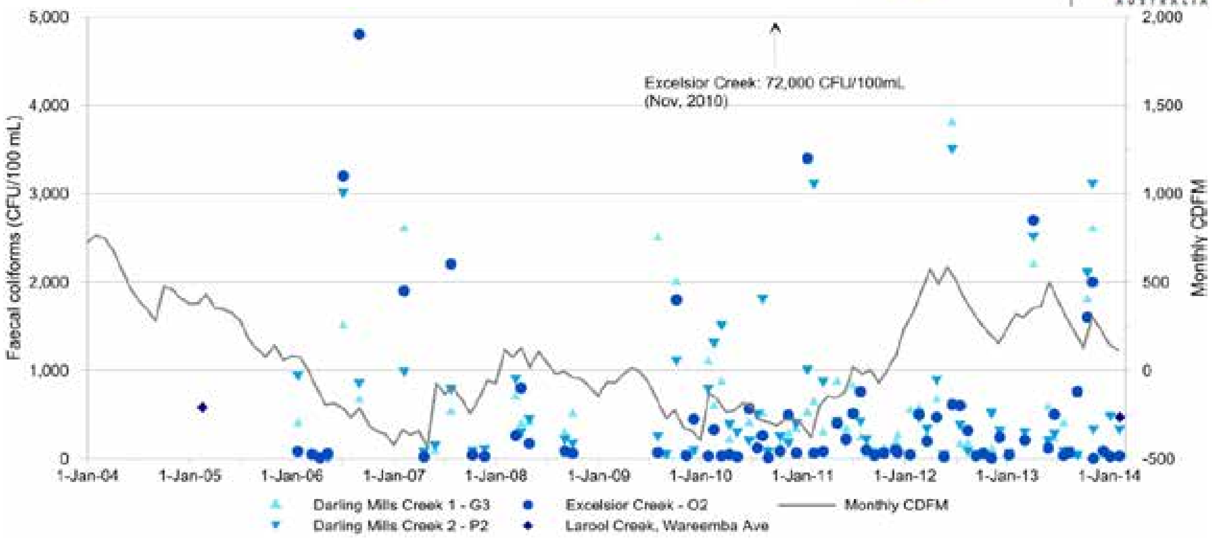


Figure 3.12 Historic surface water data – faecal coliforms and CDFM

3.7.3. Groundwater

The available historic groundwater data that is hydrogeologically relevant to the study area is limited. During the development of the EIS (AECOM 2014), a staged hydrogeological drilling investigation was undertaken across the Project area which focused on areas of potential risk and uncertainty associated with the tunnel design. The monitoring bores that were drilled as part of the Phase 1 and Phase 2 investigations targeted either Ashfield Shale or Hawkesbury Sandstone, with the intention of obtaining representative groundwater quality and level information.

Groundwater quality samples were obtained from each of the monitoring bores listed in Table 3.6. Samples were collected between 29/07/2013 and 30/07/2013. Water quality analysis comprised assessment of physical properties; major ions; dissolved metal; nutrients; total petroleum hydrocarbons (TPH); benzene, toluene, ethylbenzene and xylenes (BTEX); polycyclic aromatic hydrocarbons (PAH); and pesticides. A summary of the water quality by aquifer is provided below. The tabulated data is included in Appendix A.

i Ashfield Shale

The four sites targeting the Ashfield Shale (BH001, BH002, BH004 and BH025) display variable EC, with values ranging from 1,113 µS/cm to 4,050 µS/cm, indicating the groundwater conditions are of marginal to brackish water quality. The pH of the groundwater is acidic across all four sites (3.4–5.9 pH units) with an average of 5.0 pH units. This result is consistent with regional water quality measurements for pH within the Ashfield Shale.

The dissolved metal concentrations of cadmium, chromium, copper, nickel and zinc all exceeded the ANZECC/ARMCANZ (2000a) trigger values for slightly to moderately disturbed aquatic ecosystems. These elevated dissolved metals concentrations are typical of shale within the Sydney Basin, and are considered to be a part of the water-rock interaction.

Analysis for petroleum and pesticide contaminants, and nutrients were only undertaken for BH002. Nitrate, nitrite and total phosphorous exceeded the ANZECC/ARMCANZ (2000a) guideline values for south-east Australian lowland rivers and NSW coastal rivers. This result is not surprising due to this shallow aquifer system being located in a heavily urbanised environment.

Six manual groundwater level measurements were obtained for the monitoring bores targeting the Ashfield Shale. The monitoring period covered 24/07/2013 to 24/10/2013. The spatial spread of the shale monitoring bores along the proposed alignment allows for the conceptualisation of the groundwater flow direction, indicating a north-east – south-west flow direction. This is generally a muted reflection of the surface topography and is in line with the regional groundwater flow direction within the shale (Hydro Tasmania Consulting 2010). The large variation in groundwater levels is likely to be due to the less productive nature of the aquifer and the long time that groundwater levels take to return to equilibrium levels following a sampling event.

ii Hawkesbury Sandstone

Seven groundwater monitoring bores targeting the Hawkesbury Sandstone aquifer were assessed(BH006, BH008, BH012, BH014, BH018, BH021 and BH023).

Field EC collected at five of the seven sites (BH012, BH014, BH018, BH021 and BH023) indicated marginal water quality (895–1,820 µS/cm). Laboratory EC values provided for BH006 and BH008 were significantly higher, 4,420 µS/cm and 3,310 µS/cm respectively. BH006 and BH008 are both located down hydraulic gradient of the other five bores. Therefore the higher concentrations of EC are expected due to the higher residence time and the time available for the mobilisation of total ions. The pH of the groundwater is considered acidic to neutral (5.4 to 7.8 pH units). The pH of the groundwater sampled from BH021 was significantly higher (11.7 pH units) and is likely to be due to a sampling error.

The dissolved metals concentrations of arsenic, chromium, copper, nickel, lead and zinc all exceed ANZECC/ARMCANZ (2000a) trigger values for slightly to moderately disturbed aquatic ecosystems, with zinc and nickel concentrations significantly higher than trigger values.

Nutrients data is limited, with only two of the seven monitoring bores (BH021 and BH023) analysed for total nitrogen, nitrate, nitrite and total phosphorous. Results for BH021 are consistent with baseline monitoring results (Section 3.8.2), with exceedances of ANZECC/ARMCANZ (2000a) guideline criteria for both nitrate and nitrite. Total nitrogen and nitrate concentrations for BH023 are high (17.8 mg/L). This may be due to sampling error or could be related to the adequacy of the sampling method.

Analysis for contaminants was only undertaken for BH014 and BH018. Light and medium volatile total petroleum hydrocarbons ($TRHC_6$-C_{10} and TRH>C_{16}-C_{34}) were detected at both locations. The urbanised catchment is likely to be a source of hydrocarbon contamination through petrol and diesel spills.

3.8. Baseline monitoring data

In addition to the historic data, baseline data was collected as part of the Project and assessed to characterise conditions prior to the construction and operation phases of the Project.

The Project baseline data collection extends from August 2014 to June 2015.

Surface water and groundwater sampling was undertaken monthly. In addition, three wet weather event samples have been collected from the surface water sites between the August 2014 and April 2015 and two more in April to June 2015. However, only the data from August 2014 to March 2015 was available when project-specific water quality criteria where calculated from the available baseline data and historic data (Section 7). New criteria could be calculated from the original dataset with the addition of the final three months of baseline data and the historic data. However, it is unlikely that this would materially change the criteria but would require reanalysis of construction monitoring data against the new (but similar) criteria. It has been therefore decided to continue to use the previously calculated site specific water quality criteria.

3.8.1. Surface water monitoring

i Monitoring locations

Surface water monitoring sites were selected with a specific focus on the surface water drainages from the road infrastructure to be constructed. Consideration was given to the proposed tunnel alignment and the locations of upstream and downstream creeks in measuring representative baseline conditions.

In total, nine different waterways were monitored as part of the baseline programme. Details of the monitoring sites and rationale for selection are provided in Table 3.7 and 3.8, respectively and the locations of the sites are shown on Figure 3.7. The site selection considered the sensitive receiving environments that were identified in the EIS (AECOM 2014), and described above in Section 3.3.

However, only the data from August 2014 to March 2015 was available when project-specific water quality criteria were calculated from the available baseline data and historic data.

Table 3.7 Baseline surface water monitoring locations

Site name	Easting	Northing	Elevation (mAHD)
SW01	318844	6262890	94
SW02	320539	6265734	166
SW03	322827	6266288	159
SW04	324482	6266393	168
SW05	325606	6268796	175
SW06	317109	6262489	64
SW07	315591	6262115	26
SW08	315301	6261842	58
SW09	315100	6262124	74
SW10	319930	6263790	128

The rationale for site selection has been provided below in Table 3.1.

Table 3.1 Rationale for site selection – surface water

Sub-catchment	Site name	Waterway name	Upstream/downstream & north/south of the Project	Rationale for site selection and impacts targeted
Parramatta River	SW01	Blue Gum Creek	Downstream/north	Sensitive environment – Bidjigal Reserve/downstream of Southern Interchange Compound and the operational WTP discharge location.
	SW06	Junction of Blue Gum Creek and Darling Mills	Downstream/north	Sensitive environment – Bidjigal Reserve

Table 3.1 Rationale for site selection – surface water

Sub-catchment	Site name	Waterway name	Upstream/downstream & north/south of the Project	Rationale for site selection and impacts targeted
		Creek		
	SW07	Darling Mills Creek	Downstream/north	Sensitive environment – Bidjigal Reserve
	SW08	Darling Mills Creek	Downstream/south	Sensitive environment – Bidjigal Reserve
	SW09	Stevensons Creek	Upstream/north	Tributary of Darling Mills Creek/Sensitive environment - Bidjigal Reserve
Berowra Creek	SW02	Tedbury Creek	Downstream/north	Downstream of Wilson Rd Support Facility
Lane Cove River	SW03	Unnamed creek	Downstream/south	Downstream of Trelawney St Support Facility
	SW04	Coups Creek	Downstream/south	Sensitive environment – Lane Cove National Park/Downstream of Northern Interchange Compound
	SW10	Devlin's Creek	Downstream/south	Sensitive environment – Bidjigal Reserve
Cowan Creek/Pittwater	SW05	Cockle Creek	Downstream/south	Sensitive environment – Ku-ring-gai Chase National Park

ii Surface water quality data analysis

A summary of baseline surface water quality results is provided in Appendix B. Sampling events are tabulated in Table 3.9.

Comparison of the results against the ANZECC/ARMCANZ (2000a) guidelines is provided, although it should be noted that these guidelines are not to be used as a mandatory standard, rather they provide a default guideline for protecting the environmental values of water resources in the absence of site specific criteria.

Table 3.9 Surface water baseline sampling events

	2014							2015							
Site ID	22/08	19/09	16/10	06/11*	17/11	02/12*	15/12	15/01	22/01*	19/02	24/03	20/04*	27/05	17/06*	25/06
SW01	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SW02	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SW03	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SW04	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SW05	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SW06		X	X	X	X	X	X	X	X	X	X	X	X	X	X
SW07		X	X	X	X	X	X	X	X	X	X	X	X	X	X
SW08		X	X	X	X	X	X	X	X	X	X	X	X	X	X
SW09				X		X			X			X		X	X
SW10											X	X	X	X	X

Notes: *Wet weather sampling event.

a. Field water quality parameters

Electrical conductivity

The surface water (field measured) EC results were all within ANZECC/ARMCANZ (2000a) guideline values, and overall conditions were predominantly fresh (Figure 3.13). An EC range of 48 – 1,027 µs/cm was measured across the Project area, with higher EC at SW01 (Blue Gum Creek) and SW04 (Coups Creek), and lower EC in the southern extent of the Project area at SW02, SW05 and SW06.

The lower EC were during the December 2014 wet weather sampling event. This is indicative of the freshening effect of rainfall. However low ECs were not noted during the August 2014 wet weather sampling event.

Analysis of the standard deviation from the mean for each monitoring site confirmed that the EC at many of the surface water sites shows statistically significant variation In most cases, the variation is in response to higher rainfall events. The locations with the greatest EC fluctuations were SW01, SW03, SW07 and SW08.

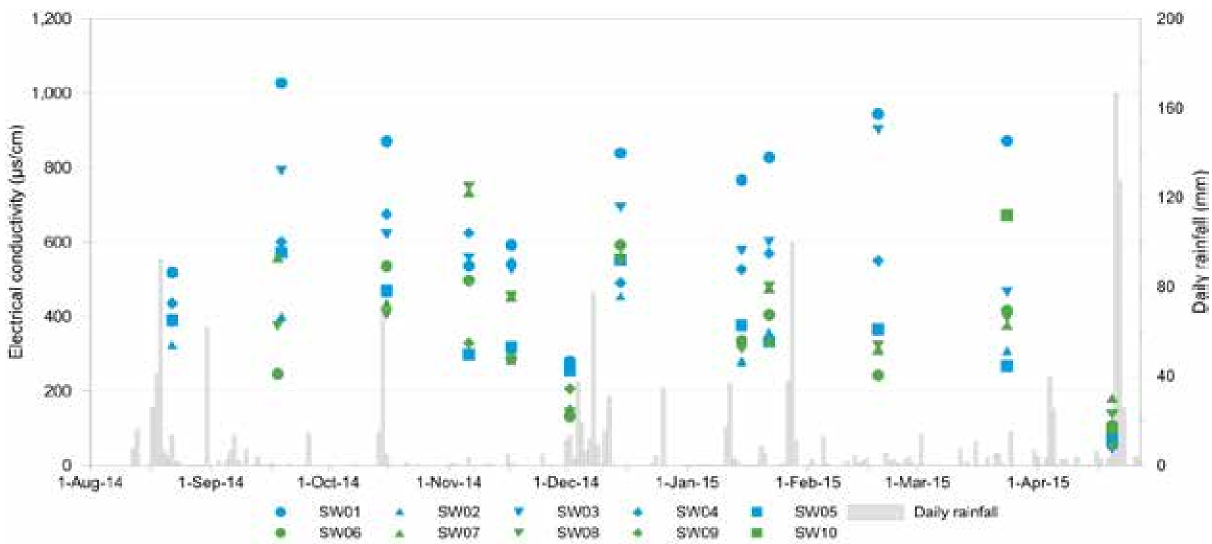


Figure 3.13 Electrical conductivity – surface water sites

pH

The surface water field measured pH at all sites (Figure 3.14) exceeded both the lower and higher default guideline values of 6.5–7.5 pH units provided by ANZECC/ARMCANZ (2000a). pH ranged from 4.60–9.29 pH units with an average of 7.68 pH units across all sites for the monitoring period. The mean pH is slightly alkaline and the pH measurements fluctuate between monitoring events, most likely in association with rainfall events.

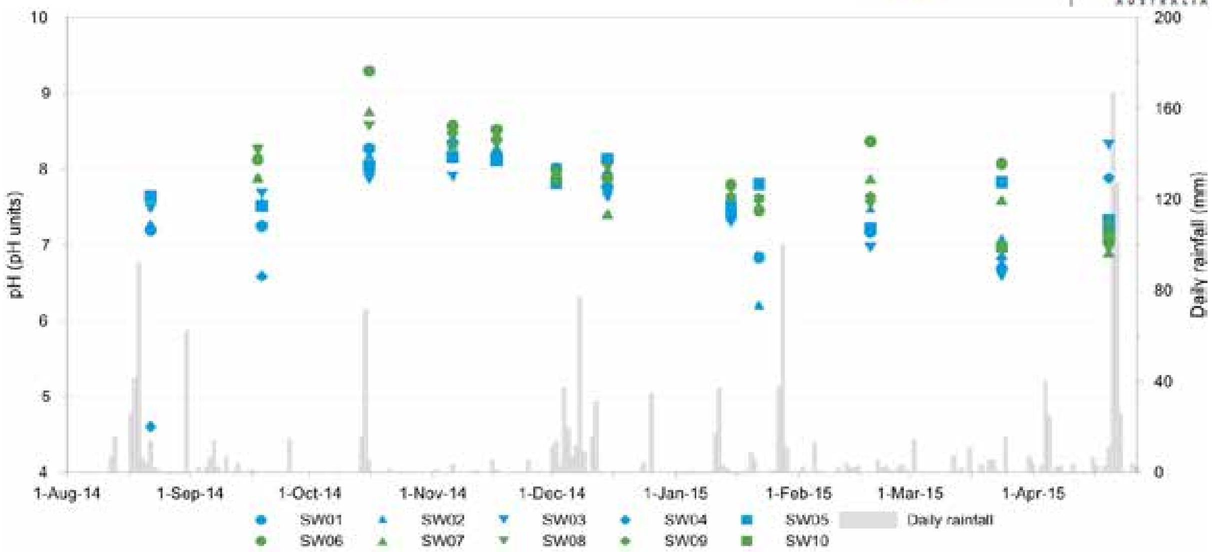


Figure 3.14 pH – surface water sites

Oxidation reduction potential (redox)

The redox potential was predominantly positive for all surface water sites (Figure 3.15), indicating oxidising conditions within the surface water environment.

Negative results were obtained for SW02, SW03 and SW04 in November and December 2014, and at SW02, SW03, SW04 and SW06 in January, February and March 2015. These sites have very low flow and can be assumed to have low oxygen saturation. Lower dissolved oxygen in surface water systems encourages a reducing environment.

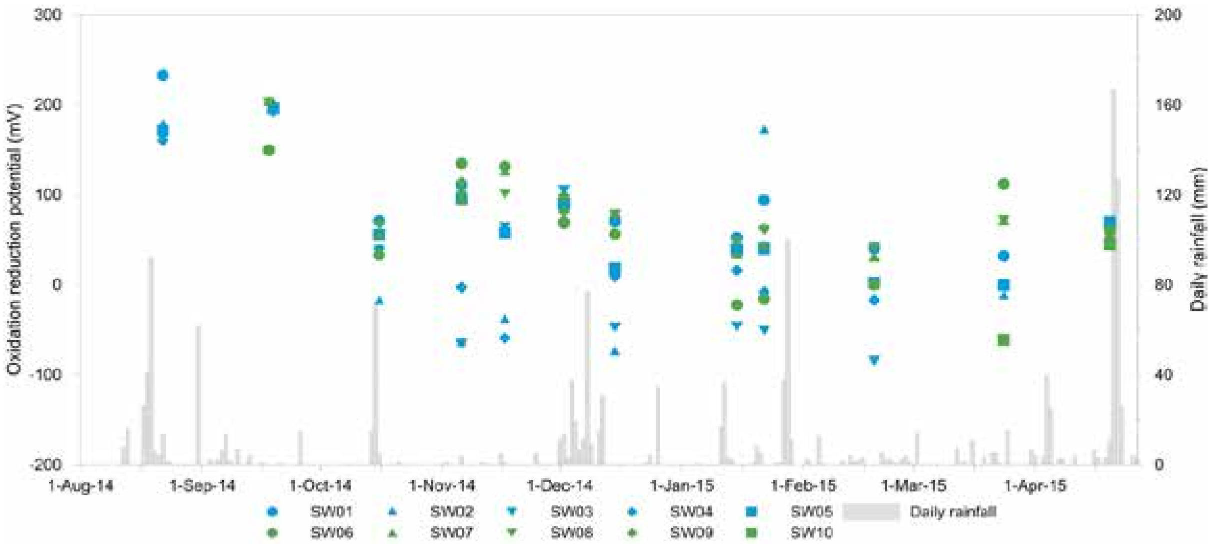


Figure 3.15 Redox – surface water sites

Dissolved oxygen

Dissolved oxygen (DO) is typically low to moderate due to the natural low flow environment of the creeks. The maximum DO concentration was 76 mg/L, at SW07 in December 2014, following a rainfall event.

b. Laboratory samples

Major ions

Chloride and sodium were the dominant ions present at most of the surface water sites, with moderate background concentrations of sulphate and calcium.

The highest total major cations and anions concentration was at SW01. This is consistent with the elevated EC at this location. The lowest concentrations of major cations and anions were measured at SW02, where the EC was low.

Dissolved metals

The dissolved copper and zinc concentrations were consistently above the ANZECC/ARMCANZ (2000a) trigger values for slightly to moderately disturbed aquatic ecosystems at all surface water monitoring locations. Interaction with the surrounding environment, particularly the outcropping Hawkesbury Sandstone is likely to have contributed to these elevated concentrations. In addition, the ANZECC/ARMCANZ (2000a) trigger values were exceeded for cadmium and chromium at SW01 and SW06, respectively. The remainder of the dissolved metal concentrations were below the laboratory level of reporting (LOR), with the exception of nickel and manganese concentrations, which were below the ANZECC/ARMCANZ (2000a) trigger value and iron, for which there is no ANZECC/ARMCANZ (2000a) trigger value.

Nutrients

Nitrate, ammonia and total phosphorous concentrations exceeded the ANZECC/ARMCANZ (2000a) guideline value for south-east Australian lowland rivers and NSW coastal rivers at all locations during most sampling events. There were some instances of the nitrite concentration exceeding the ANZECC/ ARMCANZ (2000a) guideline value (0.015 mg/L).

Nutrient concentrations were highest at SW01. Ammonia, nitrate and phosphate are all fundamental components in fertilizers and these nutrients are mobilised in runoff. Higher nutrient concentrations could also be influenced by leaking sewage, eg from household septic tanks and/or main sewerage lines.

Hydrocarbons

Total and recoverable petroleum hydrocarbons (TPH/TRH) were measured above the LOR at three surface water monitoring locations (SW01, SW03 and SW04). Medium and heavy hydrocarbon fractions were detected on two occasions at SW03 and SW04 during November 2014. Light TPH exceedances were observed at SW03 in February 2015. Heavy rainfall had preceded the sampling events on these occasions. This is likely to have mobilised contaminants on surrounding roads. The medium to heavy TPH fraction at SW01 was above the LOR during the November 2014 wet weather sampling event, further suggesting that heavy rainfall was responsible for the elevated hydrocarbon fractions in the surface water sample.

Analysis of monocyclic aromatic hydrocarbons (BTEX and naphthalene (BTEXN)) at all surface water sites determined the surface water sites to be absent of BTEXN, with the exception of SW03. Low levels of toluene were measured during the November 2014 sampling events. Toluene is a by-product of crude oil and is a derivative of benzene. The presence of toluene at SW03 following two isolated heavy rainfall events suggests that the higher hydrocarbon results are a result of contaminated runoff entering the surface water system.

3.8.2. Groundwater monitoring

There were seven groundwater monitoring bores in the baseline monitoring network (Figure 3.8). The sites were selected to ensure detailed spatial coverage (and adequate depths) along the tunnel alignment, and to collect representative samples from the shale and sandstone aquifers. Details of the monitoring bores are listed in Table 3.10.

Table 3.10 Baseline groundwater monitoring locations

Location	Easting	Northing	Elevation (m AHD)	Aquifer formation	Borehole depth (m)	Screened interval (m AHD)	Approximate horizontal distance from tunnel alignment (m)
BH004	319120	6263321	137.8	shale	36	117-114	50
BH014	322136	6266248	162.6	sandstone	40	138-135	30
BH021	323792	6267015	173.9	sandstone	44	147-144	350
BH023	324594	6267306	188.5	sandstone	41	174-171	15
BH025	324871	6267532	192.4	shale	29	183-180	40
BH1009	319513	6263752	139.1	sandstone	68	83-74	<1
BH1017	320481	6264999	179.4	sandstone	91	100-91	30

Note: AHD = Australian height datum.

In accordance with the requirements of MCoAB15(g), the rationale for the selection of each groundwater monitoring sites is provided in Table 3.11.

Table 3.11 Rationale for site selection – groundwater

Monitoring formation	Site name	Location	Rationale for site selection and impacts targeted
Ashfield Shale	BH004	Close to southern interchange compound	Tunnel intercepts shale in proximity of this location.
	BH025	Close to northern interchange compound	Tunnel intercepts shale in proximity of this location.
Hawkesbury Sandstone	BH023	Close to northern interchange compound	Adjacent to BH004, allowing the assessment of vertical hydraulic gradient and potential flow
	BH1009	Close to southern interchange compound	Adjacent to BH025, allowing the assessment of vertical hydraulic gradient and potential flow

Table 3.11 Rationale for site selection – groundwater

Monitoring formation	Site name	Location	Rationale for site selection and impacts targeted
	BH021	Northern part of the Project	Tunnel intercepts the sandstone in proximity of this location.
	BH014	Central part of the Project, near Trelawney Street support facility	Tunnel intercepts the sandstone in proximity of this location.
	BH017	Central part of the Project, near Wilson Road support facility	Tunnel intercepts the sandstone in proximity of this location.

Table 3.12 Baseline groundwater sampling events

	2014						2015					
Site ID	19/09	16/10	17/10	17/11	18/11	16/12	14/01	17/02	23/03	20/04	27/05	26/06
BH004	X		X		X	X	X	X	X	X	X	X
BH014	X		X		X	X	X	X	X	X	X	X
BH021	X		X		X	X	X	X	X	X	X	X
BH023	X	X		X		X	X	X	X	X	X	X
BH025	X	X		X		X	X	X	X	X	X	X
BH1009			X		X	X	X	X	X	X	X	X
BH1017			X		X	X	X	X	X	X	X	X

i Groundwater quality data analysis

A summary of the groundwater quality baseline results is provided in Appendix B. Sampling events (August 2014 to April 2015) have been tabulated in Table 3.12.

Electrical conductivity

Groundwater has a large EC range within both the shale and sandstone formations (Figure 3.16). Overall, the ECs were predominantly of marginal (800–1,600 µS/cm) to brackish quality (1,600–4,800 µS/cm), with some o fresh water quality (<800 µS/cm) and some slightly saline results (4,800–10,000 µS/cm) (DPI 1988) (Figure 3.16). EC concentrations were the lowest at BH014 and the highest at BH1009. Both these monitoring bores intersect the Hawkesbury Sandstone, indicating the variable salinity conditions in this unit. The average EC at BH004 and BH025, which intersect the Ashfield Shale, was brackish.

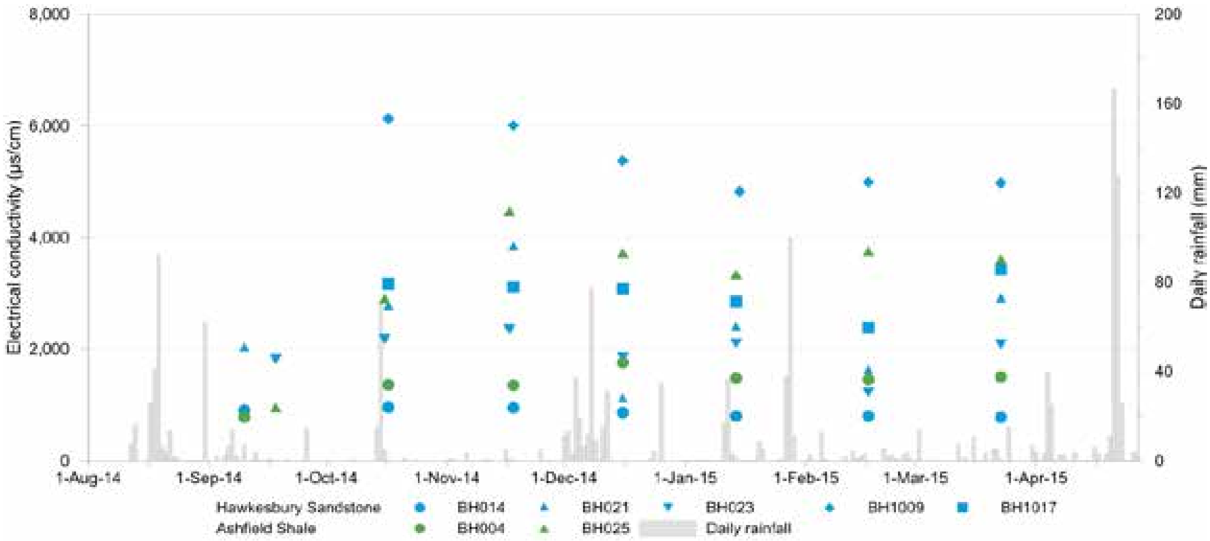


Figure 3.16 Electrical conductivity – Hawkesbury Sandstone and Ashfield Shale

pH

The field pH measurements (Figure 3.17) were consistent and comparable to literature values for groundwater within the Sydney Basin (Green 2010).

The pH in the Hawkesbury Sandstone was typically slightly acidic to neutral (average 6.3 pH units). The pH in the Ashfield Shale varied. Groundwater was acidic (average 3.9 pH units) at BH0025 in the northern extent of the Project area, and neutral to alkaline (average 8.4 pH units) at BH004 in the southern extent of the Project area.

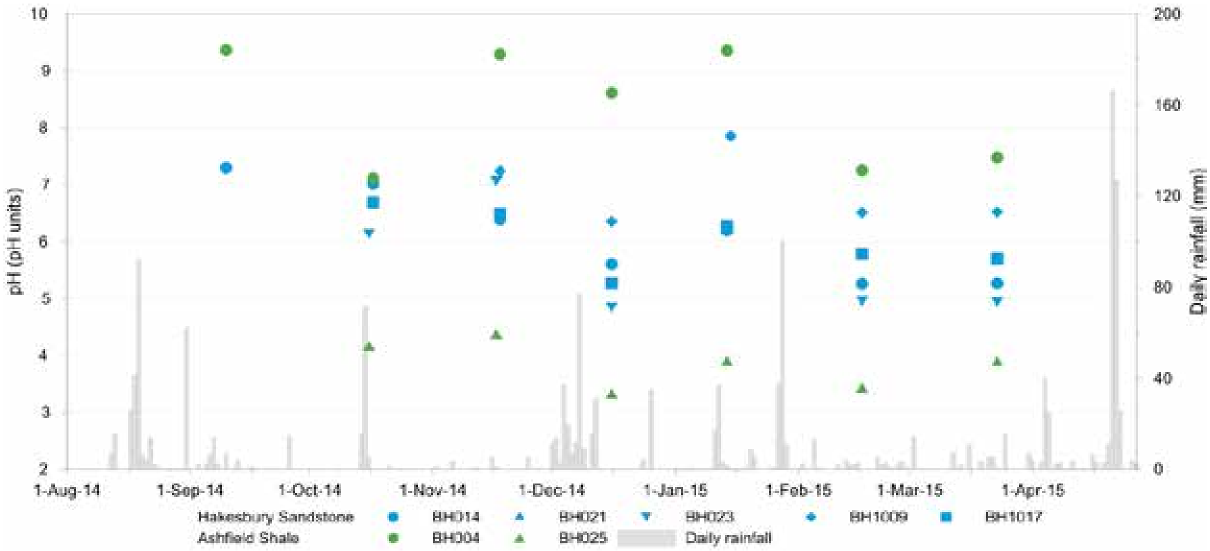


Figure 3.17 pH – Hawkesbury Sandstone and Ashfield Shale

Oxidation reduction potential (redox)

The redox potential was predominantly negative for monitoring bores targeting the Hawkesbury Sandstone aquifer indicative of reducing conditions (Figure 3.18). The exceptions were all the results at BH014, and one result from BH023 and BH1009, where positive redox potential indicated an oxidising environment.

Amongst the bores intercepting the Ashfield Shale, redox conditions were positive at BH025 (average +294 mV), indicative of oxidising conditions, while conditions were negative at BH004 (average -132 mV), indicative of reducing conditions.

Oxidising conditions are indicative of greater interaction with organic matter and bacterial transformations.

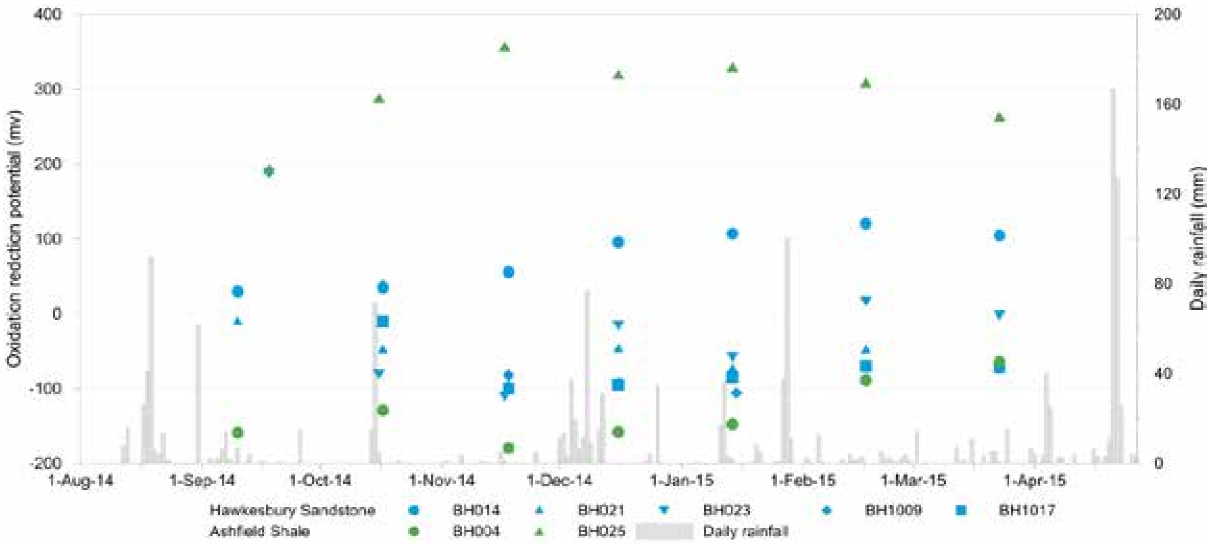


Figure 3.18 Redox – Hawkesbury Sandstone and Ashfield Shale

Dissolved oxygen

Dissolved oxygen concentrations are typically low in groundwater, however the sampling method may result in higher DO concentrations through the introduction of bailing and pumping, facilitated by the purging of the bores prior to sampling. The maximum DO result was 35.6 mg/L observed at BH21 in October 2014.

b. Laboratory samples

Major ions

Chloride and sodium were the dominant ions present in the groundwater sampled with moderate concentrations of sulphate. The dominant ions in groundwater were similar to those in the surface water, however the concentrations in the groundwater were higher. The highest concentration of major cations and anions was detected at BH1009, consistent with the elevated EC at this location.

Dissolved metals

Dissolved metal concentrations have been compared to the default ANZECC/ARMCANZ (2000a) guidelines for the protection of 95% of aquatic species (ie for the protection of slightly to moderately disturbed ecosystems). In summary:

- zinc concentrations exceeded the default trigger value (0.008 mg/L) at all groundwater monitoring locations during all sampling events;
- nickel concentrations exceeded the default trigger value (0.011 mg/L) at all sites, excluding BH004, during most sampling events. The maximum concentration was 0.032 mg/L (BH1017 in October 2014);
- lead concentrations at BH025 exceeded the default trigger value (0.0034 mg/L), the maximum concentration was 0.014 mg/L (August 2014);
- copper concentrations exceeded the default trigger value (0.0014 mg/L) at BH025, BH021, BH014 and BH004 on occasion;
- cadmium concentrations exceeded the default trigger value (0.0002 mg/L) at BH025 and BH014 on occasion;
- arsenic concentrations exceeded the default trigger value (0.013 mg/L) at BH004 and BH1009 on occasion and at BH1017 during all sampling events; and
- iron concentrations exceeded the LOR (0.05 mg/L) at BH023 and BH1017; there is no default trigger value for this ion.

These elevated dissolved metal concentrations are typical of the Permo-Triassic rocks of the Sydney Basin, and are part of the natural water-rock interaction.

Nutrients

Ammonia, nitrate and total phosphorous concentrations were above the ANZECC/ARMCANZ (2000a) guideline values for SE Australian lowland rivers and NSW coastal rivers at all groundwater monitoring locations during the majority of the sampling events. Ammonia and total phosphorous concentrations were highest at BH1017, while the nitrate concentrations were highest at BH1009. On three occasions nitrite concentrations exceeded the guideline value (0.015 mg/L) at BH004. The maximum nitrite concentration was 0.34 mg/L (February 2015).

Nutrient concentrations are likely to be anthropogenic, eg from fertiliser use or from washing detergents in the surrounding area.

Hydrocarbons

TPHs were detected at all the groundwater monitoring locations with the exception of BH1009. Light and heavy hydrocarbons were detected on all sampling events at BH021 and BH1017, with the exception of the February 2015 event. TPH concentrations were highest at BH1017 during the November 2014 sampling event, the maximum concentration was in the medium to heavy fraction C_{15}–C_{28} (2,360 µg/L).

There are no trigger values for TPHs, as they are not a desirable element of water quality and are an indication of contamination.

BTEXN concentrations above the LOR were detected at: BH025, BH021, BH014, and BH1017. However, the concentrations were low. Benzene concentrations at BH025 were above the LOR, and the other three monitoring bores had elevated toluene concentrations. BH1017 had ethylbenzene, meta-xylene, and ortho-xylene concentrations above the LOR during most monitoring events. Trace TPH and BTEXN concentrations are expected in an urban environments with major roads. Leakage of hydrocarbons into the groundwater environment is common across the Sydney Basin.

ii Groundwater levels

a. Groundwater hydrographs

Groundwater hydrographs of the continuous level data, and rainfall data (Turramurra – Kissing Point Rd or Parramatta North – Masons Drive BoM stations) are provided in Figure 3.19 to Figure 3.26.

The groundwater level at BH025 (Figure 3.19) shows a distinguished response to rainfall recharge with an immediate and sustained increase in groundwater level following rainfall events. The heavy rainfall in early December 2014 caused the groundwater level to rise by approximately 0.4 m. The monitoring bore was purged on 16 December 2014 to obtain a groundwater sample. Approximately 50 L of water was removed from the bore which has resulted in a minor lowering of the shallow water table.

Figure 3.19 BH025 (shale) groundwater level and daily rainfall (Turramurra station)

Continuous groundwater level monitoring indicated the groundwater level at BH023 (Figure 3.20) does not appear to be closely related to direct rainfall recharge. Groundwater at this location is likely confined to semi-confined. The monitoring bore was purged on 17 November and 16 December 2014, where 50 and 30 L of water was removed from the monitoring bore prior to sampling. This is seen as an obvious drawdown/recovery curves and the inferred slow groundwater recovery.

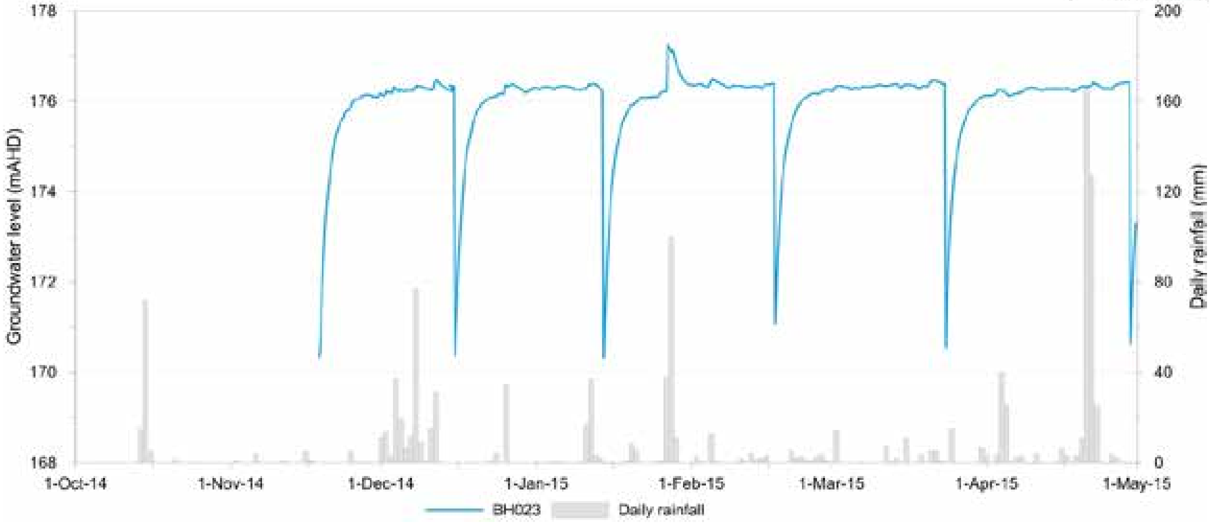


Figure 3.20 BH023 (sandstone) groundwater level and daily rainfall (Turramurra station)

Figure 3.21 BH021 (sandstone) groundwater level and daily rainfall (Turramurra station)

Similar to BH023, local groundwater levels at BH021 respond slowly to pumping as indicated by the drawdown/recovery curves on 18 November and 16 December 2014, where the monitoring bore was purged dry on both occasions with the removal of approximately 15 L and 12 L respectively. Groundwater level monitoring indicates that the groundwater level at BH014 (Figure 3.22) is not closely influenced by direct rainfall recharge.

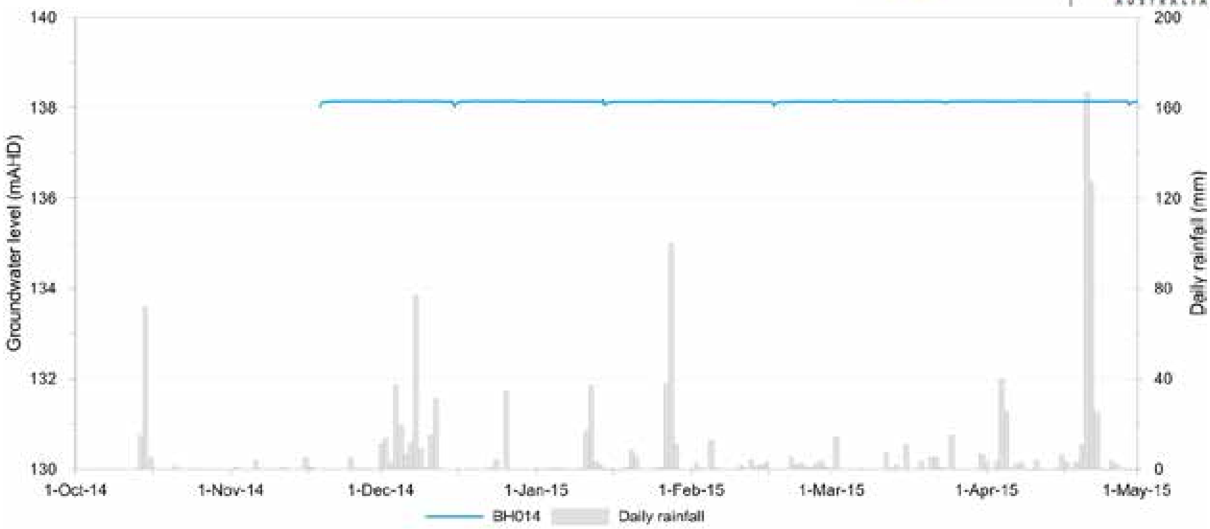


Figure 3.22 BH014 (sandstone) groundwater level and daily rainfall (Turramurra station)

The groundwater level data monitoring at BH004 indicates that the local groundwater conditions within the shale are responsive to direct rainfall (Figure 3.23). The groundwater level at this location fluctuates considerably compared to the other groundwater monitoring for the Project.

Due to the highly variable nature of the groundwater conditions and the slow recovery following sampling events on 16 November and 17 December 2014, it was not possible to monitor the initial recovery as indicated on the graph by the absence of groundwater level data.

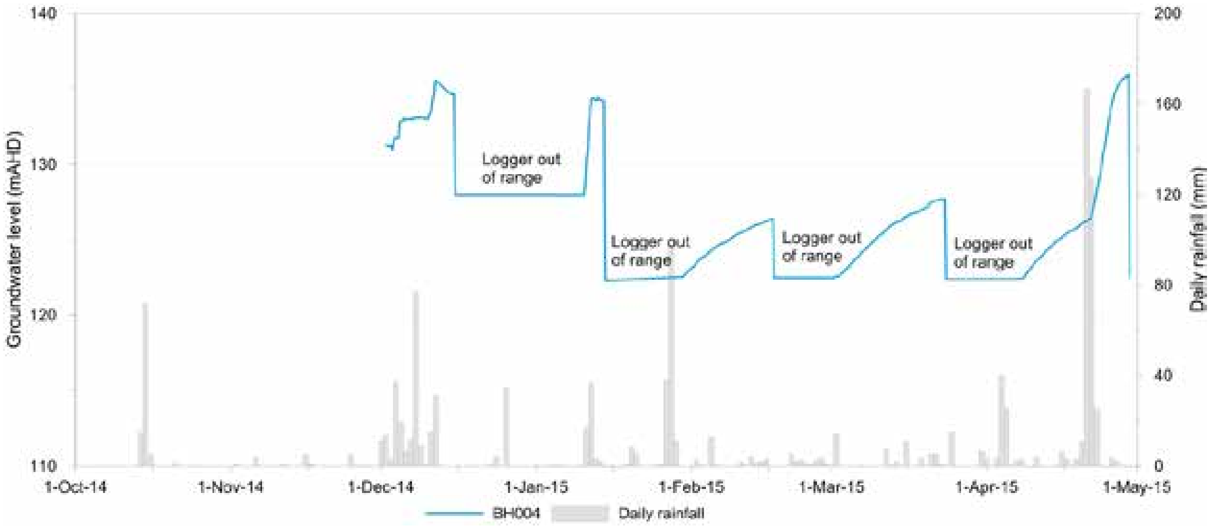


Figure 3.23 BH004 (shale) groundwater level and daily rainfall (Parramatta station)

The groundwater level monitoring at BH1009 (Figure 3.24) indicates the groundwater levels do not respond to direct rainfall recharge.

The monitoring bore was purged on 17 October 2014 to obtain a groundwater sample. Approximately 66 L of water was removed from the monitoring bore which has resulted in a lowering of the water table.

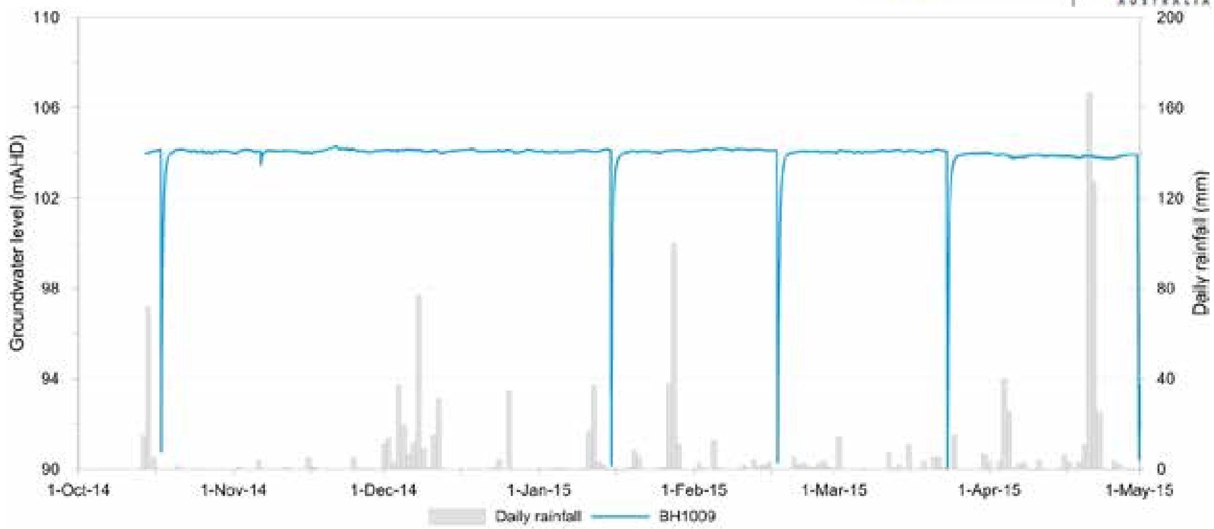


Figure 3.24 BH1009 (sandstone) groundwater level and daily rainfall (Parramatta station)

The groundwater level data obtained at BH1017 (Figure 3.25) indicates that groundwater levels do not respond to direct rainfall recharge.

The monitoring bore was purged on 17 October 2014 to obtain a groundwater sample. Approximately 90 L of water was removed from the monitoring bore prior to sampling which has resulted the lowering of the water table by approximately 2 m. Following sampling it appears as though the logger has been re-instated at a higher level, possibly catching on the uPVC casing. The logger then dropped to its normal level on 1 November 2014.

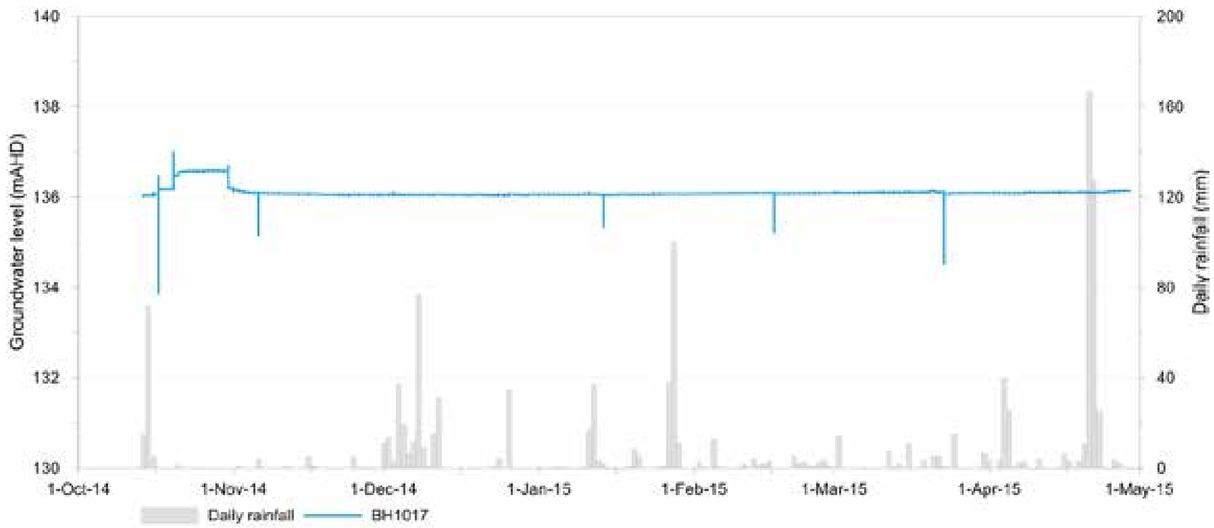


Figure 3.25 BH1017 (sandstone) groundwater level and daily rainfall (Parramatta station)

b. Groundwater levels

The BH025 and BH004 monitoring bores intercept the Ashfield Shale, and BH021 intersects the Hawkesbury Sandstone but is overlain by shale. These bores showed a direct response to rainfall recharge (Figure 3.26). This result is expected in the outcropping shale unit, as this formation does not have an overlying confining unit. The response at BH021 indicates that the sandstone at this location is receiving rainfall recharge via fractures, through Ashfield Shale infiltration or through lateral recharge. Most monitoring bores were slow to recover following purging, indicating low to moderate groundwater flow conditions.

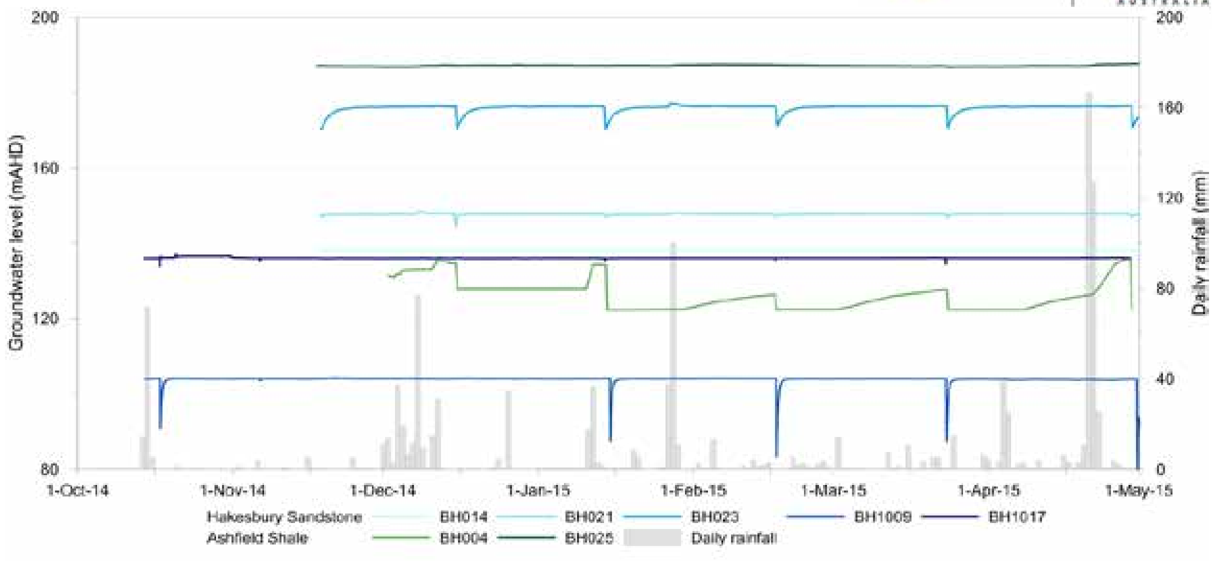


Figure 3.26 Groundwater bores and daily rainfall (Parramatta station)

c. Groundwater flow conceptualisation

Assessment of groundwater levels indicates that the groundwater flow follows a north east–south west direction within both the Ashfield Shale and Hawkesbury Sandstone. This is a muted reflection of the surface topography and matches with regional groundwater flow directions within both hydrogeological units (Hydro Tasmania Consulting 2010).

3.9. Seasonality

3.9.1. Surface water

The historic surface water quality data (1994 to 2015, generally on a monthly or quarterly basis) from watercourses crossed or adjacent to the Project area were collated. The additional project-specific baseline data collected monthly in 2014/15 supplements this historic data. Historical water quality data from catchment specific sites are consistent with the water quality results for the baseline sites. Together, these datasets characterise existing surface water quality environment across all seasons, allowing seasonality to be considered in the assessment of future monitoring results.

3.9.2. Groundwater

There is one relevant historic groundwater sampling event and eight groundwater project-specific baseline sampling events between September 2014 and March 2015. Together these datasets characterise existing groundwater environment. As groundwater monitoring bores are equipped with data loggers that record every six hours, the changes in the groundwater environment with changing rainfall have been characterised. This will allow variations resulting from changing of season rainfall to be considered when assessing monitoring results.

4. Works activities and potential impacts

The Project will comprise of twin road tunnels generally following the alignment of Pennant Hills Road, with interchanges at the northern and southern end of the Project area and the provision of a new westbound lane on the Hills M2 Motorway extending through to the Windsor Road off-ramp (Section 1.2).

Construction of the Project will involve the use of various construction materials and machinery and other activities with potential risks to the surrounding environment. This section focuses on activities with potential impacts to surface water, groundwater and GDEs.

4.1. Project activities

4.1.1. Construction

Key construction activities that could result in adverse impacts to surface water, groundwater and GDEs include:

- vegetation clearing;
- earthworks;
- culvert and drainage works;
- blasting;
- material stockpiling, including stockpiling of any potentially contaminated material;
- tunnelling;
- water discharge;
- groundwater and surface water use and/or treatment;
- increasing impervious surface areas;
- operation of compounds that may include fuel and chemical storage, refuelling, sewage systems and chemical handling; and
- noxious weed treatment including herbicide spraying.

4.1.2. Operation & Emergency

Key operational activities that could result in adverse impacts to surface water, groundwater and GDEs include:

- tunnel operation (see below);
- maintenance of GPTs and water quality basins along the Hills M2 Motorway; and
- noxious weed treatment including herbicide spraying.

Typical tunnel operations will include:

Tunnel wash-down

Tunnel wash-down will follow similar practices carried out in other motorway tunnels such as the Lane Cove Tunnel. These practices generally involve the use of commercial cleaning agents and heavy duty degreaser-detergents. The flows from tunnel wash-down

Rising main pigging/chemical flushing

Pigging is a process used to clean the internal surface of a pipeline to reduce friction losses, which in turn increases the hydraulic capacity of the pipeline and reduces the energy consumes during pump operation (GHD 2016). Pigging will also help to maintain water quality in the rising main (GHD 2016).

Pipeline pigging is a mechanical cleaning method and is undertaken by launching a Pipeline Intervention Gadget (pig) from a launcher at one end of the pipeline through to a receiver at the other end of the pipeline. It relies on the use of a physical cleaning device to generate abrasive forces on the pipe wall to shear off accumulated materials. Pigging utilises the system pressure created by the pumps in the LPS to launch and move the cleaning device from one end of the pipeline to the other. As the cleaning device travels through the pipeline it collects sludge material (foul water).

The inflow, “foul water” from pigging / chemical flushing events will be stored in the buffer tank prior to disposal to an offsite licenced disposal facility (via tanker) or discharge to sewer under a trade waste agreement. Depending on the quality (the water will be tested in the buffer tanks), the collected foul water may also be blended with groundwater in the buffer tank and slowly released to the WTP for treatment.

Deluge and hydrant testing

Deluge and hydrant system testing will be monitored and controlled by the operator to ensure that maximum buffer tank and discharge water quality levels are not exceeded due to external weather events. Tunnel deluge systems are generally tested quarterly as part of standard maintenance procedures and requires full closure of the tunnel tube. The water quality of the deluge and hydrant testing is considered similar to tunnel stormwater and will be managed as such by the system.

Water Management Infrastructure cleaning and maintenance

Redundancy has been built into the water management system to facilitate the cleaning of maintenance of the various components of the system. The LPS is compartmentalised so that inflows can be sent to different sections of the LPS to allow for cleaning and maintenance of the LPS compartments. Materials collected from the cleaning processes will be sent to licenced waste facilities for disposal.

There will also be two aboveground buffer tanks following the LPS and prior the WTP. The incorporation of two tanks into the overall system will allow for one of the tanks to be cleaned while the other is operational. Similarly there are two 20L/s treatment trains within the overall WTP (40L/s) that will allow for one of the treatment trains to be shut down for maintenance or fault rectification while the other system operates.

Standard Operating Procedures (SOPs) will be developed by the operators to define wastewater management system maintenance scheduling, triggers and activities.

Emergency flows

Water may enter the tunnel in case of an emergency, such as:

- Deluge system operation;
- Fire hydrant operation;
- Worst case firefighting operation;
- Deluge main rupture; or
- Non-hazardous chemical or hydrocarbon spillages.

In accordance with contractual requirements the system has been designed to manage:

- a maximum deluge flow of 225 L/s over a 20 minute period;
- allowance for three hydrants operating concurrently for 20 minutes has been assumed with a flow of 10 L/s per hydrant;
- a worst case firefighting scenario operating for two hours. The firefighting system is supplied by two redundant tanks, each with a nominal capacity of 1,200 m3. It is therefore theoretically possible that the systems could be operated for four hours, with the entire fire service water capacity of 2,400 m3 being discharged into the tunnel;
- the rupture of the deluge main, a maximum fire service flow of 900 L/s over a 10 minute duration before isolation of the leak;
- A chemical or hydrocarbon spillage of 50,000 L.

Flows from fire or other emergency may contain high concentrations of contaminants from firefighting chemicals and fuel, which may affect the performance of the WTP or exceed discharge quality criteria. Flows will be contained in the LPS (Section 6.3) and tankered away for off-site disposal or maybe sent to trade waste where agreement with Sydney Water Corporation is reached. Any chemical and hydrocarbon spillages will be contained at the incident site using spill containment equipment but uncontrolled spills will flow to the LPS. Sensors will detect the presence of hydrocarbons and prohibit operation of the groundwater and stormwater pumps as large volumes of hydrocarbons would be detrimental to WTP performance (specifically reverse osmosis membranes).

Small amounts of hydrocarbons are expected to be deposited onto the road surface and these will be washed down into the tunnel drainage system with rainfall, fire system testing and tunnel cleaning. These trace amounts of hydrocarbons will be processed by the WTP.

4.2. Potential project impacts

The potential for impacts is dependent on the nature, extent and magnitude of construction and operation activities, and their interaction with the natural environment. Potential impacts to surface water, groundwater and GDEs have been considered locally and regionally.

The baseline groundwater model (see Section 3.5.2) (AECOM 2014) has been used to infer the predicted zone of drawdown resulting from construction activities. As discussed in Section 3.5.2, the predicted zone of drawdown was refined in the detailed design phase of the Project and a three dimensional groundwater model created (Golder Associates 2016) (Appendix E).

Potential impacts have been listed in Sections 4.2.1, 4.2.2 and 4.2.3 in accordance with the requirements of MCoAB15(a) and B16(c).

4.2.1. Potential surface water impacts

The potential risks posed by the Project can be both short-term and long-term.

Potential impacts associated with the construction phase include:

- sedimentation of receiving waters as a result of localised soil erosion from vegetation clearing;
- depressurisation of the water table as a result of excavation activities resulting in reduced baseflow to possibly connected waterways;
- temporary works within waterways causing changes to surface water flow volumes, increased suspended solids/turbidity and possibly altered drainage patterns;
- removal of riparian vegetation causing bank instability/erosion;
- contamination of waterways from accidental chemical or fuel spills;
- contamination of waterways from WTP malfunction; and
- general construction site waste entering watercourses.

Potential surface impacts associated with the operational phase include:

- contamination of waterways from emergencies, eg chemical or fuel spills and vehicle fires on surface roads;
- contamination of waterways from operational WTP malfunction; and
- depressurisation of the water table as a result of inflows to tunnel resulting in reduced baseflow to possibly connected waterways;

4.2.2. Potential groundwater impacts

The potential risks posed to groundwater during the construction and operational phases of the Project include:

- groundwater drawdown resulting from tunnel inflow and dewatering;
- changes to groundwater flow direction and gradient resulting from localised dewatering;
- regional lowering of the groundwater table impacting on groundwater users within the groundwater catchment; and
- reductions in the regional groundwater table impacting on GDEs.

4.2.3. Potential groundwater dependent ecosystem impacts

Impacts to potential GDEs associated with the Project are dependent on impacts to local water table across the study area. Water table drawdown may lead to potential impacts on GDEs such as:

- changes to ecosystem density due to a reduction in groundwater spring flow;
- change in ecosystem distribution due to altered groundwater discharge locations; and
- unseasonal dieback of foliage due to changing spring flow conditions.

The Golder Associates (2016) (Appendix E) assessment has confirmed that the revised drawdown model estimates that there will be no change from the computed pre-tunnel discharge rates of the springs in the short or long term.

5. Risk management framework

5.1. Risk assessment and management framework

An evaluation of potential impacts to groundwater, surface water and GDEs associated with the Project activities has been completed. A risk assessment matrix has been used (Table 5.1), to identify the level of risk in accordance with the requirements of MCoAB15(b) and B16(d). The risk assessment considers:

- the likelihood of a potential impact occurring (Table 5.2); and
- the consequence if the potential impact occurs (Table 5.3).

Table 5.1 Risk assessment matrix

Likelihood	Consequences				
	1 insignificant	2 minor	3 moderate	4 major	5 severe
A almost certain	medium	significant	high	high	extreme
B likely	medium	medium	significant	high	extreme
C moderate	Low	medium	significant	high	high
D unlikely	Low	low	medium	significant	high
E rare	Low	low	low	medium	significant

Table 5.2 Classification of likelihood of a potential impact

Level	Categorisation of likelihood	Description
A	Almost certain	is expected to occur during the project, >90% probability
B	Likely	will probably occur during the project , ~50% probability
C	Moderate	might occur at some time during the project, ~25% probability
D	Unlikely	could occur at some time during the project, ~10% probability
E	Rare	only occur in exceptional circumstances, <1% probability

Table 5.3 Classification of consequence		
Level	Categorisation of consequence	Description
1	Insignificant	no significant change in flow volumes, water levels or water quality
2	Minor	minor short term and reversible change in flow volumes, water levels or water quality
3	Moderate	moderate, minor breaches of environmental statutes or changes to flow volumes, water levels or water quality
4	Major	major, ongoing breaches of environmental statutes with major changes to flow volumes, water levels or water quality
5	Severe	shutdown of the Project due to environmental breach causing severe changes to flow volumes, water levels or water quality that may be irreversible

Risks will be managed as follows based on the risk rating in Table 5.1:

- Low: no additional management measures required.
- Medium: routine monitoring and management measures to be implemented.
- Significant: specific monitoring and management measures to be implemented (see Section 9).
- High: further specific additional management measures required to reduce risk as far as possible.
- Extreme: unacceptable risk - further specific additional management measures (including redesign) required to reduce risk.

5.2. Risk evaluation

The risks of potential impacts caused by Project activities, assuming no controls are in place, are summarised in Table 5.4. Potential impacts identified as having a medium or above risk classification may be downgraded if appropriate controls and management measures are implemented and maintained. A revised risk rating of potential impacts with control measures in place is provided in Section 6. It is noted that the construction phase is four years and the operations phase is fifty years plus.

Table 5.4	Assessment of potential impacts						
Component	Potential impact		Risk analysis (likelihood and consequence)				
		Receptor	Low	Med	Sig	High	Extr
Construction phase							
Vegetation clearing	Erosion and sedimentation of disturbed areas including surrounding waterways.	Surface water				A 3	
	Increased nutrient load in waterways causing algal growth and eutrophication.	Surface water			B 3		
	Transport of vegetation in waterways resulting in flow disruption.	Surface water			B 3		
Earthworks	Spills of hydrocarbons leaching/running into waterway.	Surface water			C 3		
	Spills of hydrocarbons leaching/running into groundwater	Groundwater		C 2			
Culvert and drainage works	Disruption to flow and increased turbulence.	Surface water				A 3	
	River/creek bed and bank scouring.	Surface water			B 3		
	Direct impacts on streambeds through excavation works.	Surface water			B 3		
Blasting	Increased nutrient load (ammonium nitrate).	Groundwater		C 2			
	Increased hydraulic connection between surface and groundwater resources.	Groundwater/ surface water		D 3			
Material stockpiling	Leaching or mobilised contaminants.	Surface water/ shallow			B 3		

Table 5.4 Assessment of potential impacts

Component	Potential impact		Risk analysis (likelihood and consequence)				
		Receptor	Low	Med	Sig	High	Extr
		groundwater					
Tunnelling activities	Altering the local groundwater flow system through local depressurisation of groundwater resources.	Groundwater			C 3		
	Reducing baseflow to possibly connected waterways.	Groundwater		D 3			
	Contaminated groundwater drawn into tunnel.	Groundwater			C 3		
	Decreased baseflow to possible GDEs reliant on surface expression of groundwater	GDEs		D 3			
	Decreased groundwater availability to possible GDEs reliant on the subsurface presence of groundwater.	GDEs		D 3			
WTP discharge	Increased flow and increased turbulence in creek/drainage channel.	Surface water			B 3		
	Creek/drainage channel bed or bank scouring.	Surface water			B 3		
	Changes to baseline water quality.	Surface water				B 4	
Construction of surface infrastructure	Localised flooding.	Surface water		C 2			
	Increased surface runoff.	Surface water		B 2			
	Decreased/increased	Groundwater		C 2			

Table 5.4 Assessment of potential impacts

Component	Potential impact		Risk analysis (likelihood and consequence)				
		Receptor	Low	Med	Sig	High	Extr
	groundwater recharge.						
Fuels and chemical storage and refuelling	Spills of hydrocarbons that leach downwards or are mobilised.	Surface water				C 4	
	Spills of hydrocarbons that leach downwards or are mobilised.	Groundwater		C 2			
Noxious weed treatment including herbicide spraying	Increased nutrient load in waterways causing algal growth and eutrophication.	Surface water		D 3			
Operational phase							
Tunnel operation	Altering the local groundwater flow system through local depressurisation of groundwater resources.	Groundwater			B 3		
	Reducing baseflow to possibly connected waterways.	Groundwater		D 3			
	Contaminated groundwater drawn into tunnel.	Groundwater			C 3		
	Decreased baseflow to possible GDEs reliant on surface expression of groundwater.	GDEs		D 3			
	Decreased groundwater availability to possible GDEs reliant on the subsurface presence of groundwater.	GDEs		D 3			

Table 5.4	Assessment of potential impacts						
Component	Potential impact		Risk analysis (likelihood and consequence)				
		Receptor	Low	Med	Sig	High	Extr
WTP discharge	Increased flow and increased turbulence in creek/drainage channel.	Surface water			B 3		
	Creek/drainage channel bed or bank scouring	Surface water			B 3		
	Changes to baseline water quality.	Surface water				B 4	
	Contamination of waterways from chemical or fuel spills from traffic accident in tunnel or firefighting water.	Surface water	E 3				
	WTP malfunction.	Surface water				C 4	
Fuels and chemical storage and refuelling	Spills of hydrocarbons that are mobilised.	Surface water		C 2			
Contamination from chemical or fuel spills from surface roads	Contamination of waterways from chemical or fuel spills from traffic accident on surface roads	Surface water				A 3	
Noxious weed treatment including herbicide spraying	Increased nutrient load in waterways causing algal growth and eutrophication.	Surface water	D 2				

6. Environmental management measures

6.1. Environmental requirements and control measures

A range of environmental requirements and control measures for the Project are identified in the various documents including: the EIS, SPIR, MCoAB15(i), Lend Lease Bouygues Joint Venture (LLBJV) EMS and other RMS and NorthConnex Project Co. documents. Specific management measures to address these requirements and impacts on surface water, groundwater and GDEs are outlined in Table 6.1, in accordance with the requirements of MCoAB15(c).

Best practice and the principles of Water Sensitive Urban Design are being utilised on all aspects relating to water management on the Project, in particular the design and construction of discharge points. It is noted that all of discharge points are into existing stormwater infrastructure, and not directly into creeks or rivers.

Table 6.1 Ground and surface water management measures				
ID	Measure/requirement	When to implement	Responsibility	Reference
General				
WQMP 1	Localised depressurisation of the aquifer will be monitored with data-loggers in monitoring bores to ascertain potential of the Project to impact local groundwater users. Groundwater level data will be reviewed and reported on in the 6-monthly compliance reporting. Reporting will consider seasonality, comparisons of data with project activities and ambient water quality monitoring.	Prior to tunnelling Construction Operation	Environmental Manager	Groundwater Sharing Rules EIS Table 7-167
WQMP 2	A hydrocensus (condition) survey of local groundwater users is proposed to be undertaken prior to tunnelling to ascertain bore condition and current status of the bores located within predicted zone of drawdown. This will involve consultation with local groundwater users and provide a baseline assessment for user bores.	Prior to tunnelling	Environmental Manager	Groundwater Sharing Rules EIS Table 7-167
WQMP 3	During detailed design any additional bores identified to be within any revised predicted zone of drawdown will also be investigated by the hydrocensus to assess potential impacts from construction activities.	Design	Environmental Manager	Groundwater Sharing Rules EIS Table 7-167
WQMP 4	Bores located within the predicted zone of drawdown that are licensed and actively being used for water supply will be considered with regard to make good provisions in consultation with the bore licensee. Make good provisions only apply to bores where >2 m change in groundwater level occurs on actively used bores and is demonstrated to be caused by construction activities and not	Construction	Environmental Manager	Groundwater Sharing Rules EIS Table 7-167

Table 6.1 Ground and surface water management measures				
ID	Measure/requirement	When to implement	Responsibility	Reference
	influenced by seasonal weather/localised conditions. Make good provisions management response may include the deepening of the existing bore, lowering the pump and provisions for increased pumping costs, replacement of the borehole and associated infrastructure, or provision of an alternative supply of water at the same volume and to the same level of quality.			
Ecosystems potentially dependent on groundwater				
WQMP 5	Monitoring of identified groundwater dependent ecosystems will be carried out by project ecologist and hydrogeologists. Ongoing monitoring of GDEs will be undertaken during the operation of the Project for a minimum monitoring period of 3 years following the completion of construction or until groundwater resources are certified by an independent expert as being rehabilitated to an acceptable condition in accordance with MCoA B15(h).	Construction Operation	Environmental Manager	
WQMP 6	Quarterly GDE surveys are carried out by project ecologist and hydrogeologists. The Monitoring Program will consider both ecosystem health (etc) and also monitoring water quality to further characterise the localised nature of the source of water for these systems (and demonstrate they are not receiving water from the regional groundwater system and therefore not likely to be impacted).	Prior to tunnelling Construction	Environmental Manager	
Groundwater management				

Table 6.1 Ground and surface water management measures

ID	Measure/requirement	When to implement	Responsibility	Reference
WQMP 7	Groundwater captured during construction would be tested, treated and discharged to meet the requirements of the Project EPL.	Construction	Environmental Manager	SPIR REMM HS10
WQMP 8	The management of groundwater and surface water inflow into the tunnels, including the design of capture, treatment and discharge methods would be undertaken in consultation with the EPA.	Construction	Environmental Manager	SPIR REMM HS11
WQMP 9	Preference will be given to reuse of groundwater inflow over potable water for construction activities where reasonable and feasible.	Construction	Construction Manager Safety Manager Environmental Manager	SPIR REMM HS12
WQMP 10	A three dimensional numerical groundwater model shall be developed to verify that the extent of groundwater drawdown would be within or less than the predictions within the environmental impact statement.	Detailed design	Design Manager	SPIR REMM OpHS5
Groundwater treatment				
WQMP 11	Operational discharge criteria are presented in Section 7.6 This information has been lodged at least one year out from operation as permitted by MCoAB15.	Detailed design	Design Manager	SPIR REMM OpHS3 & OpSW3 MCoA B16(f)
WQMP 12	Temporary tunnel construction water treatment plants shall be designed with capacity for increased volumes and holding capacity.	Construction	Construction Manager Design Manager	SPIR REMM

Table 6.1 Ground and surface water management measures				
ID	Measure/requirement	When to implement	Responsibility	Reference
WQMP 13	Temporary tunnel construction and permanent operational phase water treatment plants goals are presented in Section 7.6. The goals have been designed to ensure that the discharge water quality is better (on average) than the ambient water quality in the receiving environment and hence contributes to the improvement of the condition of these highly disturbed systems.	Construction and operation	Construction Manager Environmental Manager Motorway Operator	SPIR REMM HS10 & SW 15 MCoA B16 (f)
Surface Water Management				
WQMP 14	A monitoring program developed as part of this plan to monitor water quality upstream and downstream in receiving surface waterways shall be implemented.	Construction	Environmental Manager	SPIR REMM
WQMP 15	The appropriateness of the construction discharge locations and the adequacy of their design will be reviewed annually (Table). The review will consider the potential impacts of *water treatment discharge* listed in Table 5..	Construction	Environmental Manager	SPIR REMM
WQMP 16	Discharge points shall be selected to minimise downstream scour and erosion. Scour and erosion protection measures and energy dissipation shall be implemented downstream of surface water discharge points where required in consultation with the Project Soil Conservationist.	Construction	Environmental Manager Soil Conservationist	SPIR REMM SW11 & SW12
WQMP 17	Discharge of treated construction and operation tunnel water from temporary and permanent water treatment plants will be managed to ensure the discharge does not exceed the capacity of the	Construction and operation	Environmental Manager	SPIR REMM SW17

Table 6.1 Ground and surface water management measures

ID	Measure/requirement	When to implement	Responsibility	Reference
	downstream surface water system.			
WQMP 18	Treatment of operational tunnel water shall achieve a maximum discharge water quality consistent with 95% protection level for aquatic ecosystem protection of the receiving water environment (ANZEC guidelines).	Construction and operation	Environmental Manager	SPIR REMM OpSW3
Monitoring				
WQMP 19	A surface water quality monitoring program for the construction period and one for the operation period would be implemented to monitor water quality upstream and downstream of the construction areas shall be implemented. The monitoring program will be reviewed in consultation with EPA and may be revised to meet EPL requirements.	Prior to tunnelling Construction and operation	Environment Manager	SPIR REMM SW20
WQMP 20	A groundwater monitoring plan shall be prepared for the duration of the construction period and one for the operation period and the requirements of which are detailed within this plan. Parameters to be monitored include groundwater levels and groundwater quality with field parameters, laboratory parameters and sample frequency. The monitoring program will be reviewed in consultation with EPA and may be revised to meet EPL requirements as required.	Construction and operation	Environmental Manager	SPIR REMM HS8
WQMP 21	A groundwater monitoring network established prior to tunnelling intersecting both the Ashfield Shale and Hawkesbury Sandstone shall be monitored for water levels and quality in accordance with	Prior to tunnelling Construction and operation	Environmental Manager	SPIR REMM HS9

Table 6.1 Ground and surface water management measures				
ID	Measure/requirement	When to implement	Responsibility	Reference
	the Monitoring Program provided in this plan.			
Records				
WQMP 22	Records of all water quality monitoring results, rainfall records, groundwater level measurements will be maintained.	Prior to tunnelling Construction and operation	Environmental Manager	SPIR REMM HS13
Emergency Measures				
WQMP 23	Where a spill occurs within the tunnel, spill containment and clean up measures consistent with those measures implemented on the Lane Cove Tunnel be implemented.	Design and Operation	Tunnel Operations Manager	
WQMP 24	Where a spill occurs on the Hills M2 Motorway, spill containment measures already being applied to the rest of the motorway will be implemented.	Design and Operation	Tunnel Operations Manager	
WQMP 25	Where a spill occurs on other surface roads, emergency response through Fire and Rescue NSW will be implemented.	Design and Operation	RMS M1 Operations Manager	

6.2. Revised risk evaluation considering control measures

A revised risk rating of potential impacts, with the implementation of project specific control measures is provided in Table 6.2, in accordance with the requirements of MCoAB15(b) and B15(i). As seen in Table 6.2 the control measures focus on lowering the likelihood of a possible impact, typically the consequence will remain unchanged. Further details on the control measures are in the Construction Soil and Water Management Sub Plan (CSWMP) and the Operational Environmental Management Plan (OEMP) and the following documents:

- Acid sulfate soil procedure, (CSWMP);
- Erosion and sediment control plan/strategy (Toepfers rehabilitation environmental & ecological services) (CSWMP); and
- Stockpile management protocol (CSWMP).

Table 6.2 Revised assessment of potential impacts considering control measures							
Component	Potential impact	Control measures	Risk analysis				
		Timeframes	Low	Med	Sig	High	Extr
Construction phase							
Vegetation clearing	Erosion and sedimentation of disturbed areas including surrounding waterways.	Silt fences, bund walls and geo mats/geo fabrics. Vegetation clearing will occur immediately before construction works. Progressive revegetation.	E 3				
		ERSED controls to be in place at all times in accordance with Blue Book.					
	Increased nutrient load in waterways causing algal growth and eutrophication.	Silt fences, bund walls and geo mats/geo fabrics.	E 3				
		ERSED controls to be in place at all times in accordance with Blue Book.					
	Transport of vegetation in waterways resulting in flow disruption.	Manual collection of branches. Mulch sediment traps. Vegetation clearing will occur immediately before construction works.	E 3				
		During vegetation clearing phase					

Table 6.2 Revised assessment of potential impacts considering control measures

Component	Potential impact	Control measures	Risk analysis				
		Timeframes	Low	Med	Sig	High	Extr
Earthworks	Spills of hydrocarbons leaching/running into groundwater/waterways.	Spill kits on site and training of personnel in their use. Handing of chemicals will be as per manufacturer's instructions.	E 3				
		At all times throughout construction.					
Culvert and drainage works	Disruption to flow and increased turbulence.	Silt fences and geo mats/geo fabrics. Windrows on contours to reduce. Slope length and surface flow velocities.		D 3			
		During culvert and drainage works.					
	River/creek bed and bank scouring.	Silt fences and geo mats/geo fabrics.	E 3				
		During culvert and drainage works.					
	Direct impacts on streambeds through excavation works.	Silt fences and geo mats/geo fabrics.		D 3			
		During culvert and drainage works.					
Blasting	Increased nutrient load (ammonium nitrate).	Groundwater quality monitoring as early warning mechanism.		C 2			
		During and for 6 months following blasting.					
	Increased hydraulic connection	Groundwater level monitoring to detect fluxes.		D 3			

Table 6.2 Revised assessment of potential impacts considering control measures

Component	Potential impact	Control measures / Timeframes	Risk analysis Low	Med	Sig	High	Extr
	between surface and groundwater resources.	During and for 6 months following blasting.					
Material stockpiling	Leaching or mobilised contaminants.	Silt fences and bund walls. Possible treatment with liquid lime to neutralise acid as per the acid sulfate soil procedure. *Timeframe:* During construction.	E 3				
Tunnelling activities	Altering the local groundwater flow system through local depressurisation of groundwater resources.	Ensure that grouting and/or other measures are implemented to ensure that groundwater inflow is limited to 1L/s/km *Timeframe:* As required, during tunneling in order to meet this requirement.		D3			
	Reducing baseflow to possibly connected waterways.	Ensure that grouting and/or other measures are implemented to ensure that groundwater inflow is limited to 1L/s/km *Timeframe:* As required, during tunneling in order to meet this requirement.		D 3			
	Contaminated groundwater drawn into tunnel.	Tunnel discharge will be directed to water treatment plant where it will be monitored prior to discharge *Timeframe:* At all times as detailed within this plan.		C 2			
	Decreased baseflow to possible GDEs	Groundwater level and spring / GDE monitoring as early		D 3			

Table 6.2 Revised assessment of potential impacts considering control measures

Component	Potential impact	Control measures / Timeframes	Low	Med	Sig	High	Extr
	reliant on surface expression of groundwater.	warning mechanism.					
		In accordance with Section 9.4.1					
	Decreased groundwater availability to possible GDEs reliant on the subsurface presence of groundwater.	Groundwater and surface water level monitoring as early warning mechanism.		D 3			
		In accordance with Section 9.4.1					
WTP discharge	Increased flow and increased turbulence in creek/drainage channel.	Regulate WTP discharge using appropriately sized drains and discharge locations to existing stormwater infrastructure.	E 3				
		Throughout construction.					
	Creek/drainage channel bed or bank scouring.	Regulate WTP discharge using appropriately sized drains and discharge locations to existing stormwater infrastructure.	E 3				
		Throughout construction.					
	Changes to baseline water quality.	WTP will treat water quality to meet quality objectives, this will be verified via surface water quality sampling.	E 3				
		In accordance with Section 8.					
	Contamination of waterways from chemical or fuel spills from traffic	Collect chemical, fuel, fire water in LPS and tanker away for off-site disposal.		D 3			

Table 6.2 Revised assessment of potential impacts considering control measures

Component	Potential impact	Control measures / Timeframes	Low	Med	Sig	High	Extr
	accident in tunnel or firefighting water.	At all times during construction.					
	WTP malfunction.	Process and procedures to deal with WTP operation and malfunction correction to be incorporated in the operating manuals.		D 3			
		At all times during construction.					
Construction of surface infrastructure	Localised flooding.	Construct drainage channels and bund walls.	E 2				
		As required during construction.					
	Increased surface runoff.	Construct drainage channels and bund walls.	E 2				
		As required during construction.					
	Decreased/increased groundwater recharge.	Groundwater quality monitoring as early warning mechanism. Clean and dirty runoff will be separated; dirty construction runoff will be treated.		C 2			
		As required during construction					
Fuels and chemical storage and refuelling	Spills of hydrocarbons that leach downwards or are mobilised.	Spill kits on site Storage and handling of chemicals will be as per manufacturer's instructions.		E 4			

Table 6.2 Revised assessment of potential impacts considering control measures

Component	Potential impact	Control measures	Risk analysis				
		Timeframes	Low	Med	Sig	High	Extr
		Refuelling will be undertaken away from waterways in designated, impermeable areas.					
		In accordance with the requirements of the CEMP.					

Table 6.2 Revised assessment of potential impacts considering control measures

Component	Potential impact	Control measures / Timeframes	Risk analysis: Low	Med	Sig	High	Extr
Noxious weed treatment including herbicide spraying	Increased nutrient load in waterways causing algal growth and eutrophication.	Use of chemicals will be in accordance with manufacturer's specifications. Herbicide application will not be undertaken during or following heavy rainfall. *Timeframes:* In accordance with the requirements of the CEMP.	E 3				
Operational phase							
Tunnel Operation	Local depressurisation of groundwater resources.	Ensure that grouting and/or other measures are implemented during construction phase to ensure that groundwater inflow is limited to 1L/s/km. Groundwater level monitoring as early warning mechanism. *Timeframes:* In accordance with Table 8.4 and Section 8.6.			C 3		
	Altering the local groundwater flow system.	Ensure that grouting and/or other measures are implemented during construction phase to ensure that groundwater inflow is limited to 1L/s/km. Groundwater level monitoring as early warning mechanism. *Timeframes:* In accordance with Table 8.4 and Section 8.6.			C 3		

Table 6.2 Revised assessment of potential impacts considering control measures

Component	Potential impact	Control measures / Timeframes	Risk analysis				
			Low	Med	Sig	High	Extr
	Reducing baseflow to possibly connected waterways.	Ensure that grouting and/or other measures are implemented during construction phase to ensure that groundwater inflow is limited to 1L/s/km. Groundwater level monitoring as early warning mechanism. *Timeframe:* In accordance with Table 8.4 and Section 8.6.		D 3			
	Contaminated groundwater drawn into tunnel.	Tunnel discharge will be directed to water treatment plant prior to discharge. *Timeframe:* Throughout construction and operation.		C 2			
	Decreased baseflow to possible GDEs reliant on surface expression of groundwater.	Groundwater and surface water level monitoring as early warning mechanism. *Timeframe:* In accordance with Table 8.4 and Section 8.6.		D 3			
	Decreased groundwater availability to possible GDEs reliant on the subsurface presence of groundwater.	Groundwater level and spring / GDE monitoring as early warning mechanism. *Timeframe:* In accordance with Section 9.4.1		D 3			
WTP discharge	Increased flow and increased turbulence in creek/drainage channel.	Regulate WTP discharge using appropriately sized drains or storage and discharge locations to existing stormwater infrastructure.		D 3			

Table 6.2 Revised assessment of potential impacts considering control measures							
Component	Potential impact	Control measures	Risk analysis				
		Timeframes	Low	Med	Sig	High	Extr
		Throughout operation.					
	Creek/drainage channel bed or bank scouring	Regulate WTP discharge using appropriately sized drains or storage and discharge locations to existing stormwater infrastructure.	E 3				
		Throughout operation.					
	Changes to baseline water quality.	Water treatment plant will treat water quality to meet quality objectives, this will be verified via discharge point water quality sampling.	E 3				
		In accordance with Table 8.4 and Section 8.6.					
	Contamination of waterways from chemical or fuel spills from traffic accident in tunnel or firefighting water.	Collect chemical, fuel, fire water in LPS and tanker away for off-site disposal.		D 3			
		As required if not able to be treated by the WTP.					
	WTP malfunction.	Process and procedures to deal with WTP operation and malfunction correction to be incorporated in the operating manuals.		D 3			
		Throughout operational phase.					

Table 6.2 Revised assessment of potential impacts considering control measures

Component	Potential impact	Control measures	Risk analysis				
		Timeframes	Low	Med	Sig	High	Extr
Fuels and chemical storage and refuelling	Spills of hydrocarbons that leach downwards or are mobilised	Ensure that fuels and chemicals are stored in appropriately bunded facilities. Use of chemical and fuels should be in accordance with standard operating process and manufacturers guidelines. Throughout operational phase.		C 2			
Contamination from chemical or fuel spills from surface roads	Contamination of waterways from chemical or fuel spills from traffic accident on surface roads	When on the Hills M2 Motorway, respond to surface spills in accordance with Hills M2 Motorway spill response procedures. If spill occurs on other surface roads then spills are to be responded to as an emergency response from Fire and Rescue NSW. Throughout operational phase.			A 2		
Noxious weed treatment including herbicide spraying	Increased nutrient load in waterways causing algal growth and eutrophication.	Use of chemicals will be in accordance with manufacturer's specifications. Herbicide application will not be undertaken during or following heavy rainfall. In accordance with the OEMP for the asset.	E 3				

Following the implementation of control and mitigation management measures the residual risk of the potential impacts to the various receptors have reduced in all cases. Only four significant risks remain, and no high or extreme risks remain. The significant risks relate to tunnelling and are sanctioned environmental impacts associated with these activities that have moderate consequences.

Given that there are a small number of registered groundwater users in the predicted drawdown area, the consequences of the residual risk are small.

6.3. Water treatment specifications and design

6.3.1. Design principles

The Project is committed to designing, treating and managing the water on site in accordance with best practice for Water Sensitive Urban Design principles. This will be achieved through a review of the conceptual design guidelines specific to water conservation and stormwater management objectives that are appropriate for the Sydney Basin. The proposed design broadly considers the following in accordance with these guidelines:

- Water Sensitive Urban Design policy and regulations;
- regional and locally significant ecosystems;
- identification of environmental values;
- drainage and flooding;
- the determination of waste water and stormwater minimisation objectives;
- the establishment of water conservation objectives; and
- an understanding of the water cycle infrastructure context.

The specification and design details of the WTPs are provided below in accordance with MCoA B15(c).

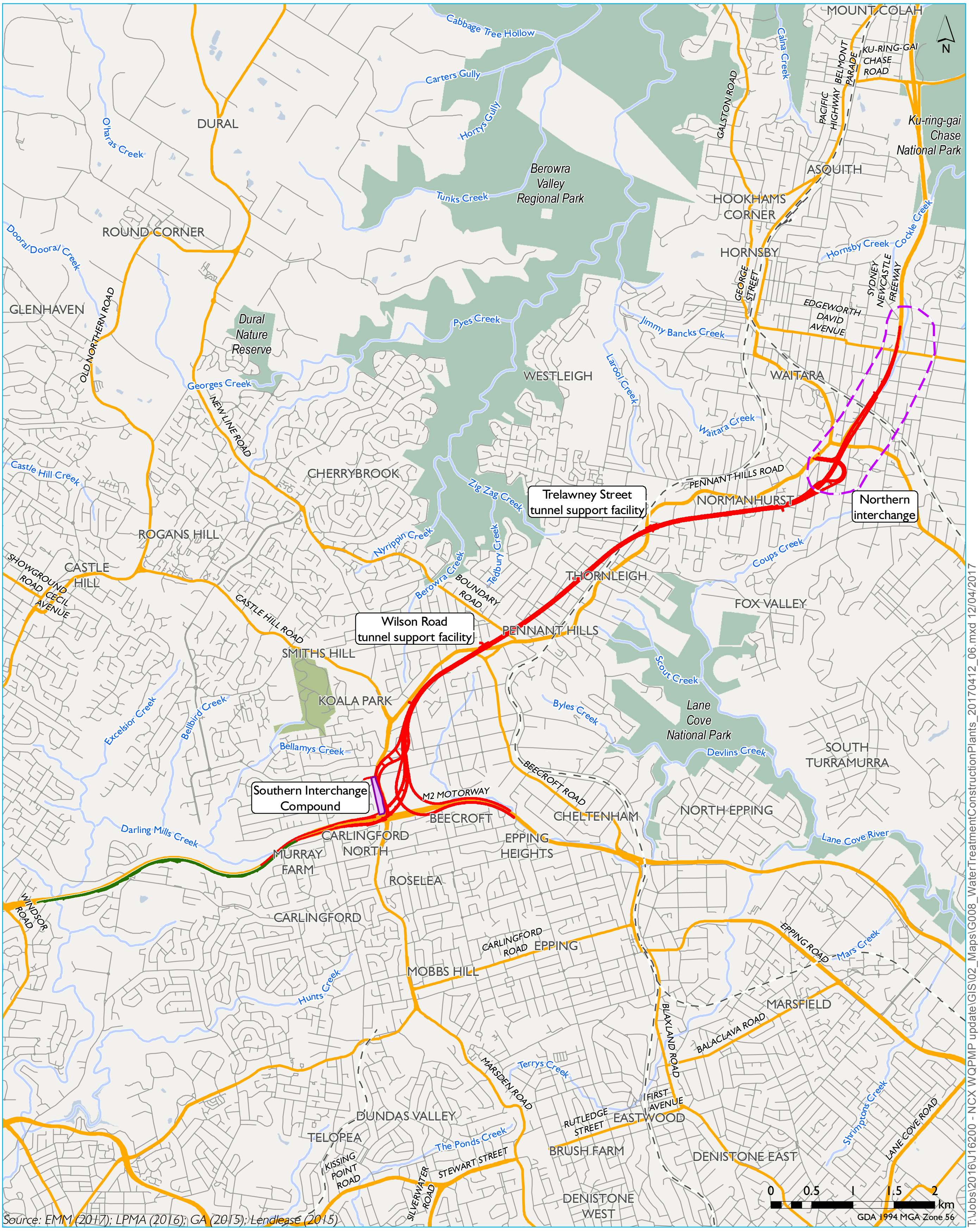
6.3.2. Water treatment plant locations

Construction Phase

There will be four WTPs across the Project area during the construction phase of the Project. The WTPs will be located at the Southern Interchange, Trelawney Street, Wilson Road and Northern Interchange compounds (Figure 6.2). All four WTPs will treat water associated with tunnel construction.

Operational Phase

One new WTP will be located at the Motorway Operations Complex and this will be used during the operational phase of the Project (Figure 6.3).



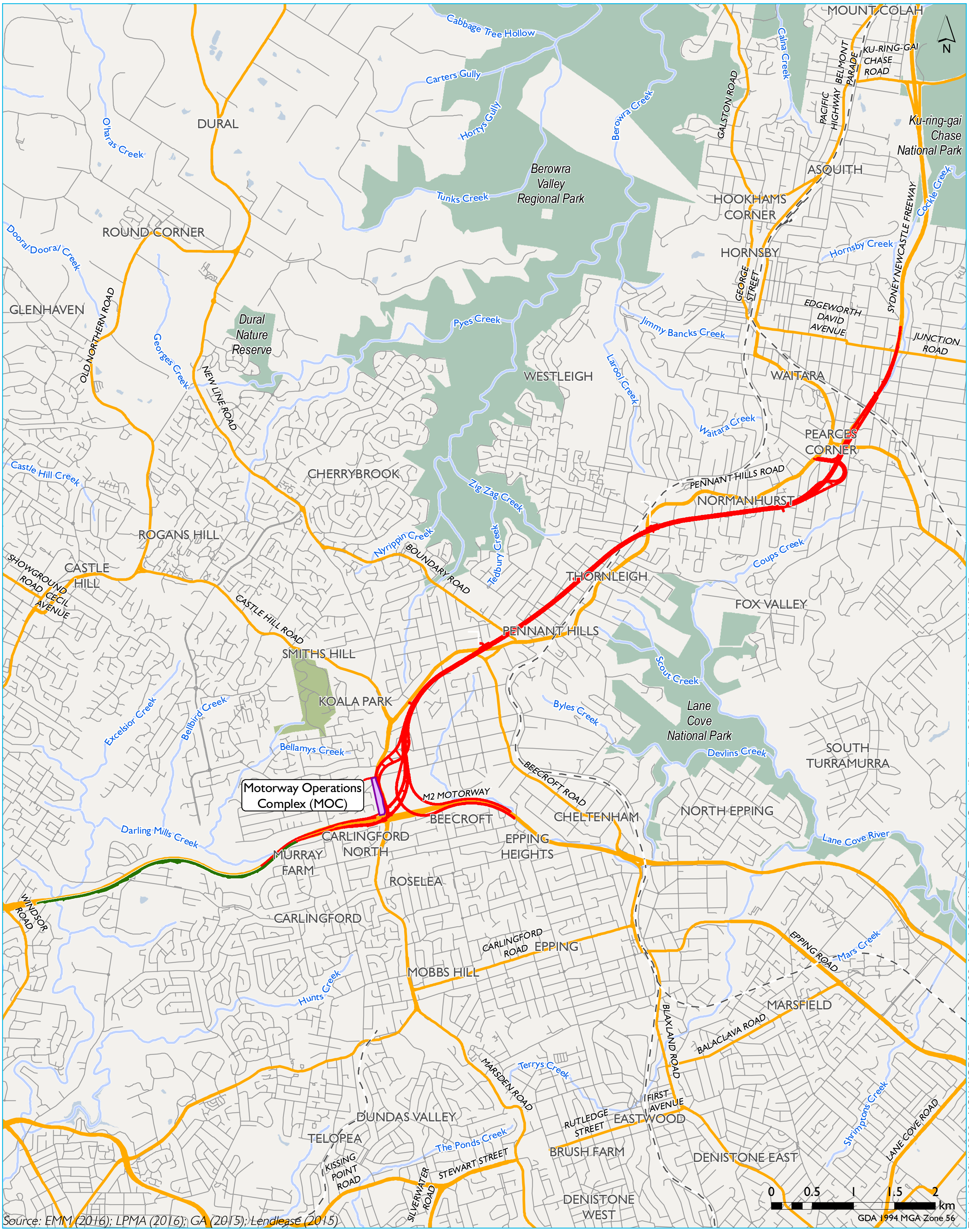
KEY

- NorthConnex tunnel
- M2 integration works
- Southern Interchange Compound
- Major road
- Minor road
- Rail line
- Watercourse
- Waterbody
- NPWS reserve
- State forest

Water treatment plant locations - Construction Phase

NorthConnex

Figure 6.2



T:\Jobs\2016\J16200 - NCX WQPMP update\GIS\02_Maps\G027_WaterTreatmentOperationPlants_20170412_03.mxd 12/04/2017

KEY

- NorthConnex tunnel
- M2 integration works
- Motorway Operations Complex (MOC)
- Major road
- Minor road
- Rail line
- Watercourse
- Waterbody
- NPWS reserve
- State forest

Water treatment plant locations - Operational Phase

NorthConnex

Figure 6.3

6.3.3. Tunnel discharge volumes

Table 6.3 lists the estimated water discharge volumes during construction and operation of the Project.

Table 6.3 Estimated water discharge volumes during construction and operation

	Southern interchange compound (C5) / Motorway Operations Complex (MOC)	Wilson Road compound (C6)	Trelawney Street compound (C7)	Northern interchange compound (C9)
Construction Phase[1]				
Anticipated total discharge volume to stormwater (ML/yr)	575	485	455	705
Anticipated average discharge rate (L/s)	6.5	7.0	7.5	8.5
Construction Phase 2[3]				
Anticipated average discharge rate (L/s	-	21	-	8.5
Operational Phase[2]				
Anticipated total discharge volume to stormwater (ML/yr)	568	N/A	N/A	N/A
Anticipated average discharge rate (L/s)	20 - 40	N/A	N/A	N/A

Source: [1]AECOM (2014); [2]GHD (2016), [3] During 2018, the WTPs at Southern and Trelawney compounds will be shut down in order to make way for permanent tunnel operations buildings. A larger new WTP is being constructed at Wilson in order to process the water that would have been sent and processed at the other sites.

6.3.4. Construction phase water management

The construction phase inflow rate is anticipated to be in the order of one litre per second per kilometre of tunnel which equates to around 0.09 mega litres per day per kilometre (ML/day/km) of excavated tunnel. Groundwater inflow rates during construction are expected to vary throughout the length of the tunnel due to the variable nature of the hydraulic conductivity with the Hawkesbury Sandstone and the Ashfield Shale.

Discharge of treated water is a standard construction practice. During the construction phase, preference will be given to reusing as much water as is practicable for on-site work before discharging any to the environment (or the sewer). The increase in impervious surface areas for the Project is limited, therefore the majority of water requiring discharge would be treated groundwater.

6.3.5. Operational phase water treatment strategy

Groundwater drainage entering the tunnel is collected by open channels, which will be placed at the side walls of the tunnel. The collected groundwater will be directed via pipes to the roadway drainage system. The roadway drainage system will also collect road runoff consisting of stormwater from the portals and tunnel service water. Tunnel service water may include water from maintenance activities and water from the tunnel's deluge and hydrant system.

The combined groundwater and stormwater collection system will send water to a LPS, the sump will receive a wide range of water qualities and quantities and will be located near the deepest part of the tunnel, located approximately 1 km from the southern portal. The LPS will have two sets of pumps: Low flow groundwater pumps and high flow stormwater pumps. Both pump sets are anticipated to operate periodically only. The groundwater and stormwater pump sets will discharge via dedicated rising mains into an above ground buffer tank system. The groundwater pumps will be rated at approximately 30 L/s to accommodate for the anticipated ground water inflows and minor rainfall events. The storm water pumps will be capable of pumping up to 250 L/s to accommodate the inflow from the fire system or a peak rain event.

Water from the LPS will be pumped to either of two buffer tanks located on the surface that will be released slowly to a Water Treatment Plant (WTP).The purpose of the buffer tank system (two tanks) is to store water in excess of the WTP capacity, in order to allow the plant to process water at a reasonably constant rate. There will be two buffer tanks to allow for reducdency and cleaning of the tanks as well as the capture of water that may be affected by tunnel / pipe cleaning (pigging) and other maintenance. The water will be tested at this point to ensure that it can be treated by the WTP. If the water is outside of the WTP specification it will be removed from site and sent to a licenced waste disposal facility by road tanker.

The WTP will be designed to treat the credible combinations of water entering the tunnel up to a flowrate of 40L/s (144 m3/h). As the inflows into the tunnel will not be at a consistent rate, the plant is designed to be capable of processing variable flows between 10 L/s and 40 L/s. To facilitate this and offer some level of redundancy and an opportunity to send out of specification water back through the system, the WTP is designed as two 50% plant capacity process trains. Each process train is designed to treat 20 L/s (72 m3/h) of feed water, therefore only one of these treatment trains need to be operational in order to process the expected water generated by the tunnel.

Treated water from the plant will be discharged into the local Council's existing piped drainage system (Gum Grove Drain), which leads into Blue Gum Creek or sent to Trade Waste should agreement be reached with Sydney Water Corporation.

As described in the EIS during significant but infrequent wet weather events, the buffer tank system's storage capacity will be exceeded and a portion of the collected drainage water may bypass treatment and directly be discharged to Blue Gum Creek via a dedicated drainage line (M2 Corridor Surface Drainage Channel) and an existing drainage channel, these instances are discussed further in Section 7.7.2.

The buffer tank, treatment plant and detention basin are located at the proposed MOC. The surface runoff water from the proposed complex and portions of the adjacent Pennant Hills Road are collected and piped via a Gross Pollutant Trap into the on-site detention basin (nom. capacity 3,750 m^3). The purpose of the detention basin is to attenuate surface run-off flows released into the Gum Grove drainage system. The release of detention basin flows are separate to discharges from the buffer tank system.

A feature of the LPS is the compartmentalisation of the sump, which provides flexibility when responding to the various operational scenarios. This developed design forms the basis of the LPS adopted for the final water treatment strategy, which is shown in Figure 2-3 and consists of the following elements:

Diversion chamber – Flows from the incoming drainage pipe are diverted to either the groundwater compartment (default), stormwater compartment, or the spill compartment. The Operator may select to manually divert flows to the spill compartment.

Groundwater compartment – By default, all groundwater and low intensity stormwater flows are received by this compartment. When capacity is exceeded, the water level in the groundwater compartment rises and back charges into the diversion chamber. At a set water level, overflows from the diversion chamber into the stormwater compartment commence.

Stormwater compartment – This will house the stormwater pumps. The stormwater compartment overflows to the shared compartment when capacity is exceeded.

Shared compartment – Provides additional storage for flows in excess of the stormwater compartment or spill compartment. A temporary drop-in pump is required to empty this compartment.

Spill compartment - Dedicated 50 m3 compartment to divert and store liquid spillages. In case the capacity of the compartment is exceeded, then the spillage may overflow into the shared compartment. An under weir between the spill compartment and the shared compartment is intended to retain hydrocarbons within the spill compartment. Diversion to the spill compartment from the diversion chamber is manually selected by the

operator.

A schematic of the operational phase water management is presented in Figure 6.4

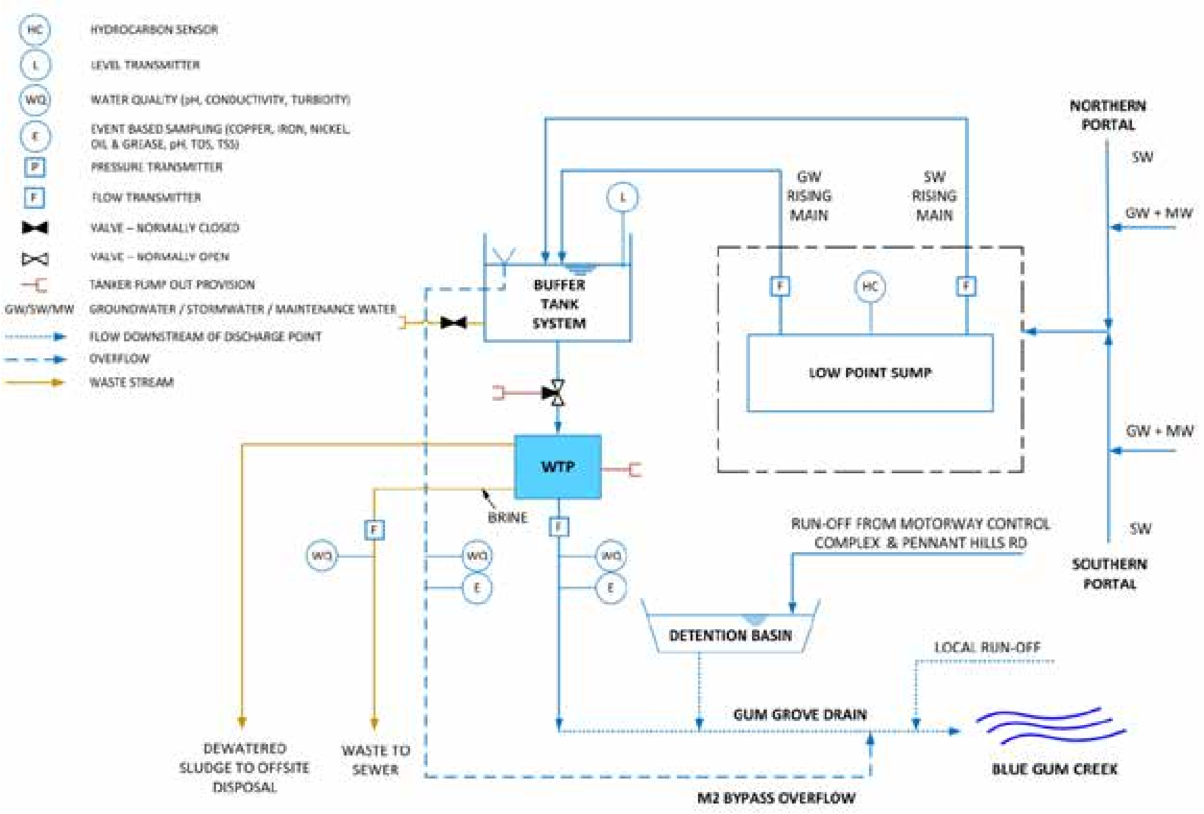


Figure 6.4 Operational phase process flow diagram

Debris within the tunnel is captured by the numerous drainage pits along the tunnels' carriageway and is unlikely to enter the LPS. Nonetheless, the initial stormwater flows, known as the "first flush", are expected to contain the majority of contaminant load from the catchment surfaces.

In addition the storm water entering the tunnels at the portals will be attributable to rain events. Storm water is expected to contain contaminants deposited on the catchment surfaces. Initial storm water flows, known as the "first flush", are expected to contain the majority of these contaminants.

Based on NSW EPA guidelines, it is assumed that a typical first flush is defined by the initial 15 mm of rainfall over the catchment for impervious surfaces containing oil, grease and hydrocarbons. Storm water after the first flush is expected to be of quite good water quality and can be discharged directly to the environment.

The nature of contaminants in storm water first flush run-off depends largely on the land use and activities in the catchment. There are a number of typical contaminants related to vehicle emissions, trapped within a tunnel and deposited on the road and other surfaces in the catchment. These contaminants may be washed into the drainage system in the first flush event and need to be treated by the WTP.

Coincident first flush flows (first flush stormwater concurrently arriving from the north and south portals to the LPS) are not considered a credible scenario give the 9km distance between the portals. Therefore, the initial first flush received into the LPS is assumed to originate from the closer (and larger) southern portal. The corresponding volume is estimated as 190 m3. First flush stormwater will be blended with groundwater collected by the combined drainage system and treated by the WTP.

6.3.6. Water treatment

Water from the construction or operational phase water management system will be transferred to an above ground buffer tanks adjacent the WTP's. The buffer tanks will provide additional water management system redundancy. This water will be transferred to a WTP, or, if of appropriate quality, may be released directly to the stormwater or to sewer as trade waste.

Each WTP will comprise of a series of modular water-tight tanks with automated probes and dosing units designed to test and treat the water to the required standard. The final configurations will be designed to meet the specific construction phase EPL requirements, and to meet the water quality trigger values proposed in this WQPMP during the operational phase.

Water treatment would typically involve one of, or multiple processes, such as:

- flocculation to remove suspended solids such as iron and manganese (which are naturally high in groundwater within the Hawkesbury Sandstone);
- dissolved air floatation (Operational WTP only) and micro-filtration to remove remaining particulates;
- carbon filtration to remove volatile organic compounds such as benzene and toluene;
- reverse osmosis where required to reduce salinity and dissolved solid concentrations to acceptable levels; and
- correction of pH level through the addition of lime or acid.

Where an RO plant is required, such as with the operational phase WTP the brine waste stream will be sent to trade waste under agreement with Sydney Water Corporation.

The sludge produced from the dissolved air floatation process system will be collected in a Sludge Tank and will be transferred to the Sludge Dewatering unit (Centrifuge). The centrifuge consists of a feed tube, feed chamber and a screw conveyor housed within a solid bowl. The screw conveyor and solid bowl rotate in the same direction but at a slightly different speed.

In addition to being used to improve liquid clarity, polymer dosing also improves the dewatering characteristics of the sludge by agglomerating the solids and increasing the effective size of the solids. This is a variable that must be proven by field-testing.

The solid cake produced by the sludge dewatering process is to be stored in a skip for removal to off-site processing. The water that is separated in the dewatering process is returned back into the WTP process for further treatment.

Treatment of microbiology through ultraviolet disinfection is not considered appropriate for the Project as microorganisms are likely to be in much higher concentrations in the receiving environment than in the groundwater. Treated water will be discharged into the local stormwater system in accordance with the requirements of the EPL or to trade waste during the construction phase and in accordance with this plan during the operational phase.

The operational phase WTP will include a Reverse Osmosis Plant which will substantially remove contaminants from the processed water including salinity, suspended solids, nutrients, metals and hydrocarbons.

A WTP schematic is provided in Figure 6.5.

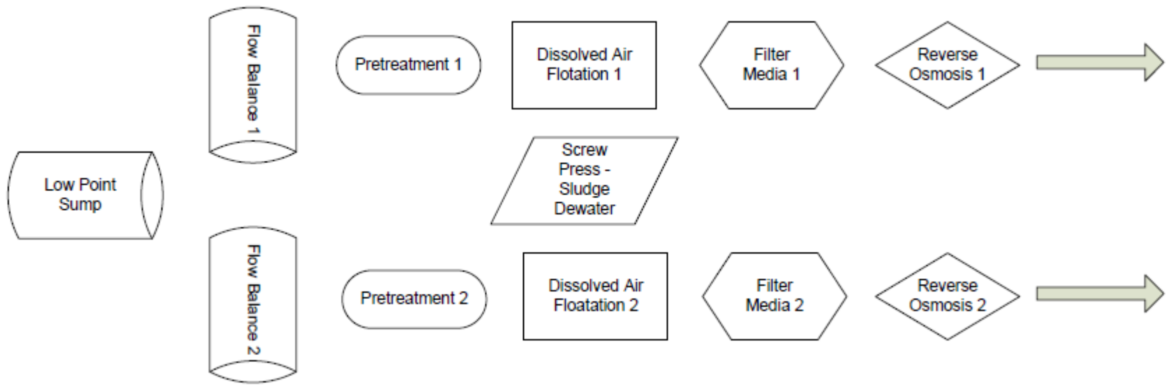


Figure 6.5 Water treatment plant schematic

Each WTP has one discharge point with a flow meter to ensure that the flow rate does not exceed the permitted discharge rate. These are licensed discharge points in the EPL. Daily readings of cumulative flow will be recorded from each flow meter and tabulated. Discharged volumes will be reported on in the six-monthly compliance reporting (Table 10.1).

Water flow

While MCoAB15(d) requires that discharge points to watercourses emulate a natural stream system, where feasible and reasonable, all WTP discharges will be to the pre-existing Council stormwater system and not directly to natural watercourses. The existing stormwater system discharge points to the creeks are generally distant from the WTP discharge points. It is not feasible to reinstall the long-established existing stormwater infrastructure, including the discharge points to emulate a natural system.

The discharge of treated water, at the estimated rates shown in Table 6.3 may result in an increase in the instantaneous peak flow rates in downstream watercourses in peak flow events. However, the majority of discharge is treated groundwaters, which will inflow at a relatively consistent rate regardless of rainfall events. The natural existing flow rates in downstream watercourses would be significantly higher than the discharge rate from the Project during large rainfall events and therefore impacts to downstream watercourses would be minimal during high natural flows following rainfall.

In summary, it is not feasible (as the stormwater system is long established) or reasonable (as no significant impacts are predicted) for the Project to install additional measures at the existing stormwater discharge points to watercourses.

Water quality

Catchment-specific discharge water quality criteria have been developed to maintain and improve the water quality within the receiving environment and where possible consistent with ANZECC/ARMCANZ (2000a) slightly to moderately disturbed aquatic ecosystems in accordance with the requirements of MCoAB16(f). These criteria are presented in Sections 7.6 and 7.7 of this plan.

6.3.7. Water Balance and WTP Capacity Details

The maximum allowable groundwater infiltration rate permitted in the project design requirements is 1 L/s/km tunnel for a total 20 km of tunnel. This equates to a maximum infiltration rate of 22.5 L/s (including a 2.5 L/s allowance for water from the ventilation shaft). Groundwater modelling through a hydrogeological assessment by Golder & Associates (2016) has however predicted that inflow rates would be much lower at 10 L/s. Notwithstanding the predicted inflow rates, all components of the water treatment system are sized to be capable of managing the maximum potential groundwater flow of 22.5 L/s.

The water treatment plant will comprises two trains capable of treating from 10L/sec to 20L/sec, thus providing the capacity to treat from between 10l/sec up to 40l/sec, and providing redundancy and availability during maintenance activities. Treated water is discharged to council stormwater system in Gum Grove Place, and the residual concentrated brine is discharged to sewer via a trade waste agreement with Sydney Water at a maximum rate of 10L/sec.

The capacity of the stormwater system has been sized based on hydrograph analysis of 1:100 year events from a 10 min duration up to 24 hour duration. The minimum hydraulic buffering requirement to prevent flooding in the tunnel beyond the specification determined by the modelling is estimated as 510 cubic meters. The corresponding critical storm event was a 1:100 year event of 270 min duration. The resultant volumes in the low point sump are approximately:

a. a diversion chamber;
b. a 95 cubic meter groundwater compartment;
c. a 460 cubic meter stormwater compartment;
d. a 150 cubic meter shared compartment;
e. a 50 cubic meter spill compartment

Tunnel water flows can be managed by using combinations of the compartments. For example, low intensity rainfall can be accommodated in the single stormwater compartment. High intensity flows can be accommodated by both the stormwater and shared compartment with a resultant storage of 460+150=610 cubic meters.

Pump rates shall be 30L/sec for the groundwater rising main, and a maximum 250L/sec for the stormwater rising main.

The buffer tank volume at the surface is a total 400 cubic meter (two 200 cubic meter tanks). The two tanks enable flexibility of storage – one ‘untreatable’ for off-site disposal and one ‘treatable’, or redundancy for maintenance. The total volume of low point sump and buffer tank 1010 cubic meter (610+400) exceeds the 920 cubic meter (420+500) in the EIS Fig 7-81.

The combined tunnel stormwater catchments at all the portal troughs is approximately 2ha. Collected stormwater will flow from the south and north to the single low point sump. Within the tunnel regular inflows will be from groundwater infiltration, and from tunnel fire system testing during scheduled maintenance closures. Two ‘Credible Scenarios’ are used to evaluate the Tunnel Water Management Strategy. These are:

Scenario 1 – fire event with deluge and hydrant water + 1year ARI + groundwater

Scenario 2 – groundwater + 1:100year ARI (ascertained to be 270min duration event)

Scenario 1 is regarded as a 'spill event' and contaminated water is stored at the low point sump and tankered away. Scenario 2 results in treatment of first flush water and the high flow discharged as a bypass flow owing to the high dilution of the groundwater inflows.

Surface stormwater catchments at the south have been modified and result in an overall reduction in the intensity of drainage flows in parts of the network through the reduction of some catchments and the attenuation of flows through detention tanks.

Downstream flows to the piped or channel system and creeks has been reduced by the following reductions in catchments or by attenuation of flows through the MOC detention tank:

1. An increase from 2.37ha to 4,18ha in the detention basin catchment by including all the MOC land not previously drained. This effectively reduces and moderates the rate of peak flow in the downstream catchments drained via Hillside Place, Gum Grove Place, other local streets;
2. A reduction from 10.17ha to 9.70ha in the Gum Grove Place catchment (owing to the MOC land being drained via the increased detention basin) – reduction of 0.47ha;
3. A reduction from 28.74ha to 28.03ha in the Savoy Crescent catchment – reduction of 0.71ha;
4. A reduction from 61.92ha to 60.94ha in the Oakes Road catchment – reduction of 0.98ha.
5. Tunnel entry and exit troughs at the south drain into the tunnel, reducing the overall surface catchment. Tunnel stormwater pump out to the surface is delayed as the tunnel piped drainage flows to the lowpoint sump from the south and then from the north. As a result the tunnel peak flows rarely coincide with surface peak flows.

These reductions in catchments result in reductions of the following 1:100ARI peak flows:

1. Detention basin peak flows maintain current piped drainage discharge rate;
2. Gum Grove Place flow rate reduced by 1.33 cubic meters/sec
3. Savoy Crescent flow rate reduced by 1.36 cubic meters /sec The reduction becomes 1.11 cubic meters /sec, if the By-Pass overflow of 0.25cu.m/sec is flowing; CULVERT 21
4. Oakes Road flow rate reduced by 1.48 cubic meters /sec The reduction becomes 1.23 cubic meters /sec, if the By-Pass overflow of 0.25 cubic meters /sec is flowing; DOWNSTREAM of OAKES RD
5. Blue Gum Creek rate reduced by 1.38 cubic meters /sec. The reduction becomes 1.13 cubic meters /sec, if the By-Pass overflow of 0.25 cubic meters /sec is flowing;

Peak tunnel stormwater flows are managed separately to the surface stormwater from the MOC. After first flush, the stormwater overflows from the buffer tank and discharges via an overland channel along the M2 Corridor and discharge to the Creek downstream of the Savoy Crescent piped drainage headwall. The peak flow in this channel is assessed at the pump out rate of 250L/sec (0.25 cubic meters /sec).

Tables 7.10 & 7.11 provide the details of the frequency and volumes of WTP bypass discharges.

7. Performance standards

7.1. Overview

The performance objectives of this monitoring plan focus on the protection of surface water quality, groundwater resources and quality, licensed groundwater users and GDEs. The proposed performance standards provide a framework against which the protection of these aspects can be assessed in accordance with condition MCoAB15(e).

7.2. Water quality guidelines

7.2.1. Application of guidelines

The ANZECC/ARMCANZ (2000a) guidelines provide numerical concentration trigger values and/or narrative statements to assess whether water quality meets water quality objectives to maintain or improve a designated water use or environmental value(s). Guideline values are general tools to assist in protecting environmental values. Many undisturbed systems naturally exceed the guideline values and, therefore, exceedance of the values does not necessarily indicate a degraded system or potential for an impact.

The comparison of water quality results to site-specific guideline values is recognised as industry best practice, and promotes a holistic approach to water management. The comparison of waters to the guideline values needs to be considered within the context of the intent of the ANZECC/ARMCANZ (2000a) guidelines, and not used as the only mechanism for determining whether an impact has the potential to occur.

Generally, the guidelines are applied to the quality both of surface water and of groundwater since the environmental values which they protect relate to above-ground uses (eg irrigation, drinking water, aquatic ecosystems and recreation). The application of the guideline values needs to take into consideration the environment type, value and existing condition as well as the level of change that is considered acceptable. There are different guideline values for varying environmental conditions and degrees of change. Within the Project area the most conservative environmental value is considered to be 'aquatic ecosystem.'

7.2.2. Protection levels

In the application of the ANZECC/ARMCANZ (2000a) guidelines, the level of protection needs to be determined. This is based on both the existing baseline conditions and the level of change that is considered acceptable. Three levels of ecosystem conditions are recognised for aquatic ecosystems (ANZECC/ARMCANZ 2000a):

- highly conservative: effectively unmodified or highly-valued ecosystem;
- slightly to moderately disturbed: relatively small but measurable human activity, although ecosystem integrity is largely retained; and
- highly disturbed: measurably degraded ecosystems of low ecological value.

The ecosystem protection and degree of acceptable change translates to the level of protection, which includes default trigger values for the protection of 99%, 95%, 90% and 80% of aquatic species. The trigger values for the protection of 99% of species relate to the most conservative guideline values and the 80% trigger values the least conservative values. ANZECC/ARMCANZ (2000a) recommends that in the absence of site-specific trigger values, the default trigger values for the protection of 99% of species should be applied to highly conservative environments; while the trigger values for the protection of 95% of species should be applied to slightly to moderately disturbed environments. The Project area is considered to be highly disturbed. However, ANZECC/ARMCANZ (2000a) trigger values for slightly to moderately disturbed ecosystems (generally for the protection of 95% of species) have also been applied. This approach contributes to the improvement of the downstream environment in accordance with MCoA B16(f) as detailed below.

7.3. Site-specific trigger values

Historical data and baseline monitoring for the Project has indicated that the levels of some groundwater and surface water quality parameters currently exceed the default ANZECC/ARMCANZ (2000a) guidelines for slightly to moderately disturbed aquatic ecosystems. These default trigger values consider the potential toxicity of a stressor or chemical a wide range of species in Australia and New Zealand, are not site-specific, and do not consider the underlying geology. The exceedance of a guideline value is common and is often a product of the natural environment, ie water-rock hydro-geochemical interactions. ANZECC/ARMCANZ (2000a) recognise this, stating:

> Some surface waters will contain concentrations of toxicants that may naturally exceed the default guideline trigger values tabulated in section 3.4 [of ANZECC/ARMCANZ (2000a)]. Where this is the case and as recommended in section 3.4.3.2 [of ANZECC/ARMCANZ (2000a)], new trigger values should be based on background (or baseline) data. (Note that 'background' in this case, refers to natural toxicant concentrations that are unrelated to human disturbance.)

The use of, site-specific trigger values derived using baseline data are a much more rigorous and accurate approach to assessing potential impacts.

ANZECC/ARMCANZ (2000a) describes potential the sources of information for determining the reference condition, and therefore appropriate triggers values, as follows:

> The reference condition for sites that may or may not be disturbed at present can be defined in terms of these sources of information: historical data collected from the site being assessed; spatial data collected from sites or areas nearby that are uninfluenced (or not as influenced) by the disturbance being assessed; or data derived from other sources.

Where appropriate, catchment-specific design specifications (Section 7.6.2) and ambient trigger values (Section 7.4) have been determined using the historical and monitoring data described in Sections 3.7 and 3.8. Data from each of the four catchments have been grouped to provide sufficient temporal (up to ten years of data) and spatial coverage and to extend the site-specific monitoring undertaken specifically for the Project (as there were 13 pre-construction sampling events).

It is noted that section 2.2.1.9 of the ANZECC/ARMCANZ (2000a) guidelines specifically state that the:

> The guidelines have not been designed for direct application in activities such as discharge consents, recycled water quality or stormwater quality, nor should they be used in this way.

Nevertheless, the guidelines are considered a useful tool when developing discharge goals.

7.4. Ambient surface water catchment-specific trigger values

Catchment-specific trigger values have been developed. Exceedance of the trigger values during baseline sampling was expected as this environment is highly disturbed, in an urban catchment area and the underlying geology is likely to be influencing surface water and groundwater quality.

Ambient catchment-specific trigger values have been developed on for the four sub-catchments by combining historic data (over about ten years) and baseline data collected for the Project (over nine months). The datasets assigned to the four sub-catchments are included in Table 7.1.

Table 7.1 Sub-catchment sites		
Sub-catchment	Site name	Source
Parramatta River	SW01	Baseline site
	SW06	Baseline site
	SW07	Baseline site
	SW08	Baseline site
	SW09	Baseline site
	02 Excelsior Creek	Hills Shire Council
	Blue Gum Creek at Lisle Court	Streamwatch
	Darling Mills Creek 1-G3	Hills Shire Council
	Darling Mills Creek 2-P2	Hills Shire Council
Lane Cove River	SW03	Baseline site
	SW04	Baseline site
	SW10	Baseline site
	006-Coups Creek	Ku-ring-gai Council
	008 –Devlin's Creek	Hornsby Shire Council
	025-Glade Oval	Ku-ring-gai Council
Berowra Creek	SW02	Baseline site
	004-Berowra Creek	Hornsby Shire Council
	010-Larool Creek	Streamwatch
	023-Waitara Creek	Hornsby Shire Council
	Tedbury Creek-upstream	Streamwatch
	Tedbury Creek-midstream	Streamwatch
	Tedbury Creek-downstream	Streamwatch
Cowan Creek/Pittwater	SW05	Baseline site
	012-Cockle Creek	Ku-ring-gai Council

Catchment-specific surface water monitoring locations are shown on Figure 3.7.

The ambient catchment-specific trigger values are based on 80th percentile values of monitoring data. For parameters where the 80th percentile value is lower that the ANZECC/ARMCANZ (2000a) default value for slightly to moderately disturbed ecosystems (generally protecting 95% of species), the catchment-specific trigger value and the ANZECC/ARMCANZ (2000a) default value have been adopted as trigger values.

Trigger values for parameters where the catchment-specific trigger value is greater than the default ANZECC/ARMCANZ (2000a) default trigger value are listed in Table 7.2. For these parameters, the ANZECC/ARMCANZ (2000a) default trigger will be exceeded in a sample where the catchment-specific trigger value is exceeded.

Trigger values for parameters where the catchment-specific trigger value is less than the default ANZECC/ARMCANZ (2000a) default trigger value are listed in Table 7.2.For these parameters, a comparison will be made to the ANZECC/ARMCANZ (2000a) default trigger when the catchment-specific trigger value is exceeded.

Comparison of monitoring results against these trigger values will determine whether further management actions are implemented (as described in Section 9). The ANZECC/ARMCANZ (2000a) default trigger values for cadmium, chromium, nickel and lead for a hardness of 30 mg/L $CaCO_3$ have been adjusted to the site-specific hardness (see ANZECC/ARMCANZ (2000a) section 3.4.3) based on the median hardness measured at SW01D, SW06D and SW08D during the pre-construction monitoring (136 mg $CaCO_3$/L).The collection of baseline data for electrical conductivity across the surface water monitoring sites has determined that the average surface water EC is lower than the recommended ANZECC/ARMCANZ (2000a) guideline upper limit of 2,200 µs/cm for SE Australian lowland rivers and NSW coastal rivers, but higher than the upland river limit (350 µS/cm). As EC is an important indicator of water quality, site-specific trigger values have been derived for each surface water monitoring location.

As the petroleum compounds TPH/BTEX are not considered to be natural features of any surface water system a trigger value of zero has been included in Table 7.2.

Table 7.2 Catchment-specific ambient trigger values (based on the 80th percentile of historical/baseline data)

Monitoring location	Surface water EC	pH	Aluminium	Copper	Zinc	Ammonia as N	Nitrite as N	Nitrate as N	Total nitrogen	Total phosphorous as P	TPH / BTEXN
	µs/cm	pH	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L
ANZECC 2000 trigger values[1]	125–2,200[2] 200–300[3]	6.5–8.5[4]	0.055	0.0014[5]	0.008[5]	0.013[2]	-	0.7[1] 0.015[2]	0.25*	0.025	<LOR
Parramatta River Catchment-specific	505	6.5-8.3	-	0.008	0.04	0.07	0.01	0.6	ANZECC	0.04	<LOR
Default (toxicity-based)	-	-	0.055	-	-	0.9	-	0.7	-	-	-
Lane Cove River	600	7.1–7.6	0.347	0.006	0.033	0.06	ANZECC	0.3	0.95	0.07	<LOR
Berowra Creek	500	7.0–7.4	0.374	0.006	0.035	0.06	ANZECC	0.2	0.7	0.08	<LOR
Cowan Creek/Pittwater	299	7.3–8.0	ANZECC	0.008	0.05	0.12	ANZECC	0.39	0.39	0.1	<LOR

Note: 1ANZECC/ARMCANZ (2000a) – slightly to moderately disturbed aquatic ecosystems 2. Guideline value for SE Australian lowland rivers (noting the nitrate trigger value is the concentration of nitrate and nitrite (NO_x)).

3. Guideline value for NSW coastal rivers 4. As per EPL, <LOR – below limit of reporting. 5. For default water hardness of 30 mg $CaCO_3$/L.

Table 7.3 Trigger values where the default trigger value (ANZECC/ARMCANZ guideline (2000a) values) is greater than the catchment-specific trigger - Parramatta River catchment

	Arsenic	Cadmium[1]	Chromium[1]	Lead[1]	Nickel[1]	Manganese
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Catchment-specific	0.001	0.0001	0.001	0.001	0.002	0.13
Default (toxicity-based)	0.013	0.0005	0.002	0.013	0.026	1.9

Source: ANZECC/ARMCANZ (2000a) default trigger values for slightly to moderately disturbed ecosystems.

Note 1. Adjusted for median hardness.

2. Median hardness measured at SW01D, SW06D and SW08D during the pre-construction monitoring was 136 mg CaCO3/L.

Due to the limited baseline or historic data for TSS or turbidity, it is proposed that where monitoring locations are available upstream and downstream of construction work areas, the trigger value for management action will be an elevated level downstream in excess of 20% of the upstream result. This approach is discussed further in Section 8.2.1.

7.5. Ambient groundwater-specific trigger values

Some groundwater will discharge to surface water, with the potential to impact the receiving environment. This is monitored through surface water trigger values. However over that, as the main potential risk to groundwater quality during tunnel construction is associated with spills (fuels, additives and lubricants) and from emergencies during the operational phase, specific groundwater triggers for TPH/BTEXN have been developed. Baseline concentrations of TPH/BTEXN are present in most of the ground water monitoring bores.

The site specific trigger values for groundwater TPH/BTEX will also use 80th percentile values from historic and baseline monitoring are listed in Table 7.4. This approach accounts for the inherently high variability between monitoring events due to the volatile nature of petroleum hydrocarbons. It also accounts for fluctuating water levels that may capture different sections of the contaminant smear zone. During some monitoring events, concentrations were below the LOR. In these cases, the concentration was taken to be half the LOR. This is more a conservative approach than assuming the contaminant is not present.

Table 7.4 Site specific TPH/BTEXN trigger values for groundwater (mg/L)

Analytes	BH025	BH023, BH116	BH021, BH9004	BH014, BH012, BH111, Nelson	BH004	BH1009, BH005	BH1017
Total petroleum hydrocarbons							
C_6 - C_9 fraction	<20	<20	<20	<20	<20	<20	40
C_{10} - C_{14} fraction	<50	<50	101	61	53	<50	740

Table 7.4 Site specific TPH/BTEXN trigger values for groundwater (mg/L)

Analytes	BH025	BH023, BH116	BH021, BH9004	BH014, BH012, BH111, Nelson	BH004	BH1009, BH005	BH1017
C_{15} - C_{28} fraction	<100	<100	985	296	336	<100	220
C_{29} - C_{36} fraction	<50	<50	128	126	<50	<50	110
C_{10} - C_{36} fraction sum	<50	<50	1094	478	440	<50	1010
Total recoverable hydrocarbons							
C_6 - C_{10} fraction	<20	<20	<20	<20	<20	<20	50
C_6 - C_{10} fraction minus BTEX	<20	<20	<20	<20	<20	<20	<20
>C_{10} - C_{16} fraction	<100	<100	106	<100	122	<100	770
>C_{16} - C_{34} fraction	<100	<100	1008	368	348	<100	350
>C_{34} - C_{40} fraction	<100	<100	<100	<100	<100	<100	<50
>C_{10} - C_{40} fraction sum	<100	<100	1020	368	460	<100	1010
>C_{10} - C_{16} fraction - napthalene	<100	<100	102	<100	122	<100	770
BTEXN							
Benzene	4	<1	<1	<1	<1	<1	<1
Toluene	<2	<2	<2	<2	<2	<2	9
Ethylbenzene	<2	<2	<2	<2	<2	<2	1
Meta-xylene	<2	<2	<2	<2	<2	<2	7
Ortho-xylene	<2	<2	<2	<2	<2	<2	3
Total xylenes	<2	<2	<2	<2	<2	<2	10

Table 7.4 Site specific TPH/BTEXN trigger values for groundwater (mg/L)							
Analytes	BH025	BH023, BH116	BH021, BH9004	BH014, BH012, BH111, Nelson	BH004	BH1009, BH005	BH1017
Sum of BTEX	4	<1	<1	<1	<2	<1	19
Naphthalene	<5	<5	<5	<5	<5	<5	<5

Note: 1. Trigger values were rounded to the nearest decimal place

Groundwater levels will be monitored throughout the construction phase using data loggers with manually checking quarterly. Monitoring of groundwater levels will continue into the operation phase.

Groundwater levels in Project's monitoring bores (and potentially other licensed bores) will be compared to groundwater modelling predictions (Section 9.3) as part of the assessment of the model, and predicted zone of impact.

Groundwater levels in the licensed bores in the predicted zone of impact (Table 3.3) will be monitored to determine if there are impacts on groundwater users with reference to the AIP (Section 2.3.1), ie greater than 2 m drawdown.

7.6. Construction phase water treatment performance goals

The level of treatment required at each of the water treatment plants will be determined based on discharge goals. Discharge water quality will be consistent with improving the water quality within the receiving ambient environment compared to the existing water quality or, for parameters where ANZECC/ARMCANZ (2000a) trigger values for slightly to moderately disturbed aquatic ecosystems are generally achieved currently, are consistent with maintaining water quality compliance with these trigger values, in accordance with the requirements of MCoAB16(f).

The ANZECC/ARMCANZ (2000a) guidelines define the preferred hierarchy for deriving trigger values in section 3.1.1.2. The guideline states that, wherever possible, 'local site specific information' should be used to develop trigger values in preference to using default trigger values.

The WTPs are designed to treat water to a level so that water quality objectives downstream will be maintained or improved in the long term. Water quality design specifications for these plants have been developed based on a combination of catchment-specific and default ANZECC/ARMCANZ (2000a) guideline values.

Guideline values have been derived to be used as WTP discharge criteria and to be used as WTP design specifications. Both are to be applied to the water quality immediately prior to discharge when discharge is to the Council stormwater system. The discharge criteria are designed to be frequently measured to provide an indication of whether each WTP is operating in a manner that minimises risk to the environment.

The design specifications will be used in designing and operating the WTPs. Exceedance of the design specifications during the operation of the WTP will trigger an investigation into the causes and implementation of measures so the design specifications will be achieved.

7.6.1. Construction phase discharge criteria

Construction phase discharge criteria have been provided in the EPL. These have been based on parameters that are readily measurable to allow continuous or frequent monitoring of the discharge to ensure compliance and agreed with the NSW EPA. Further, these parameters are indicators that the levels of other parameters in the discharge are sufficiently low so as to maintain or improve the downstream environment in the long term.

The discharge criteria in EPL 20570 are provided in Table 7.5.

Table 7.5 Discharge criteria – Construction phase

Parameter	Construction phase (as per EPL 20570)
TSS[1] (mg/L)	50
pH (pH units)	6.5 – 8.5
Oil and Grease	Not Visible

Note: 1. It is proposed that compliance with the TSS criteria is determined through the measurement of turbidity once a statistical correlation, which identifies the relationship between TSS and turbidity is established.

7.6.2. Construction Phase Design specifications

The catchment-specific design specifications for each parameter are based on the median (50th percentile) of historic and baseline ambient concentrations. These will provide much more conservative goals than if the ambient criteria were used which are based on the 80th percentile of historic and baseline ambient concentrations. The use of the catchment-specific design specifications based on the medians values (ie values that are exceeded half-of the time) for each parameter will mean that water quality in the discharged water will always have better water quality than currently occurs in the creeks for half the time. This will prevent the discharged water ever having the poor quality that already occurs in the creeks. It is this existing poor water is more likely to result in ecotoxicity and other impacts. The catchment-specific design specifications will have the general effect of reducing the median ambient concentrations in the creeks hence improving the downstream water quality as per MCoA B16(e).

For parameters where the median value is lower than the ANZECC/ARMCANZ (2000a) default value for 'slightly to moderately disturbed ecosystems', the default value has been adopted as the trigger value. This will ensure that the water quality objective based on the protection of slightly to moderately disturbed ecosystems are continued to be met in the 'highly disturbed' creeks.

The efficacy of the water treatment plants will be determined during the commissioning phase and their performance will be validated periodically (Sections 7.6.3 & 7.7.7) through the construction and operational phases.

Design specifications have been chosen that are representative of groups of stressors having similar behaviour. Stressors have been selected that are occur at substantially higher levels in groundwater than the receiving environment (on average) and where the average level in groundwater is higher than default values ANZECC/ARMCANZ (2000a) trigger values.

Catchment-specific design specifications have been developed from the median percentile of historic and baseline ambient concentrations for EC and copper.

There are no ANZECC/ARMCANZ (2000a) default trigger values for iron for the protection of aquatic ecosystems. However, high iron concentrations may result in the precipitation of orange iron oxides or the orange/yellow staining of watercourses. Therefore, ANZECC/ARMCANZ (2000a) provides a water quality guideline for iron for recreational purposes (0.3 mg/L). This trigger value was used for the design specification for iron.

The ANZECC/ARMCANZ (2000a) default trigger values for 'slightly to moderately disturbed ecosystems' was used as design specifications for nickel (all catchments).

Table 7.6 Catchment-specific design specifications– Construction Phase

Monitoring location	Catchment	Electrical conductivity	Copper	Iron[1]	Nickel
		µS/cm	mg/L	mg/L	mg/L
ANZECC/ARMCANZ (2000a) trigger values[2]	-	125–2,200[3] 200–300[4]	0.0014	0.30	0.011
Southern Interchange compound	Parramatta River	356	0.0040	0.30 (ANZECC default)	0.011 (ANZECC default)
Wilson Road Support Facility	Berowra Creek	370	0.0030	0.49	0.011 (ANZECC default)
Trelawney Street Support Facility	Lane Cove River	490	0.0030	0.30 (ANZECC default)	0.011 (ANZECC default)
Northern Interchange compound	Lane Cove River	490	0.0030	0.30 (ANZECC default)	0.011 (ANZECC default)

Notes: 1. ANZECC/ARMCANZ (2000a) water quality guideline for recreational purposes.
2. ANZECC/ARMCANZ (2000a) default trigger value for slightly to moderately disturbed aquatic ecosystems.
3. Guideline value for SE Australian lowland rivers.
4. Guideline value for NSW coastal rivers.

7.6.3. Water treatment testing regime - Construction Phase

i Commissioning

Commissioning of each of the four WTPs, involved two rounds of commissioning sampling dertaken to determine their efficacy. All of the parameters listed in Table 7.5 and Table 7.6 were tested during this commissioning phase. The parameters listed in Table 7.5 were tested daily during discharge.

The main objectives of the commissioning testing was to determine:

1. if the WTPs perform to meet the proposed discharge criteria in Table 7.5 and the design specifications in Table 7.6 — design or operational modifications may be required if a WTP does not meet the required specifications;
2. if compliance with the proposed discharge criteria in Table 7.5 is a suitable indicator that the design specifications are being met during post-commissioning monitoring (see below) — if this cannot be fully established within the two rounds of commissioning, further testing of some or all of the parameters in Table 7.6 may be required or the post-commissioning testing regime described below may need to be modified; and

3. the relationship between TSS and turbidity to allow turbidity to be measured as a proxy for TSS — this will require more samples than for the other parameters and may continue into the post-commissioning phase.

ii Post-commissioning

In addition to the commissioning sampling, the WTP discharge will be sampled for water quality analysis for the parameters listed in Table 7.5 prior to and during discharge. The results will be reviewed by personnel during each discharge to ensure that the discharged water meets discharge criteria.

Monthly sampling of the parameters listed in Table 7.6 will be undertaken to ensure that each of the WTP continues to meet design specifications. If the design specifications in Table 7.6 are met for three consecutive months, a proposal will be made to EPA to reduce this monitoring to quarterly. Monthly monitoring of these parameters would be reinstated if design specifications are exceeded.

Water quality results will be reported in the six-monthly compliance reporting (Table 10.1).

7.7. Operational phase water treatment performance goals

The Blue Gum Creek in the Parramatta River catchment is the receiving environment for discharges from the operational tunnel system and is a small watercourse, located within the Bidjigal Reserve. Surface water monitoring site SW01 is downstream of the proposed Motorway Operations Complex on Blue Gum Creek. SW06 monitoring site is located further downstream at the junction with Darling Mills Creek is useful for characterising the surface water quality of the creek.

Monitoring data obtained from the background (pre-development) and construction phase water quality sampling from sites SW01 and SW06 are summarised in Table 7.7 and Table 7.8 below respectively.

For the site SW01 a total of 13 samples were taken between August 2014 and May 2015. Following this, additional samples from this site provide up to 38 data points for consideration. For the downstream site SW06, a total of 12 samples were taken between September 2014 and May 2015. Data from a few additional samples, collected up to December 2016, are available for consideration. Due to such limited dataset, only a discrete number of samples for each site may be identified as during 'wet weather', which form part of the data shown in below tables.

From the data, the following observations could be highlighted with regard to contaminants that breach ANZECC/ARMCANZ (2000A) Guidelines:

- Site SW01 - Pre-construction water quality data at this site, which is at close proximity to the development site, is similar to the water quality over the entire monitoring period, including construction. There are slightly elevated median and concentrations of copper in the drainage channel compared to ANZECC trigger values.. Median concentrations of iron and nickel remain below their respective ANZECC trigger values, although 90th percentiles and maximum values indicate a propensity for occasional, increased concentrations. Of other parameters, pH and electrical conductivity (EC) show some evidence of increases, post-construction, indicated by their maximum values breaching the respective trigger values. However, median concentrations of both pH and EC have remained within the trigger values.

- Site SW06 - Pre-construction water quality data at this downstream Blue Gum Creek site is similar to the water quality over the entire monitoring period, including construction. There are slightly elevated median and 90th percentile concentrations of copper in the drainage channel compared to the ANZECC trigger value. An assessment of the limited data available indicates that median copper concentrations at or just above the hardness-adjusted ANZECC trigger values. While the median concentrations of iron are below the trigger value, the dataset reveals a propensity for increased iron concentrations up to a maximum measured of 1.44 mg/L, which is almost 5- times above the aesthetically-based guideline. As at the upstream site, nickel concentrations downstream in the creek are low and well below the ANZECC trigger value. Of other parameters, a maximum pH recorded (9.3) indicates the possibility of occasional alkaline conditions arising in the creek, outside the ANZECC range, during both pre-and post-construction conditions.

Overall, the water quality data from Blue Gum Creek indicates that the creek is currently 'mildly impaired' in terms of contaminant concentrations and levels recommended by the ANZECC Guidelines for the protection of aquatic ecosystems. The Project's 'Environmental Impact Statement (EIS)' (AECOM, 2014) describes Blue Gum Creek with 'degraded' aquatic habitat and the downstream Darling Mills Creek with 'moderate quality' aquatic habitat.

The non-urban land within Blue Gum Creek sub-catchment could be considered as having moderate habitat conservation value and high aesthetic and visual values, as the creek drains through the Bidjigal Reserve. Along the creek line, native species diversity can be expected to be high within the nature reserve, with areas of good connectivity and retention of natural vegetation. Although only limited surveys were conducted the value of the riparian vegetation could be considered as high, providing refuge habitat for native fauna affected by landscape alterations and developments in the adjacent areas (AECOM, 2014). Ecological and landscape values are likely to decrease in areas where the creek runs close to urbanised and residential areas which are heavily impacted by developments.

Table 7.7 Summary of water quality data for relevant discharge catchment (SW01D)

Table 7.7	SW01D Background (Pre-development) Monitoring 22/08/2014 to 27/05/2015					
SW01D	Samples	Median	80th %ile	90th %ile	Max.	ANZECC[1]
EC (uS/cm]	13	827	901	993	1027	125-2200 200–300[3]
pH	13	7.4	8.2	8.3	8.3	6.6-8.5
Turbidity (NTU)	3	6.8	N/A	N/A	116	6-50
TSS (mg/L)	3	62	N/A	N/A	163	-
Copper (mg/L)	13	0.007	0.013	0.018	0.019	0.005[4]
Nickel (mg/L)	13	0.002	0.003	0.004	0.004	0.043[4]
Iron[2] (mg/L)	13	0.070	0.102	0.116	0.120	0.300
Background (Pre-development) & Construction Monitoring 22/08/2014 to 23/6/2017						
EC (uS/cm]	37	677	978	1288	2270	125-2200 200–300[3]
pH	37	7.7	7.9	8.1	8.3	6.6-8.5
Turbidity (NTU)	26	9	100	417	545	6-50
TSS (mg/L)	27	12	54	145	285	-
Copper (mg/L)	38	0.005	0.009	0.016	0.019	0.006[5]
Nickel (mg/L)	39	0.002	0.002	0.003	0.080	0.044[5]
Iron[2] (mg/L)	38	0.085	0.164	0.180	0.360	0.300

Notes: Table based on data from 'NCX Surface Water Monitoring Register', LLB, 2017a. EC – Electrical Conductivity. TSS – Total Suspended Solids. N/A – Limitation in dataset does not permit statistical analysis.
1 Trigger values for 'slightly-moderately disturbed systems' for freshwater ecosystems, protection of 95% of species;
2 The Canadian guideline level of 0.3 mg/L (CCME, 2016) have been used as an interim indicative level, in the absence of data in ANZECC/ARMCANZ (2000A) Guidelines.
3 Guideline value for NSW coastal rivers.
4 Harness-adjusted for a median hardness of 148 mg $CaCO_3$/L for SW01D pre-development monitoring.
5 Harness-adjusted for a median hardness of 152 mg CaCO3/L for SW01D all monitoring.

Table 7.8 Summary of water quality data for relevant discharge catchment (SW06D)

Table 7.8	SW06D Background (Pre-development) Monitoring 19/09/2014 to 27/05/2015					
SW01D	Samples	Median	80th %ile	90th %ile	Max.	ANZECC[1]
EC (uS/cm]	12	369	557	662	693	125-2200 200-300[3]
pH	12	8.1	8.5	9.1	9.3	6.6-8.0
Turbidity (NTU)	3	4	N/A	N/A	56	6-50
TSS (mg/L)	3	3	N/A	N/A	52	-
Copper (mg/L)	12	0.004	0.007	0.009	0.010	0.0032[4]
Nickel (mg/L)	12	<0.001	<0.001	0.002	0.002	0.025[5]
Iron[2] (mg/L)	11	0.20	0.39	1.23	1.44	0.30
Background (Pre-development) & Construction Monitoring 19/09/2014 to 16/12/2016						
EC (uS/cm]	16	369	569	638	693	125-2200 200-300[3]
pH	16	8.0	8.5	8.8	9.3	6.6-8.0
Turbidity (NTU)	6	2	N/A	N/A	56	6-50
TSS (mg/L)	9	3	6	52	52	-
Copper (mg/L)	18	0.004	0.005	0.008	0.010	0.0045[5]
Nickel (mg/L)	18	0.001	0.001	0.001	0.002	0.036[5]
Iron[2] (mg/L)	16	0.21	0.39	0.72	1.44	0.30

Notes: Table based on data from 'NCX Surface Water Monitoring Register', LLB, 2017a. EC – Electrical Conductivity. TSS – Total Suspended Solids. N/A – Limitation in dataset does not permit statistical analysis.
1 Trigger values for 'slightly-moderately disturbed systems' for freshwater ecosystems, protection of 95% of species;
2 The Canadian guideline level of 0.3 mg/L (CCME, 2016) have been used as an interim indicative level, in the absence of data in ANZECC (2000)ANZECC/ARMCANZ (2000A) Guidelines.
3. Guideline value for NSW coastal rivers.
4 Harness-adjusted for a median hardness of 79 mg $CaCO_3$/L for SW06D pre-development monitoring.
5 Harness-adjusted for a median hardness of 119 mg $CaCO_3$/L for SW01D all monitoring.

7.7.1. Creek Flows

Dry weather

Limited information is available to characterise the flows in Blue Gum Creek (at or around monitoring point SW06) during dry weather. The 'NorthConnex Technical Working Paper: Biodiversity' (Eco Logical Australia, 2013) has described the creek as typically 'slow flowing' with < 0.1 L/s and 80-90% pooling suggesting that in dry weather any discharges would only be marginally diluted.

Wet weather

During wet weather, the creek flow is significant. Major contributors to the creek flow rate are the local Councils' existing stormwater drainage systems, which collect surface run-off water from the catchments of West Pennant Hills, the adjacent M2 Motorway and catchments south of the M2 Motorway. The run-off water is collected in piped systems and then transferred into a channel, which finally discharges to Blue Gum Creek.

The drainage model to estimates pre- and post-development drainage flows within each catchment impacted by the development, as well as the aforementioned drainage channel that leads to Blue Gum Creek. Due to the impacts of the Project on the catchment, post-development flows for the relevant sub-catchments are generally smaller than the pre-development flows. As such, the smaller post-development flows have been considered in this assessment to determine dilution ratios for the tunnel system discharges.

7.7.2. Operational Phase Discharges

Dry weather discharges

Dry weather flows primarily consist of groundwater from the tunnel and at times it may also include minor service water flows. These are typically collected in the LPS and transferred to the WTP for treatment prior discharge to Blue Gum Creek via the council stormwater system. All discharges will meet the nominated water quality targets presented in Table 7.9 below.

The operational phase catchment-specific design specifications have been developed from the median percentile of historic and baseline ambient concentrations for EC and copper while the specifications for aluminium, arsenic, cadmium, chromium, nickel, lead and zinc are based on the ANZECC/ARMCANZ (2000a) trigger values (as adjusted for water harness where appropriate).

Table 7.9 Catchment-specific WTP design specifications– Operational Phase

Monitoring location	Catchment	Electrical conductivity	Copper	Iron[1]	Nickel	Arsenic	Aluminium	Lead	Cadmium	Chromium	Zinc	Manganese	pH	TSS[5]
		µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pH	mg/L
ANZECC/ARMCANZ (2000a) trigger values[2]	-	125–2,200[3] 200–300[4]	0.003[6]	0.30	0.026[6]	0.013	0.055	0.013[6]	0.0005[6]	0.002[6]	0.019[6]	1.9		
Motorway Operations Complex (WTP)	Parramatta River	125 - 356	0.003[6](ANZECC default)	0.30 (ANZECC default)	0.011[7]	0.013 (ANZECC default)	0.055 (ANZECC default)[8]	0.013 (ANZECC default)	0.0005 (ANZECC default)	0.002[6] (ANZECC default)	0.019 (ANZECC default)	1.9 (ANZECC default)	6.5 – 8.0	16

Notes: 1.ANZECC/ARMCANZ (2000a) water quality guideline for recreational purposes.
2.ANZECC/ARMCANZ (2000a) default trigger value for slightly to moderately disturbed aquatic ecosystems.
3.Guideline value for SE Australian lowland rivers.
4.Guideline value for NSW coastal rivers.
5.It is proposed that compliance with the TSS criteria is determined through the measurement of turbidity once a statistical correlation, which identifies the relationship between TSS and turbidity is established. A minimum sample size of 20 will be required to identify if a statistically robust correlation is present.
6.Adjusted for hardness based on the median hardness measured at SW01D, SW06D and SW08D during the pre-construction monitoring of 136 mg $CaCO_3$/L.
7.Hardness adjusted trigger value is 0.026 mg/L. However, left construction WTP design specification unchanged.

Considering, on average, 84.6 mean rain days per year (historic rain days as noted in Table 4-2 of the Project's 'Construction Soil and Water Management Pan', document ALL-LLB-01-0001-QA-PL- 0056, Rev. 06, dated 28/05/2015), and based on historic rainfall data, it is expected that these dry weather discharges occur, on average, 280 days a year.

First flush

The water management system includes provision to capture 400 m3 of tunnel stormwater that is in excess of the treatment capacity. Such capacity is more than adequate to capture the first flush stormwater required 190m3 that will be received into the LPS

Wet weather discharges

Wet weather events vary widely in intensity and duration, resulting in a range of tunnel stormwater qualities and quantities received at the LPS. Not all wet weather events lead to discharges of tunnel stormwater to the environment.

Water balance modelling estimates that discharges of untreated tunnel stormwater to the environment would commence for rain events equivalent to a 1:1 year ARI (Average Reoccurrence Interval), 90 minutes duration event (assuming an anticipated groundwater flow rate of 10 L/s). Such event is equivalent to approximately 36 mm of total rainfall and is herein referred to as 'Design Storm Event'.

Figure 7.1 below shows a graphic representation of which historic storm events would have been captured by the WTS and subsequently treated to the nominated discharge target quality. The graph shows recorded rainfall events in the order of increasing intensity. The graph does not account for dry weather days. From the more than 7,000 rain events recorded over a 68 year period, it is estimated that approximately 6,500 would have been captured by the water management system.

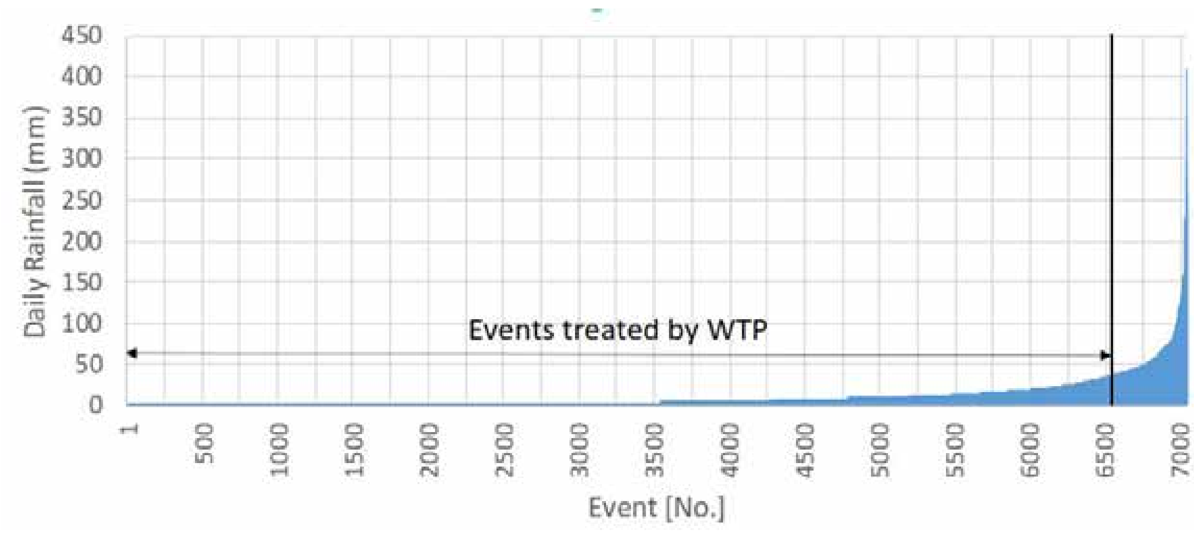


Figure 7.1 Historic rainfall events recorded at West Pennant Hills BOM station

The corresponding percentile rank for the Design Storm Event is estimated as 92.9%. The 'percentile rank' gives an indication of the probability of a rainfall event of a given magnitude (in mm) when considering recorded rain events since 1949 at the Bureau of Methodologies (BOM's) weather station at west Pennant Hills.

Note that the percentile rank relates to recorded rain events, but excludes dry weather days. In order to gain an understanding of the number of days per year an event would have exceeded the Design Storm Event, the number of dry days per year must be known. In accordance with Table 4- 2 of the Project's 'Construction Soil and Water Management Pan', document ALL-LLB-01-0001- QA-PL-0056, LLB, 2015, the mean rain days per year are 84.6.

Based on the above historic data, it is estimated that, on average, the Design Storm event would have been exceeded up to eight times a year, and discharges of untreated tunnel stormwater would have occurred.

Water balance modelling estimated that a worst case water quality would be discharged during low intensity storm events, where rainfall is equivalent to the Design Storm Event. For the purpose of this assessment, the Design Storm is selected as a worst case wet weather event.

In addition, to understand impacts of storms with different severity, a 1:1 year ARI event (270 minutes) and a 1:100 year ARI event (120 minutes) are also assessed.

Details for the selected storm events are summarised in Table 7.10 and Table 7.11 where both the anticipated and maximum groundwater infiltration rates are considered. It is noted that the duration of the bypasses during the more frequent storms would be relatively short term, for example, 3 hours for a 5 year ARI storm (less than or equal to 24 hours duration), 2 hours for a 2 year ARI storm (less than or equal to 24 hours duration) and around 1 hour for a 1 year ARI storm (less than or equal to 24 hours duration).

The 80th-percentile concentrations of arsenic, cadmium, chromium and lead were at or below the analytical limit of reporting (LOR) at the monitoring locations in the pre-construction monitoring samples in Parramatta River catchment. However, the concentrations of copper, nickel, zinc, manganese and iron were often above the LOR.

Table 7.10 Anticipated water quality for selected storm events assuming anticipated groundwater infiltration rate

Table 7.10 Tunnel Stormwater = "Clean" Stormwater + 10 L/s Groundwater			
	1yr ARI 90 min	1yr ARI 270 min	100 yr ARI 120 min
Equivalent Rainfall [1] (mm)	36	59	122
Percentile [2]	92.9%	97.1%	99.3%
Rain days exceeding [3] (d/yr)	6	2.5	0.6
Volume via M2 Bypass (ML)	0.1	0.7	1.8
Duration of Bypass [4] (min)	5	41	106
TSS (mg/L)[5]	47	64	16
EC (mS/cm) [5]	278	268	91
Aluminium (mg/L) [6]	0.1066	0.0769	0.0364
Arsenic (mg/L) [5]	0.0010	0.0008	0.0004
Cadmium (mg/L) [5]	0.0005	0.0003	0.0002
Chromium (mg/L) [5]	0.0047	0.0034	0.0058
Copper (mg/L) [5]	0.0171	0.0126	0.0058
Iron (mg/L) [5]	0.753	0.549	0.257
Lead (mg/L) [5]	0.0408	0.0297	0.0139
Nickel (mg/L) [5]	0.0064	0.0049	0.0022
Zinc (mg/L) [5]	0.0931	0.0683	0.0318

Notes:

[1] Total equivalent collected rainfall during event

[2] Percentile rank for daily rainfall at West Pennant Hills (Cumberland State Forest) BOM station in last 68 years. The 'percentile rank' gives an indication of the probability of a rainfall event of a given magnitude (in mm) when considering recorded rain events since 1949. Note that data set is not continuous over the entire period and there are periods with no records. These periods have been considered as dry weather days.

[3] Based on 84.6 mean rain days per year, as per Table 4-2 of the Project's 'Construction Soil and Water Management Pan', document ALL-LLB-01-0001-QA-PL-0056, Rev. 06, dated 28/05/2015.

[4] Bypasses may occur over a number of periods during the storm event. Duration noted is the total duration of bypasses during the storm

[5] 50%ile concentrations for groundwater quality were used to calculate the tunnel stormwater concentrations. Data sourced from *Groundwater Inflow Quality Analysis,* Golder Associates, 2017.

[6] Aluminium has not been previously included in Golder's assessment of groundwater quality. Subsequent sampling of groundwater by LLB at Wilson Road Tunnel on 24 April 2018 (one sample) indicates that aluminium levels are below the limit of detection (less than 0.01 mg/L). Given the limited dataset for aluminium, for conservatism, the limit of detection has been adopted for the model rather than the typical method of 50% of the limit of detection

Table 7.11 Anticipated water quality for selected storm events assuming max. permissible groundwater infiltration rate

Table 7.11 Tunnel Stormwater = "Clean" Stormwater + 22.5 L/s Groundwater			
	1yr ARI 90 min	1yr ARI 270 min	100 yr ARI 120 min
Equivalent Rainfall [1] (mm)	28	59	122
Percentile [2]	90.3%	97.1%	99.3%
Rain days exceeding [3] (d/yr)	8.2	2.5	0.6
Volume via M2 Bypass (ML)	0.1	0.7	1.8
Duration of Bypass [4] (min)	4	41	106
TSS (mg/L) [5]	69	72	21
EC (mS/cm) [5]	681	555	207
Aluminium (mg/L) [6]	0.1095	0.0703	0.0335
Arsenic (mg/L) [5]	0.0015	0.0011	0.0005
Cadmium (mg/L) [5]	0.0005	0.0003	0.0001
Chromium (mg/L) [5]	0.0052	0.0035	0.0057
Copper (mg/L) [5]	0.0188	0.0124	0.0057
Iron (mg/L) [5]	0.805	0.526	0.247
Lead (mg/L) [5]	0.0434	0.0283	0.0133
Nickel (mg/L) [5]	0.0078	0.0054	0.0024
Zinc (mg/L) [5]	0.1021	0.0675	0.0313

Notes:

[1] Total equivalent collected rainfall during event

[2] Percentile rank for daily rainfall at West Pennant Hills (Cumberland State Forest) BOM station in last 68 years. The 'percentile rank' gives an indication of the probability of a rainfall event of a given magnitude (in mm) when considering recorded rain events since 1949. Note that data set is not continuous over the entire period and there are periods with no records. These periods have been considered as dry weather days.

[3] Based on 84.6 mean rain days per year, as per Table 4-2 of the Project's 'Construction Soil and Water Management Pan', document ALL-LLB-01-0001-QA-PL-0056, Rev. 06, dated 28/05/2015.

[4] Bypasses may occur over a number of periods during the storm event. Duration noted is the total duration of bypasses during the storm

[5] 50%ile concentrations for groundwater quality were used to calculate the tunnel stormwater concentrations. Data sourced from *Groundwater Inflow Quality Analysis,* Golder Associates, 2017.

[6] Aluminium has not been previously included in Golder's assessment of groundwater quality. Subsequent sampling of groundwater by LLB at Wilson Road Tunnel on 24 April 2018 (one sample) indicates that aluminium levels are below the limit of detection (less than 0.01 mg/L). Given the limited dataset for aluminium, for conservatism, the limit of detection has been adopted for the model rather than the typical method of 50% of the limit of detection.

7.7.3. Ecological risk assessment

Under wet weather conditions, urban waterways, such as Blue Gum Creek, would already be collecting large amounts of stormwater from sub-catchments. As a result, the contaminant concentrations depend on the nature of the immediate drainage sub-catchments.

It should be noted that this ecological risk assessment is limited to the consideration of specific contaminants, arising in groundwater, discharged into Blue Gum Creek, which may have an impact on the creek's environment. The assessment is based on pre-development (baseline) and construction phase data ((between 22/08/2014 – 16/12/2016) from the water quality monitoring program, including the background water quality data of the receiving waters and fluctuation over time, in the context of relevant guidelines and practices. More recent construction phase data (between 16/12/2016 – 16/03/2018) indicates raised concentrations for some contaminants, which are not representative of the expected background creek water quality during the tunnel's operational phase, and are therefore, excluded from this assessment.

The water quality of the untreated and collected tunnel stormwater is also reviewed to determine the potential impacts each contaminant may have on the receiving environment.

Methodology

The ANZECC Guidelines for the protection of 95% of species, as applied to 'slightly-to-moderately disturbed' environments can be used to provide a reference for examining the potential impacts of the effluent discharges. However, water quality parameters in many relatively undisturbed systems may occasionally exceed the guidelines. The ANZECC Guidelines are therefore regarded as conservative. Adopting these guidelines, where possible, represents best practice environmental protection of waterways.

The ANZECC Guidelines also recommend, where possible, to use local site specific data to develop trigger values, in preference to the default trigger values (given in Table 7.9).

In addition to ANZECC Guidelines, ecological health risk assessments often use Toxicity Reference Values (TRVs), which have been derived from empirical studies (Sydney Water, 1997). TRV is a general term for any effects threshold value that can be used to estimate a potential risk to organisms exposed to a contaminant. Sometimes, even a water quality guideline criterion, such as those given by ANZECC Guidelines for ecosystem protection, could be used as the TRV for aquatic ecological risk assessments.

In applying the TRV approach, an essential step is to derive a Hazard Quotient (HQ), which represents the ecological risk associated with each contaminant and its concentration in a waterway. The HQ is determined by the concentration of the contaminant in question, in comparison to the TRV for that contaminant, as follows:

$$\text{Hazard Quotient (HQ)} = \frac{\text{Concentration of Contaminant (mg/L)}}{\text{TRV (mg/L)}}$$

In establishing the relevant acute or chronic TRV and determining the HQ (acute or chronic), an assumption is made that the biota will experience a constant exposure to the contaminant (i.e. the contaminant would be 100% bio-available for organisms). However, often this may not be the case because contaminants may:

- Be flushed out by fast flows;
- Settle out of the water column;
- Bind to dissolved matter, including organic ligands and chelators;
- Be detoxified by chemical changes and by biological transformations.

As a result of the above factors, in the case of some metals, dissolved concentrations are regarded as better estimates of what is bioavailable. The resulting HQs are consequently regarded as conservative values.

In this approach, typically, a HQ of greater than 1.0 represents a risk, while a HQ of less than 1.0 signifies a concentration that is not likely to cause an adverse impact.

TRV values for acute and chronic exposure of organisms to the relevant contaminants and constituents in the treated influent were sourced from reference documents (Sydney Water, 1997, Appendices) and from ANZECC Guidelines.

For the purpose of assessing impacts of infrequent wet weather discharges, and noting the short duration of exposure to such discharges, only acute TRVs relevant to this ecological risk assessment have been chosen, and have been based on the five potential contaminants ('ecosystem stressors') that had been nominated as water treatment performance goals (Refer Table 7.9):

1. Electrical conductivity;
2. Total suspended solids; and
3. Metals – aluminium, arsenic, cadmium, chromium, copper, iron, lead, manganese, nickel and zinc.

Electrical Conductivity

Electrical conductivity tends to be high at the discharge location (SW01 median 677 µS/cm). This is within the ANZECC range of 125-2200 µS/cm. The ANZECC Guidelines also indicate that the typical NSW coastal rivers are in the range of 200-300 µS/cm; however, this may still be different for urban creeks. Conductivity above 1500 µS/cm (approximately, a salinity level of 1000 mg/L) is considered as the upper limit, above which freshwater aquatic organisms are likely to be adversely affected.

A discharge criterion of 356 µS/cm, which is the upper limit of NSW coastal rivers, was initially adopted by the Project during the construction phase, so as to improve the quality of the flows in the creek. However, for wet weather discharge, and in absence of any flow related water quality data for the creek, a 90th percentile creek concentration, thus far measured (i.e. 1228 µS/cm, SW01D) was adopted as the acute TRV for the ecological risk assessment.

Total Suspended Solids (TSS)

Suspended solids represent one of the biggest sources of stream water pollution. When suspended particles settle to the bottom of a water body, they become sediments, often referred to as 'silt'. Water with high sediment loads is 'muddy' or turbid in appearance. This is especially evident in streams and rivers, where the force of moving water keeps the sediment particles suspended. Suspended solids consist of an inorganic fraction (small mineral particles, silts, clays, etc.) and an organic fraction (algae, zooplankton, bacteria, and detritus), which are carried along by water as it runs off the land. The inorganic portion is usually considerably greater than the organic. Both contribute to turbidity, or cloudiness of the water.

The geology and vegetation and impervious surfaces of a catchment affect the amount of TSS. If the catchment has steep slopes and is rocky with little plant life, top soil tends to get washed away into the waterway with every rain event. On the other hand, if the catchment has a higher cover of firmly rooted vegetation, such vegetation will act as a sponge to trap water and soil and thereby reduce or eliminate most erosion. Most TSS come from accelerated erosion from agricultural land, logging operations (especially where clear-cutting is practiced), surface mining, and construction sites. Another source of TSS is the re-suspension of sediments, which accompanies dredging or creek alignments that are undertaken in urban catchments.

Higher TSS (>1000 mg/L) may greatly affect water use by limiting light penetration and can limit aquatic life through sedimentation of suspended matter. TSS-levels and fluctuations influence aquatic life, from phytoplankton to fish. Suspended solids can clog fish gills, either killing them or reducing their growth rate. They also decrease light penetration, which reduces the ability of phytoplankton to produce food and oxygen. When the water slows down, such as when it enters a reservoir, the suspended sediment settles out and drops to the bottom. This process, referred to as 'siltation', causes the water to clear, but as the silt or sediment settles out it may change aquatic life at the bottom. The silt may smother bottom-dwelling organisms, cover breeding areas, and smother eggs.

Indirectly, the suspended solids affect other water quality parameters, such as temperature and dissolved oxygen. Because of the greater heat absorbency of the particulate matter, the surface water becomes warmer and this tends to stabilize the stratification (layering) in stream pools, embayments, and reservoirs. This, in turn, interferes with mixing, decreasing the dispersion of oxygen and nutrients to deeper layers. In river basins where erosion is a serious problem, suspended solids can blanket the river or stream bed, thereby destroying fish habitat.

TSS, especially when the individual particles are small (< 63 µm), carry many substances that are harmful or toxic. As a result, suspended particles are often the primary carrier of these pollutants to lakes and to coastal zones of oceans where they settle. In rivers, lakes and coastal zones these fine particles are a food source for filter feeders which are part of the food chain, leading to biomagnification of chemical pollutants in fish and, ultimately, in man.

There are no quantitative criteria for TSS in ANZECC Guidelines. However, in the USA, the Water Quality Standards for aquatic life state that suspended solids '…shall not be changed to the extent that the indigenous aquatic community is adversely affected…' and '…the addition of settleable solids that may adversely alter the stream bottom is prohibited….'

In the USA, the US National Academy of Sciences has recommended that TSS concentration should not reduce light penetration by more than 10%. In a study conducted in the State of Kentucky, when TSS was increased to 80 mg/L, the macroinvertebrate population decreased by 60% (Commonwealth of Kentucky, 2017). In the absence of an ANZECC Guideline for TSS, the 80 mg/L trigger was used in this assessment.

Metals

Several metals are likely to occur as contaminants in the tunnel groundwater and (first flush) stormwater. These include aluminium (Al), arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), iron (Fe), lead (Pb), manganese (Mn), nickel (Ni) and zinc (Zn). As a result of stormwater collected from the existing urban catchments, many of these metals are also present in Blue Gum Creek (the receiving water). Metal concentrations in waterways typically vary greatly, and are largely reflective of the immediate local drainage sub-catchments.

During dry weather and low intensity/short duration rainfall, the water treatment plant (WTP) is expected to remove these metals to sufficiently low concentrations to enable discharge to Blue Gum Creek without causing any significant downstream environmental impacts.

During high intensity/long duration wet weather events, flows may overflow from the buffer tank system and bypass the WTP untreated to Blue Gum Creek via the M2 Bypass. The potential downstream environmental impacts of metals and metalloids on Blue Gum Creek are assessed in the following sections.

Aluminium (Al)

Aluminium is found as a normal constituent of soil, plants and animal tissues. Varying amounts of Al are present naturally in groundwater and surface water. Based on US data, ANZECC (2000) and references therein indicate that the amount of Al in surface water could range from 0.012 to 2.25 mg/L in rivers. Because Al is ubiquitous in the environment and is used in a variety of manufactured products and processes, daily exposure of aquatic organisms to Al in urban catchments is regarded as inevitable.

Aluminium's low solubility around neutral pH values generally prevents it from being present as a dissolved species at high concentration in most oxygenated surface waters. However, acidic conditions (low pH) lead to dissolution of Al from minerals.

Aluminium toxicity depends on the species of Al present (cationic, anionic or neutral) in water, and this is affected by pH and the presence of complexing ligands, such as fluoride, sulphate and dissolved organic materials in the water. Organic ligands, particularly humic acids, which are very common in natural waters, form complexes with Al and this complexation is known to ameliorate the bioavailability of Al, and hence, reduce potential toxicity of Al to biological organisms (CCREM, 1987[1]; Driscoll & Letterman, 1995)[2]. Because Al is only sparingly soluble at pH 6.0 to 8.0, its bioavailability would be quite low at pH ranges around or above neutral. In contrast, when pH in a waterway falls below about 5.0, Al would become available for uptake by both animals and plants, and can potentially be quite toxic to a range of organisms.

Factors, such as temperature, pH, types and concentrations of dissolved materials, as well as the types of particulate matter present, influence the amount and nature of residual Al that would be left after coagulation, filtration and removal, during the water treatment process. It is assumed that any flocculant dosing (e.g. alum) at the NorthConnex WTP will be sufficiently removed by subsequent treatment processes such as reverse osmosis filtration. Concentrations of Al in the finished water above 0.3 mg/L usually reflect a lack of optimization in the coagulation, sedimentation or filtration stages of treatment.

The ANZECC (2000) Guidelines propose a moderately-reliable trigger value of 0.055 mg/L for Al for freshwater ecosystem protection (95% of species). This trigger value is for neutral or slightly alkaline water (pH>6.5) and was adopted as the TRV for the ecological risk assessment.

Arsenic (As)

Arsenic is released into the environment naturally by weathering of arsenic-containing rocks and volcanic activity. However, the amount of arsenic released as a result of human activities is about twice that from weathering (ANZECC, 2000, and references therein). Arsenic occurs in natural waters in several valency states, depending upon the redox potential and pH, the two most common being As (III) and As (V). Both these forms can combine with carbon, resulting in numerous, highly stable, organo-arsenic compounds, some of which are quite toxic to plants and animals.

The ANZECC trigger value for As is 0.013 mg/L for As (V), which is more toxic to animals and plants, including phytoplankton, than As (III). The ANZECC trigger value for As (III) is slightly higher at 0.024 mg/L. The lower guideline (0.013 mg/L), reflecting a potentially more toxic concentration, was adopted as the acute TRV to assess the wet weather discharges.

Cadmium (Cd)

In natural surface waters, cadmium occurs predominantly as Cd^{2+} form, comprising several inorganic and organic compounds (ANZECC, 2000 and references therein). The solubility of dissolved cadmium decreases with increasing pH and alkalinity (buffering capacity of water). Low background levels of cadmium are found in many natural waters.

---

[1] CCREM (1987). (Canadian Council of Resource and Environment Ministers). Canadian Water Quality Guidelines. Task Force on Water Quality Guidelines. Ottawa, Canada.

[2] Driscoll, C. T. & Letterman, R. D. (1995). Factors regulating residual Aluminium concentrations in treated waters. Environmetrics, 3: 287-309.

Cadmium is known to be accumulated by a number of aquatic organisms, with bio-concentration known to be in the order of 100-100,000-fold. Cadmium toxicity is hardness–dependent. Cadmium is less toxic in freshwater at lower pH, although toxicity is also reduced above pH 8.

Dissolved Organic Matter (DOM) reduces Cd toxicity by complexation, which is usually greatest under conditions of low hardness and alkalinity, neutral pH and high natural DOM. Cadmium is absorbed strongly by suspended material, with both inorganic and/or organic ligands, generally reducing bio-availability, and hence, toxicity.

The ANZECC trigger value for Cd is 0.0002 mg/L, a low concentration, which was adopted as the acute TRV to assess the wet weather discharges. This guideline is for water of low buffering capacity (alkalinity 30 mg/L).

Chromium (Cr III, Cr IV)

In natural waters, chromium is present mainly in the trivalent Cr (III) and hexavalent Cr (VI) forms (ANZECC, 2000 and references therein). The form of chromium significantly affects its behaviour in the aquatic environment and toxicity to aquatic organisms. Precipitation of $Cr(OH)_3$ is considered to be the dominant removal mechanism for Cr (III) in natural water. Cr (III) is much less toxic than Cr (VI). The toxicity of both forms decreases with increasing water hardness and alkalinity. Studies in lake water have also shown that the ratio of Cr (III) to Cr (VI) is affected by the amount of organic matter and dissolved oxygen. While Cr (III) is reduced by organic matter, Cr (VI) is quite soluble, existing in solution as a complex anion, and not greatly reduced by organic matter. Bio-concentration of Cr is also known to occur in some organisms, in some cases, between 100 and 1000-fold (CCREM, 1987).

The ANZECC trigger value with high reliability for Cr (VI), which is the more toxic form, is 0.001 mg/L, which was adopted for the ecological risk assessment.

Copper (Cu)

Copper is toxic to many organisms, including fungi, bacteria and viruses. Copper is commonly found as Cu (II) in natural waters and the free Cu (II) ion is potentially very toxic to aquatic life, both acutely and chronically. Its toxicity increases with decreasing water hardness and dissolved oxygen concentration, and decreases with high concentrations of DOM and suspended solids. Alkalinity and pH are other factors that influence copper toxicity. Copper is normally complexed in soil, greatly diminishing its toxicity. No environmental data are available on the short-term and the long-term effects of copper to plants, birds, or land animals.

The ANZECC trigger value for copper is 0.0014 mg/L, which is lower than the copper concentration at SW01D (0.0178 mg/L). The nominated discharge criterion is set to 0.004 mg/L. However, during wet weather scenarios this discharge criterion could be relaxed due to increased dilution achieved in the creek itself. Using the concept of the TRVs (refer to Sydney Water, 1997, which adopted the USEPA 1994 data), a wet weather copper concentration of 0.00782 was selected as the acute TRV for the ecological risk assessment.

Iron (Fe)

Iron is the fourth most abundant element in the Earth's crust and is often a major constituent of clay soils, particularly abundant in Australia. Iron is also present in natural waters in varying quantities, depending up on the geology of the area and other chemical components of a given waterway. The most common oxidisation states of iron in water are the ferrous (Fe^{2+}) and the ferric (Fe^{3+}) states, although other forms may be present in organic and inorganic wastewater streams.

In well-oxygenated surface waters, iron is generally present in the oxidised, ferric (Fe^{3+}) state; in water with low dissolved oxygen (reducing waters), the ferrous form (Fe^{2+}) can persist. For the purpose of the ecological risk assessment, iron is assumed to be present in the Fe^{3+} (ferric) form, due to potentially prolonged exposure to oxygen within the tunnel drainage and collection system, and within the process elements of the WTP.

Of primary biological importance is waterways is the insoluble Ferric; suspended flocs of Ferric can often cause problems with turbidity, decreased light penetration and smothering of benthic organisms. Such flocs (yellow and orange coloured) are sometimes seen in stagnant water pools and in other wetland situations, such as rice fields.

The total iron concentrations in freshwater can be very high (100 mg/L or more) since they are associated with suspended soil particles. Groundwater can have high concentrations of dissolved iron, which can be as high as 20 mg/L. Sediment pore water concentrations in mining areas can have very high concentrations of dissolved iron (Fe^{2+}) – up to 2000 mg/L (see CCME, 2008[3] and references therein).

There is no ANZECC trigger value for iron; however, the Canadian Guidelines is 0.3 mg/L (CCME, 2008). Such a value appears appropriate as a dry weather discharge criterion. During wet weather scenarios, this discharge criterion could be relaxed due to the increased dilution achieved in the creek itself. As such, for the purpose of the ecological risk assessment, an iron concentration of 1.0 mg/L was selected as an acute TRV for wet weather discharges.

Lead (Pb)

Lead reaches the aquatic environment through precipitation, fall-out of lead dust, street runoff and industrial and municipal wastewater discharges. Lead is generally present in very low concentrations in natural waters. In fresh water, the main forms of lead are $PbCO_3$ and lead-organic complexes, with very much smaller amounts of free lead ions. Lead mostly occurs in the Pb^{2+} and Pb^{4+} valency states, although elemental lead is also relatively soluble in low hardness and low pH water. Water hardness, alkalinity and pH, therefore, plays a significant role in the input of Pb into the aquatic environment.

The uptake and toxicity of lead in freshwater organisms generally decreases with increasing water hardness and alkalinity. Lead toxicity in the water is reduced by low solubility of many forms of lead, particularly in alkaline waters. Lead is also strongly complexed by Dissolved Organic Matter (DOM) in most natural waters, as it is adsorbed strongly by suspended clay, humic substances and other suspended material.

The ANZECC trigger value for Pb is 0.0034 mg/L, which was adopted as the acute TRV to assess the wet weather discharges. This guideline is for water with low buffering capacity (alkalinity 30 mg/L).

Manganese (Mn)

Manganese is most commonly found as the oxide, MnO_2. Manganese is also an essential trace element for microorganisms, plants and animals, and some organisms are known to bio-concentrate it up to 4-orders of magnitude, possibly to facilitate essential uses. Manganese is present in natural waters in suspended form (similar to iron) although soluble forms may persist at low pH or low DO. Manganese toxicity is generally regarded as low compared to other trace metal toxicants in waterways. Therefore the ecological risk assessment excluded manganese, because it is not considered a major toxicant in most natural waterways.

Nickel (Ni)

Nickel can enter the environment naturally through weathering of minerals and rocks, and through anthropogenic sources. More than 90% of the Ni in the aquatic environment is associated with particulate matter of sediments (ANZECC, 2000 and references therein). Nickel is typically found at low background concentrations as Ni^{2+} in most natural waters. Nickel is an essential trace element for aquatic organisms; however, it may be toxic at higher concentrations. Nickel dissolution in water increases with low pH (acidic) conditions.

The ANZECC trigger value for Nickel is 0.011 mg/L, which was adopted as the acute TRV to assess wet weather discharges.

---

[3] CCME (2008). Canadian Council of Ministers of the Environment. CCME Canadian Water Quality Guidelines. Nov, 2008.

Zinc (Zn)

Zinc can enter the environment from both natural processes (e.g. weathering and erosion) and anthropogenic (e.g. zinc production, waste incineration, urban runoff) processes (ANZECC, 2000). Zinc is an essential trace element required by most organisms for their growth and development. It is found in most natural waters at low concentrations. In natural waters at pH around 8.5, the predominant species is Zn^{2+} and there is consensus Zn toxicity to aquatic organisms is pH dependent (toxicity decreases from pH 8.0 to about pH 4.0).

At alkaline pH (>8.0), Zn^{2+} easily forms complexes with Dissolved Organic Matter (DOM) and commonly exists as complexes (i.e. Zn-DOM) or insoluble forms ($ZnOH^{+}$; $ZnCO_3$; or particularly, in the presence of sulfides, insoluble ZnS). The stability of these Zn forms are dependent on pH, water hardness (determined largely by concentrations of Ca^{2+} and Mg^{2+}) and alkalinity.

The ANZECC trigger value for Zn is 0.008 mg/L, which was adopted as the acute TRV to assess the wet weather discharges. It should be noted that this guideline is also for water of low buffering capacity (alkalinity 30 mg/L).

7.7.4. Risk assessment – Dry weather

During dry weather, the level of treatment provided at the WTP will ensure meeting the nominated performance goals (Table 7.9). If these are met, it would be reasonable to expect some improvement of the water quality of the receiving waterways, relative to its current, ambient condition.

7.7.5. Risk assessment - Design Storm Event

For storm events less severe than the Design Storm Event (1:1 year ARI, 90 min.), all tunnel stormwater will be collected by the WTS and subsequently treated (assuming a groundwater infiltration rate of 10 L/s). The level of treatment provided at the WTP will ensure meeting the nominated performance goals (Table 7.9). If these are met, it would be reasonable to expect some improvement of the water quality of the receiving waterways, relative to its current, ambient condition.

7.7.6. Risk assessment - Wet weather

In considering the wet weather discharges, three scenarios were assessed during which untreated tunnel stormwater may be directly discharged into the creek.

These events were:

- 1-year ARI, ≤ 90 minutes duration (selected worst case - Note that for a groundwater flowrate of 22.5 L/s overflows may commence at storm events exceeding 1:1 year ARI with a duration of 60 minutes).
- 1-year ARI, 270 minute duration.
- 100-year ARI, 120 minute duration (representative of high-intensity event).

For each of these scenarios, the two groundwater infiltration rates were assessed:

- 10 L/s, or 0.5 L/s/km (estimated likely flowrate at commencement of operation).
- 22.5 L/s, or 1 L/s/km (max. permissible groundwater infiltration rate as per CoA B12).

The concentrations of most of the ecosystem stressors (EC, TSS, and metals – Al, As, Cd, Cr, Cu, Fe, Pb, Ni and Zn) will be diluted in the catchment downstream of the discharge point and the creek itself. The estimated dilution ratios are shown in Tables 7.12, 7.13, 7.14 and 7.15. During the selected 1:1 year ARI event, dilution would occur in the catchment downstream of the discharge point and the creek itself (estimated to be, most likely, 12:1 (Ratio environmental flows: discharges) at SW01 and 50:1 at SW06). Significant dilution would occur during intense wet weather events, such as the selected 100-year ARI event (estimated to be, most likely, 50:1 at SW01 and 220:1 at SW06).

Using the relevant TRV (acute exposure trigger values for protection of species was considered, as water would be flowing fast in wet weather events and hence the exposure to the contaminant is limited), the concentrations of each stressor, after mixing and dilution in the creek, were used to estimate the HQ. The results are presented in Table 7.12 and Table 7.13. The assessment was carried out for creek water at or near the discharge point location (close to the water quality sampling site SW01) and approximately, 1.6 km downstream at Blue Gum Creek (sampling site SW06).

As presented in the ecological risk assessment, concentrations of some contaminants are elevated, indicating potential ecological risks to the downstream creek environment. A summary of the key findings are presented in Tables 7.16 and 7.17. The results are discussed below, with particular emphasis on the contaminants with elevated ecological risk profiles.

Table 7.12 Assessment for untreated discharges of tunnel stormwater based on potential groundwater flows at 10 L/s at discharge point (SW01D)

Storm Event	Contaminant	Creek Quality[1] (90th %ile)	Discharge Quality	Dilution in Catchment [2]	Creek quality after mixing	Acute TRV	ANZECC Guideline [3]	Guideline chosen	Acute HQ after mixing
1 Year ARI 90 min	TSS (mg/L)	123	47	12 : 1	117	80	N/A	80	1.5
	EC (mS/cm)	1069	278		1009	1288	2200	1288	0.8
	Aluminium (mg/L) [4]	0.1200	0.1066		0.1190	0.750	0.0550	0.0550	2.2
	Arsenic (mg/L)	0.0010	0.0010		0.0010	0.360	0.0130	0.0130	0.1
	Cadmium (mg/L)	0.0001	0.0005		0.0001	0.0011	0.0002	0.0002	0.6
	Chromium (mg/L)	0.0010	0.0047		0.0013	0.0016	0.0010	0.0010	1.3
	Copper (mg/L)	0.0166	0.0171		0.0166	0.00782	0.0014	0.0078	2.1
	Iron (mg/L)	0.193	0.753		0.236	1.000	N/A	1.000	0.2
	Lead (mg/L)	0.0008	0.0408		0.0039	0.0199	0.0034	0.0034	1.1
	Nickel (mg/L)	0.0030	0.0064		0.0033	0.0110	0.0110	0.0110	0.3
	Zinc (mg/L)	0.0994	0.0931		0.0989	0.0457	0.0080	0.0080	12.4
1 Year ARI 270 min	TSS (mg/L)	123	64	8 : 1	116	80	N/A	80	1.5
	EC (mS/cm)	1069	268		980	1288	2200	1288	0.8
	Aluminium (mg/L) [4]	0.1200	0.0769		0.1152	0.750	0.0550	0.0550	2.1
	Arsenic (mg/L)	0.0010	0.0008		0.0010	0.360	0.0130	0.0130	0.1
	Cadmium (mg/L)	0.0001	0.0003		0.0001	0.0011	0.0002	0.0002	0.6
	Chromium (mg/L)	0.0010	0.0034		0.0013	0.0016	0.0010	0.0010	1.3
	Copper (mg/L)	0.0166	0.0126		0.0162	0.00782	0.0014	0.0078	2.1
	Iron (mg/L)	0.193	0.549		0.233	1.000	N/A	1.000	0.2
	Lead (mg/L)	0.0008	0.0297		0.0040	0.0199	0.0034	0.0034	1.2
	Nickel (mg/L)	0.0030	0.0049		0.0032	0.0110	0.0110	0.0110	0.3
	Zinc (mg/L)	0.0994	0.0683		0.0959	0.0457	0.0080	0.0080	12.0
100 Year ARI 120 min	TSS (mg/L)	123	16	50 : 1	121	80	N/A	80	1.5
	EC (mS/cm)	1069	91		1050	1288	2200	1288	0.8
	Aluminium (mg/L) [4]	0.1200	0.0364		0.1184	0.750	0.0550	0.0550	2.2
	Arsenic (mg/L)	0.0010	0.0004		0.0010	0.360	0.0130	0.0130	0.1
	Cadmium (mg/L)	0.0001	0.0002		0.0001	0.0011	0.0002	0.0002	0.5
	Chromium (mg/L)	0.0010	0.0058		0.0011	0.0016	0.0010	0.0010	1.1
	Copper (mg/L)	0.0166	0.0058		0.0164	0.00782	0.0014	0.0078	2.1
	Iron (mg/L)	0.193	0.257		0.194	1.000	N/A	1.000	0.2
	Lead (mg/L)	0.0008	0.0139		0.0011	0.0199	0.0034	0.0034	0.3
	Nickel (mg/L)	0.0030	0.0022		0.0030	0.0110	0.0110	0.0110	0.3
	Zinc (mg/L)	0.0994	0.0318		0.0981	0.0457	0.0080	0.0080	12.3

Notes: [1].Measurements of creek quality below detection level are given the value of 50% of the minimum detected value

[2] Ratio Environmental flows: discharges. Ratio derived for 1:1 yr 270 min and 1:100 yr, 120 min from ASJV drainage estimates and water balance model discharge flows. In lieu of any drainage data, 1:1 yr, 90 min ratio assumed to be equivalent to 1:1 yr, 270 min event.

[3]. ANZECC Guidelines (2000), 95% Protection of Species or USA EPA TSS Guidance. Cells shaded green indicate acceptable HQ<1.0; cells shaded amber indicate HQ>1.0 potential environmental risks.

[4]. Aluminium concentration in the creek is based on one sample and therefore represents the maximum.

Table 7.13 Assessment for untreated discharges of tunnel stormwater based on potential groundwater flows at 10 L/s at downstream site (SW06D)

Storm Event	Contaminant	Creek Quality[1] (90th %ile)	Discharge Quality	Dilution in Catchment [2]	Creek quality after mixing	Acute TRV	ANZECC Guideline [3]	Guideline chosen	Acute HQ after mixing
1 Year ARI 90 min	TSS (mg/L)	52	47	50 : 1	52	80	N/A	80	0.6
	EC (mS/cm)	638	278		611	1288	2200	1288	0.5
	Aluminium (mg/L)[4]	0.1200	0.1066		0.1190	0.750	0.0550	0.0550	2.2
	Arsenic (mg/L)	0.0007	0.0010		0.0007	0.360	0.0130	0.0130	0.1
	Cadmium (mg/L)	0.0001	0.0005		0.0001	0.0011	0.0002	0.0002	0.4
	Chromium (mg/L)	0.0008	0.0047		0.0011	0.0016	0.0010	0.0010	1.1
	Copper (mg/L)	0.0082	0.0171		0.0089	0.00782	0.0014	0.0078	1.1
	Iron (mg/L)	0.719	0.753		0.722	1.000	N/A	1.000	0.7
	Lead (mg/L)	0.0011	0.0408		0.0051	0.0199	0.0034	0.0034	1.2
	Nickel (mg/L)	0.0021	0.0064		0.0015	0.0110	0.0110	0.0110	0.2
	Zinc (mg/L)	0.0434	0.0931		0.0472	0.0457	0.0080	0.0080	5.9
1 Year ARI 270 min	TSS (mg/L)	52	64	34 : 1	53	80	N/A	80	0.7
	EC (mS/cm)	638	268		597	1288	2200	1288	0.5
	Aluminium (mg/L)[4]	0.1200	0.0769		0.1152	0.750	0.0550	0.0550	2.1
	Arsenic (mg/L)	0.0007	0.0008		0.0007	0.360	0.0130	0.0130	0.1
	Cadmium (mg/L)	0.0001	0.0003		0.0001	0.0011	0.0002	0.0002	0.4
	Chromium (mg/L)	0.0008	0.0034		0.0010	0.0016	0.0010	0.0010	1.0
	Copper (mg/L)	0.0082	0.0126		0.0087	0.00782	0.0014	0.0078	1.1
	Iron (mg/L)	0.719	0.549		0.700	1.000	N/A	1.000	0.7
	Lead (mg/L)	0.0011	0.0297		0.0052	0.0199	0.0034	0.0034	1.3
	Nickel (mg/L)	0.0021	0.0049		0.0015	0.0110	0.0110	0.0110	0.2
	Zinc (mg/L)	0.0434	0.0683		0.0462	0.0457	0.0080	0.0080	5.8
100 Year ARI 120 min	TSS (mg/L)	52	16	220 : 1	51	80	N/A	80	0.6
	EC (mS/cm)	638	91		628	1288	2200	1288	0.5
	Aluminium (mg/L)[4]	0.1200	0.0364		0.1184	0.750	0.0550	0.0550	2.2
	Arsenic (mg/L)	0.0007	0.0004		0.0006	0.360	0.0130	0.0130	0.0
	Cadmium (mg/L)	0.0001	0.0002		0.0001	0.0011	0.0002	0.0002	0.3
	Chromium (mg/L)	0.0008	0.0058		0.0008	0.0016	0.0010	0.0010	0.8
	Copper (mg/L)	0.0082	0.0058		0.0082	0.00782	0.0014	0.0078	1.0
	Iron (mg/L)	0.719	0.257		0.710	1.000	N/A	1.000	0.7
	Lead (mg/L)	0.0011	0.0139		0.0023	0.0199	0.0034	0.0034	0.4
	Nickel (mg/L)	0.0021	0.0022		0.0011	0.0110	0.0110	0.0110	0.2
	Zinc (mg/L)	0.0434	0.0318		0.0432	0.0457	0.0080	0.0080	5.4

Notes: Refer below Table 7.12

Table 7.14 Assessment for untreated discharges of tunnel stormwater based on upper groundwater flows at 22.5 L/s at discharge point (SW01D)

Storm Event	Contaminant	Creek Quality[1] (90th %ile)	Discharge Quality	Dilution in Catchment [2]	Creek quality after mixing	Acute TRV	ANZECC Guideline [3]	Guideline chosen	Acute HQ after mixing
1 Year ARI 60 min	TSS (mg/L)	123	69	12 : 1	118	80	N/A	80	1.5
	EC (mS/cm)	1069	681		1040	1288	2200	1288	0.8
	Aluminium (mg/L) [4]	0.1200	0.1095		0.1192	0.750	0.0550	0.0550	2.2
	Arsenic (mg/L)	0.0010	0.0015		0.0010	0.360	0.0130	0.0130	0.1
	Cadmium (mg/L)	0.0001	0.0005		0.0001	0.0011	0.0002	0.0002	0.6
	Chromium (mg/L)	0.0010	0.0052		0.0013	0.0016	0.0010	0.0010	1.3
	Copper (mg/L)	0.0166	0.0188		0.0168	0.00782	0.0014	0.0078	2.1
	Iron (mg/L)	0.193	0.805		0.240	1.000	N/A	1.000	0.2
	Lead (mg/L)	0.0008	0.0434		0.0041	0.0199	0.0034	0.0034	1.2
	Nickel (mg/L)	0.0030	0.0078		0.0034	0.0110	0.0110	0.0110	0.3
	Zinc (mg/L)	0.0994	0.1021		0.0996	0.0457	0.0080	0.0080	12.5
1 Year ARI 270 min	TSS (mg/L)	123	72	8 : 1	117	80	N/A	80	1.5
	EC (mS/cm)	1069	555		1012	1288	2200	1288	0.8
	Aluminium (mg/L) [4]	0.1200	0.0703		0.1145	0.750	0.0550	0.0550	2.1
	Arsenic (mg/L)	0.0010	0.0703		0.0087	0.360	0.0130	0.0130	0.7
	Cadmium (mg/L)	0.0001	0.0003		0.0001	0.0011	0.0002	0.0002	0.6
	Chromium (mg/L)	0.0010	0.0035		0.0013	0.0016	0.0010	0.0010	1.3
	Copper (mg/L)	0.0166	0.0124		0.0161	0.00782	0.0014	0.0078	2.1
	Iron (mg/L)	0.193	0.526		0.230	1.000	N/A	1.000	0.2
	Lead (mg/L)	0.0008	0.0283		0.0039	0.0199	0.0034	0.0034	1.1
	Nickel (mg/L)	0.0030	0.0054		0.0033	0.0110	0.0110	0.0110	0.3
	Zinc (mg/L)	0.0994	0.0675		0.0959	0.0457	0.0080	0.0080	12.0
100 Year ARI 120 min	TSS (mg/L)	123	21	50 : 1	121	80	N/A	80	1.5
	EC (mS/cm)	1069	207		1052	1288	2200	1288	0.8
	Aluminium (mg/L) [4]	0.1200	0.0335		0.1183	0.750	0.0550	0.0550	2.2
	Arsenic (mg/L)	0.0010	0.0005		0.0010	0.360	0.0130	0.0130	0.1
	Cadmium (mg/L)	0.0001	0.0001		0.0001	0.0011	0.0002	0.0002	0.5
	Chromium (mg/L)	0.0010	0.0057		0.0011	0.0016	0.0010	0.0010	1.1
	Copper (mg/L)	0.0166	0.0057		0.0164	0.00782	0.0014	0.0078	2.1
	Iron (mg/L)	0.193	0.247		0.194	1.000	N/A	1.000	0.2
	Lead (mg/L)	0.0008	0.0133		0.0010	0.0199	0.0034	0.0034	0.3
	Nickel (mg/L)	0.0030	0.0024		0.0030	0.0110	0.0110	0.0110	0.3
	Zinc (mg/L)	0.0994	0.0313		0.0981	0.0457	0.0080	0.0080	12.3

Notes: Refer below Table 7.12

Table 7.15 Assessment for untreated discharges of tunnel stormwater based on potential groundwater flows at 22.5 L/s at downstream site (SW06D)

Storm Event	Contaminant	Creek Quality[1] (90th %ile)	Discharge Quality	Dilution in Catchment [2]	Creek quality after mixing	Acute TRV	ANZECC Guideline [3]	Guideline chosen	Acute HQ after mixing
1 Year ARI 60 min	TSS (mg/L)	52	69	50 : 1	53	80	N/A	80	0.7
	EC (mS/cm)	638	681		642	1288	2200	1288	0.5
	Aluminium (mg/L)[4]	0.1200	0.1095		0.1192	0.750	0.0550	0.0550	2.2
	Arsenic (mg/L)	0.0007	0.0015		0.0007	0.360	0.0130	0.0130	0.1
	Cadmium (mg/L)	0.0001	0.0005		0.0001	0.0011	0.0002	0.0002	0.4
	Chromium (mg/L)	0.0008	0.0052		0.0011	0.0016	0.0010	0.0010	1.1
	Copper (mg/L)	0.0082	0.0188		0.0090	0.00782	0.0014	0.0078	1.2
	Iron (mg/L)	0.719	0.805		0.726	1.000	N/A	1.000	0.7
	Lead (mg/L)	0.0011	0.0434		0.0053	0.0199	0.0034	0.0034	1.3
	Nickel (mg/L)	0.0021	0.0078		0.0016	0.0110	0.0110	0.0110	0.2
	Zinc (mg/L)	0.0434	0.1021		0.0479	0.0457	0.0080	0.0080	6.0
1 Year ARI 270 min	TSS (mg/L)	52	72	34 : 1	54	80	N/A	80	0.7
	EC (mS/cm)	638	555		629	1288	2200	1288	0.5
	Aluminium (mg/L) [4]	0.1200	0.0703		0.1145	0.750	0.0550	0.0550	2.1
	Arsenic (mg/L)	0.0007	0.0703		0.0084	0.360	0.0130	0.0130	0.6
	Cadmium (mg/L)	0.0001	0.0003		0.0001	0.0011	0.0002	0.0002	0.4
	Chromium (mg/L)	0.0008	0.0035		0.0011	0.0016	0.0010	0.0010	1.1
	Copper (mg/L)	0.0082	0.0124		0.0087	0.00782	0.0014	0.0078	1.1
	Iron (mg/L)	0.719	0.526		0.698	1.000	N/A	1.000	0.7
	Lead (mg/L)	0.0011	0.0283		0.0050	0.0199	0.0034	0.0034	1.2
	Nickel (mg/L)	0.0021	0.0054		0.0016	0.0110	0.0110	0.0110	0.2
	Zinc (mg/L)	0.0434	0.0675		0.0461	0.0457	0.0080	0.0080	5.8
100 Year ARI 120 min	TSS (mg/L)	52	21	220 : 1	51	80	N/A	80	0.6
	EC (mS/cm)	638	207		630	1288	2200	1288	0.5
	Aluminium (mg/L) [4]	0.1200	0.0335		0.1183	0.750	0.0550	0.0550	2.2
	Arsenic (mg/L)	0.0007	0.0005		0.0006	0.360	0.0130	0.0130	0.0
	Cadmium (mg/L)	0.0001	0.0001		0.0001	0.0011	0.0002	0.0002	0.3
	Chromium (mg/L)	0.0008	0.0057		0.0008	0.0016	0.0010	0.0010	0.8
	Copper (mg/L)	0.0082	0.0057		0.0082	0.00782	0.0014	0.0078	1.0
	Iron (mg/L)	0.719	0.247		0.710	1.000	N/A	1.000	0.7
	Lead (mg/L)	0.0011	0.0133		0.0023	0.0199	0.0034	0.0034	0.4
	Nickel (mg/L)	0.0021	0.0024		0.0011	0.0110	0.0110	0.0110	0.2
	Zinc (mg/L)	0.0434	0.0313		0.0432	0.0457	0.0080	0.0080	5.4

Notes: Refer below Table 7.12

Table 7.16 Summary of conclusions on discharging under wet weather, with potential groundwater flows of 10 L/s for contaminants with HQ ≥1.0

Criteria	Storm Event	Percentile[1] [%]	Volume[2] [ML]	Duration [3] [min]	Creek Dilution [4]	Creek HQ (SW01)	Creek HQ (SW06)	At Discharge Point (SW01)	At Blue Gum Creek (SW06)
Aluminium	1 Year ARI, 90 min.	92.9	0.1	5	16:1	2.2	2.2	Elevated HQ and some ecological risk; partly due to ambient Al levels being already quite high in the creek; effects are likely to be attenuated by infrequent occurrence and only limited volume being discharged over short period of time. Dilution of Al is also likely in the creek.	Elevated HQ and some ecological risk, partly due to ambient Al levels being already quite high in the creek; effects are likely to be attenuated by infrequent occurrence and only limited volume being discharged over short period of time. Dilution of Al is also likely in the creek.
	1 Year ARI, 270 min	97.1	0.7	41	16:1	2.1	2.1		
	100 Year ARI, 120 min	99.3	1.8	106	60:1	2.2	2.2		
IronChromium	1 Year ARI, 90 min.	92.9	0.1	5	16:1	1.3	< 1.1	HQ below 1.0; significant dilution in the creek; therefore no ecological risk at discharge point Slightly elevated HQ and some ecological risk, partly due to ambient Cr levels being already high in the creek; effects are likely to be attenuated by infrequent occurrence and only limited volume being discharged over short period of time. Dilution of Cr is also likely in the creek.	HQ below 1.0; due to significant dilution in the creek; therefore, no ecological risk of Iron at the downstream Blue Gum Creek site Slightly elevated HQ and some ecological risk, partly due to ambient Cr levels being already high in the creek; effects are likely to be attenuated by infrequent occurrence and only limited volume being discharged over short period of time. Dilution of Cr is also likely in the creek.
	1 Year ARI, 270 min	97.1	0.7	41	16:1	< 1.3	1.0		
	100 Year ARI, 120 min	99.3	1.8	106	60:1	< 1.1	<1.0		
Copper	1 Year ARI, 90 min.	92.9	0.1	5	16:1	12.1	1.1	Elevated HQ and some ecological risk, partly due to ambient Cu levels being already high in the creek; effects are likely to be attenuated by infrequent occurrence and only limited volume being discharged over short period of time. Dilution of Cu is also likely in the creek.	Elevated HQ and some ecological risk, partly due to ambient Cu levels being already high in the creek; effects are likely to be attenuated by infrequent occurrence and only limited volume being discharged over short period of time. Dilution of Cu is also likely in the creek.
	1 Year ARI, 270 min	97.1	0.7	41	16:1	12.1	1.1		
	100 Year ARI, 120 min	99.3	1.8	106	60:1	2.1	1.0		
Lead	1 Year ARI, 90 min.	92.9	0.1	5	16:1	1.1	1.2	Slightly elevated HQ and some ecological risk, ambient Pb levels are relatively low in the creek; effects are likely to be attenuated by infrequent occurrence and only limited volume being discharged over short period of time. Dilution of Pb is likely in the creek.	Slightly elevated HQ and some ecological risk; ambient Pb levels are slightly higher in the creek; effects are likely to be attenuated by infrequent occurrence and only limited volume being discharged over short period of time. Dilution of Pb is likely in the creek.
	1 Year ARI, 270 min	97.1	0.7	41	16:1	1.2	1.3		
	100 Year ARI, 120 min	99.3	1.8	106	60:1	< 1.0	<1.0		
EC and NickelZinc	1 Year ARI, 90 min.	92.9	0.1	5	16:1	< 112.4	5.9	In all scenarios, HQs are lower than 1.0 for EC and Nickel, which do not pose any additional risks due to the discharges. Highly elevated HQ and some ecological risk, partly due to ambient Zn levels being already high in the creek; effects are likely to be attenuated by infrequent occurrence and only limited volume being discharged over short period of time. Dilution of Zn is likely in the creek.	In all scenarios, HQs are lower than 1.0 for EC and Nickel, which do not pose any additional risks due to the discharges. Highly elevated HQ and some ecological risk, partly due to ambient Zn levels being already high in the creek; effects are likely to be attenuated by infrequent occurrence and only limited volume being discharged over short period of time. Dilution of Zn is likely in the creek.
	Year ARI, 270 min100 year ARI,120 min.	> 97.1	Max. 1.890.7	Max. 10641	> 16:1	< 112.0	5.8		
	100 Year ARI, 120 min	99.3	1.8	106	60:1	12.3	5.4		

: [1] Percentile based on historical events; [2] Total volume of bypasses;[3] Total duration where discharges occur ;[4] Estimated dilution; refer to Table 7.12 and Table 7.13.

Table 7.17 Summary of conclusions on discharging under wet weather, with potential groundwater flows of 22.5 L/s for contaminants with HQ ≥1.0

Criteria	Storm Event	Percentile[1] [%]	Volume[2] [ML]	Duration [3] [min]	Creek Dilution [4]	Creek HQ (SW01)	Creek HQ (SW06)	At Discharge Point (SW01)	At Blue Gum Creek (SW06)
IronAluminium	1 Year ARI, 90 min.	90.392.9	0.1	45	16:1	< 12.2	2.2	HQ below 1.0; therefore, no ecological risk at discharge point Elevated HQ and some ecological risk; partly due to ambient Al levels being already quite high in the creek; effects are likely to be attenuated by infrequent occurrence and only limited volume being discharged over short period of time. Dilution of Al is also likely in the creek.	HQ below 1.0 for Iron; significant dilution in the creek; therefore, no ecological risk at the downstream creek siteElevated HQ and some ecological risk, partly due to ambient Al levels being already quite high in the creek; effects are likely to be attenuated by infrequent occurrence and only limited volume being discharged over short period of time. Dilution of Al is also likely in the creek.
	1 Year ARI, 270 min	97.1	0.7	5441	16:1	< 2.1	2.1		
	100 Year ARI, 120 min	99.3	1.8	116106	60:1	< 12.2	2.2		
CopperChromium	1 Year ARI, 90 min.	90.392.9	0.1	45	16:1	1.3	1.1	Slightly elevated HQ and some ecological risk, partly due to ambient Cr levels being already high in the creek; effects are likely to be attenuated by infrequent occurrence and only limited volume being discharged over short period of time. Dilution of Cr is also likely in the creek.	Slightly elevated HQ and some ecological risk, partly due to ambient Cr levels being already high in the creek; effects are likely to be attenuated by infrequent occurrence and only limited volume being discharged over short period of time. Dilution of Cr is also likely in the creek.
	1 Year ARI, 270 min	97.1	0.7	5441	16:1	1.3	1.1		
	100 Year ARI, 120 min	99.3	1.8	106	60:1	1.1	<1.0		
Copper	1 Year ARI, 90 min.	92.9	0.1	5	16:1	2.1	1.2	Elevated HQ and some ecological risk, partly due to ambient Cu levels being already high in the creek; effects are likely to be attenuated by infrequent occurrence and only limited volume being discharged over short period of time. Dilution of Cu is also likely in the creek.	Elevated HQ and some ecological risk, partly due to ambient Cu levels being already high in the creek; effects are likely to be attenuated by infrequent occurrence and only limited volume being discharged over short period of time. Dilution of Cu is also likely in the creek.
	1 Year ARI, 270 min	97.1	0.7	41	16:1	2.1	1.1		
	100 Year ARI, 120 min	99.3	1.8	106	60:1	2.1	1.0		
Lead	1 Year ARI, 90 min.	92.9	0.1	5	16:1	1.2	1.3	Slightly elevated HQ and some ecological risk, ambient Pb levels are relatively low in the creek; effects are likely to be attenuated by infrequent occurrence and only limited volume being discharged over short period of time. Dilution of Pb is likely in the creek.	Slightly elevated HQ and some ecological risk; ambient Pb levels are slightly higher in the creek; effects are likely to be attenuated by infrequent occurrence and only limited volume being discharged over short period of time. Dilution of Pb is likely in the creek.
	1 Year ARI, 270 min	97.1	0.7	41	16:1	1.1	1.2		
	100 Year ARI, 120 min	99.3	1.8	116106	60:1	< 1.0	<1.0		
EC and NickelZinc	1 Year ARI, 90 min.	90.392.9	0.1	45	16:1	< 112.5	6.0	In all scenarios, HQs are lower than 1.0 for EC; therefore, EC does not pose an Highly elevated HQ and some ecological risk, partly due to ambient Zn levels being already high in the creek; effects are likely to be attenuated by infrequent occurrence and only limited volume being discharged over short period of time. Dilution of Zn is likely in the creek.	In all scenarios, HQs for EC and Nickel are lower than 1.0; therefore, EC or Highly elevated HQ and some ecological risk, partly due to ambient Zn levels being already high in the creek; effects are likely to be attenuated by infrequent occurrence and only limited volume being discharged over short period of time. Dilution of Zn is likely in the creek.
	Year ARI, 270 min100 year ARI, 120 min.	> 97.1	Max. 1.90.7	Max. 11641	> 16:1	< 112.0	5.8		
	100 Year ARI, 120 min	99.3	1.8	106	60:1	12.3	5.4		

: [1] Percentile based on historical events; [2] Total volume of bypasses;[3] Total duration where discharges occur ;[4] Estimated dilution; refer to Table 7.12 and Table 7.13.

Commentary

Aluminium

Possibly reflecting anthropogenic influences (i.e. drainage, including road run-off from the urban catchment), the Al concentrations recorded in Blue Gum Creek are already highly elevated (i.e. range: 0.020 – 0.120 mg/L). The modelled discharge concentrations (0.036-0.107 mg/L) for the different wet weather scenarios fall within the recorded range of elevated creek concentrations but do not exceed these.

The median pH of Blue Gum Creek water at the two sites are around neutral to slightly alkaline (close to discharge location SW01D pH 7.6; downstream SW06D site pH 8.0). Since Al is only sparingly soluble at pH 6.0 to 8.0 Al bioavailability would be quite low at pH ranges around or above neutral, which are encountered much of the time in the discharge environment. In contrast, if the average pH was below 5.0, Al may become available and can potentially be quite toxic to a range of organisms.

Alkalinity is a second important factor. The median alkalinity of Blue Gum Creek at the site close to the discharge location SW01D is 78 mg/L; and at the downstream SW06D site is 55 mg/L. While alkalinity above 100 mg/L introduces significant buffering capacity against rapid pH changes, the measured data indicate that elevated alkalinity concentrations (above 30 mg/L is a benchmark used by ANZECC, 2000) in the Blue Gum Creek would provide varying levels of buffering against pH changes, which would reduce the bio-availability of Al to organisms and hence, adverse ecological impacts.

Under the different wet weather discharge scenarios and potential groundwater flows, although the HQ (Tables 7.12 - 7.15) can be above 1.0 under some scenarios, the downstream ecological risks due to Al are low, largely because of the aforementioned toxicity attenuating factors. Furthermore, the fast-flowing conditions in the creek during wet weather following an untreated bypass will most likely significantly dilute and flush any elevated concentrations.

Arsenic

The As concentrations recorded in the Blue Gum Creek are quite low (i.e. 0.001 mg/L). Arsenic concentrations in the treated discharges, modelled under different wet weather scenarios, are likely to be more or less the same, or even lower (range: 0.0002-0.001 mg/L). As indicated by a HQ<1.0, these concentrations are not likely to pose any ecological risks to the downstream environments.

Cadmium

The Cd concentrations recorded in the Blue Gum Creek are quite low (i.e. 0.0001 mg/L), although the discharge concentrations, modelled under different wet weather scenarios are likely to be slightly higher (range: 0.0002-0.0005 mg/L). As indicated by a HQ<1.0, these concentrations are not likely to pose any ecological risks to the downstream environments.

Chromium

The baseline Cr concentrations recorded in the Blue Gum Creek are 0.0010 mg/L at SW01D near the discharge point, but lower at the downstream site SW06D (0.0008 mg/L). The discharge concentrations, modelled under different wet weather scenarios are likely to be slightly higher (range: 0.0034-0.0058 mg/L). The mixed concentrations, under both low and high flow groundwater conditions, are 0.0013 mg/L at SW01D, and 0.0011 mg/L at the downstream SW06D site. As indicated by a HQ>1.0, these concentrations are indicative of some ecological risks to the downstream environments.

The toxicity of both forms of chromium decreases with increased water hardness and alkalinity, as well as by the amount of organic matter in the creek. As previously discussed, the creek is characterised by neutral and slightly alkaline pH, as well as elevated alkalinity at the discharge point. These factors would reduce any unfavourable ecological effects. Moreover, as with Cu (see below), overall, aquatic organisms associated with the waterway, exposed to the fast flowing and infrequent discharges for short periods of time, are not likely to be adversely affected by slightly elevated Cr concentrations. If some adverse conditions remain in the waterway, they are likely to be relatively minor, and limited to local effects at some locations only (such as stagnant pools, which may occur under low flow conditions).

Copper

The baseline copper concentrations in the Blue Gum Creek (0.0166 mg/L at SW01D and 0.0082 mg/L at SW06D) already exceed the ANZECC Guideline and the acute toxicity TRV chosen (0.0782 mg/L). Given that elevated copper concentrations characterised the (pre-construction) creek environment, it would be reasonable to assume that the aquatic species present within this waterway would be somewhat adapted to these conditions, which may present the natural case, or a disturbed case, due to the nature of the existing urban catchment and groundwater impacts through urban development.

Copper concentrations in the mixed concentrations at both SW01D and SW06D also exceed the ANZECC Guideline for a 95% level of protection of aquatic species (0.0014 mg/L). The unmitigated discharge from the tunnel during certain infrequent wet weather is expected to slightly further increase the concentration of copper in the combined discharges.

Given that the copper in the creek cannot be mitigated ecologically, elevated levels may be temporarily unfavourable to organisms. However, aquatic organisms associated with the waterways, with short-term exposure to the fast flowing and infrequent discharges, are not likely to be adversely affected by slightly elevated copper concentrations. If some adverse conditions remain in the waterway, they are likely to be relatively minor, and limited to local effects at some locations only (such as stagnant pools, which may occur under low flow conditions). However given the Proposal will result in a steady flow of water down the creek, stagnant pools are unlikely.

Lead

Possibly reflecting anthropogenic influences (i.e. road run-off from the urban catchment), the lead concentrations recorded in the Blue Gum Creek are low (i.e. range: 0.0005 – 0.002 mg/L). These concentrations are also lower than the ANZECC Guideline for ecosystem protection (0.0034 mg/L). The lead concentrations in the discharge concentrations under the different wet weather scenarios that were modelled (range: 0.0139-0.0408 mg/L) are somewhat more elevated than in the creek, however are diluted by catchment flows in the creek during wet weather. Overall this results in a slightly elevated ecological risk in the creek due to lead.

Water hardness, alkalinity and pH are major factors that affect the bio-availability of lead in the aquatic environment and their potential ecological consequences. The uptake and toxicity of lead in freshwater organisms is known to decrease with increasing water hardness and alkalinity. Lead toxicity in the water is further reduced by low solubility of many forms of lead, particularly in alkaline waters. Lead is also strongly complexed by dissolved organic matter in most natural waters, as it is adsorbed strongly by suspended clay, humic substances and other suspended material.

Lead in the creek cannot be mitigated ecologically. Such elevated concentrations have existed in the creek over an extended period prior commencement of construction activities. Although elevated levels may be unfavourable to some aquatic organisms, aquatic organisms associated with the waterway, with short-term exposure to the fast flowing and infrequent discharges, are not likely to be adversely affected by slightly elevated lead concentrations. If some adverse conditions remain in the waterway, they are likely to be relatively minor, any adverse effects at some locations are likely to be only very localized (such as in stagnant pools, which may occur under low flow conditions). However given the Proposal will result in a steady flow of water down the creek, stagnant pools are unlikely.

Nickel

The Nickel concentrations recorded in the Blue Gum Creek are quite low (i.e. range: 0.0005 – 0.003 mg/L). The Ni concentrations in the discharges under different wet weather scenarios are also quite low (range: 0.002-0.006 mg/L). Both of the maximum concentrations recorded in the creek, and modelled, as likely in the discharges, are below the ANZECC guideline (0.011 mg/L). Given these low concentrations, an HQ <1.0 (see Tables 7.12 – 7.15) indicates that environmental risks, due to Nickel concentrations that may be in the treated discharges are highly unlikely.

Zinc

Zinc is an essential trace element required by most organisms for their growth and development. Therefore, organisms living in an aquatic environment could be expected to be adopted to living in fluctuating and somewhat elevated zinc concentrations. ANZECC (2000) and references therein also indicate that zinc has been found to bio-accumulate in some freshwater animal tissues, 50 to 1130 times, but bio-accumulation is not generally considered a problem for zinc in animals and plants.

Possibly reflecting anthropogenic influences, the zinc concentrations recorded in Blue Gum Creek are quite high (i.e. range recorded at SW01D: 0.0050 – 0.140 mg/L), which are up to 17 times the ANZECC Guideline for ecosystem protection (0.008 mg/L). The zinc concentrations in the creek are also higher than the modelled discharge concentrations, under different wet weather scenarios (range: 0.0318-0.0931 mg/L). Therefore, the mixed concentrations in the discharges are all elevated well above the ANZECC Guideline for zinc, which indicates a potential environmental risk. It is also important to note that the ANZECC Guideline has been derived mostly from chronic toxicity data, which may be conservatively applied to conditions under which water would be fast-flowing in the creek during wet weather.

As previously discussed, at alkaline pH (>8.0), Zn^{2+} easily forms complexes with organic matter and commonly exists as complexes (i.e. Zn-DOM) or various insoluble forms, such as $ZnOH^{+}$; $ZnCO_3$; or insoluble ZnS. The stability of these Zn forms are dependent on pH, water hardness (determined by concentrations of Ca^{2+} and Mg^{2+}) and alkalinity (buffering capacity of water). Typically, inorganic and organic complexes ameliorate the uptake and toxicity of zinc by reducing the concentration of dissolved Zn^{2+}.The measured pH and alkalinity concentrations near the discharge location SW01D and downstream SW06D are likely to mitigate against zinc dissolution and attenuate pH changes, which would considerably reduce any ecological risks.

In considering the potential ecological implications, it is important to take note that the zinc concentrations in the creek cannot be mitigated ecologically, elevated levels may be temporarily unfavourable to organisms. However, overall, aquatic organisms associated with the waterways, with short-term exposure to the fast flowing and infrequent discharges, are not likely to be adversely affected by slightly elevated Zn concentrations. If some adverse conditions remain in the waterway, they are likely to be relatively minor, local effects at some locations only (such as stagnant pools, which may occur under low flow conditions). However given the Proposal will result in a steady flow of water down the creek, stagnant pools are unlikely. However given the Proposal will result in a steady flow of water down the creek, stagnant pools are unlikely.

Conclusion

During dry weather, all groundwater and service water collected within the NorthConnex's twin tunnel system will be treated by an on-site Water Treatment Plant (WTP) and directed to a detention basin before being discharged to the Blue Gum Creek.

During wet weather, rain falling on the entry/exit ramps and around the portals to the tunnels enters the tunnels and flows to a LPS. Rainfall collected in this manner is pumped to an above ground buffer tank system, and then to the WTP for treatment. The storage volume in the LPS and the buffer tank system attenuates the flow to the

Water Treatment Plant such that the capacity of the WTP is not exceeded on most wet weather days. Key design parameters have been selected for the Water Treatment Plant, the LPS, the buffer tank system and the stormwater pumping system, and, an assessment of the performance of the system with respect to the intent of the ANZECC guidelines and Clauses B16 and B16 (e) and (f) of the Conditions of Approval, has been carried out.

The key design parameters for the system include the provision of a LPS with capacity of not less than 510 m3, a stormwater pumping rate of 250 L/s and a buffer tank system of 400 m3, and a WTP with a capacity of 40 L/s

Overall, when assessing the performance of the system, the analysis found that, based on historic rainfall records, during an average year there would be 280 days, which would be rain free. On these days, the water leaving the WTP, primarily treated groundwater, would be of high quality and the modelling indicates that, when these flows are discharged to the Blue Gum Creek, it would be reasonable to expect some improvement of the water quality of the receiving waterways.

The analysis also found that, based on historic rainfall records, on average, there would be approximately 85 days on which there would be rainfall events, and, because of the attenuation in the LPS and the buffer tank, the water treatment plant would not be bypassed on 77 of these days. On these days, the water leaving the WTP would be a mixture of treated groundwater and rainwater of the same high quality as on rain free days, and the modelling indicates that, when these flows are discharged to the creek, it would be reasonable to expect some improvement of the water quality of the receiving waterways. Thus, it has been estimated that improvement of the quality of the water in the creek will occur on 357 days of the year. This aligns with:

- Clause B16 of the Conditions of Approval, which requires that the potential impact of discharges on receiving waters be avoided …., and
- Clause B16 (f) which requires that the proposal should demonstrate that any groundwater discharge water quality be consistent with supporting a ‘slightly to moderately disturbed’ level of aquatic ecosystem protection for receiving waters as defined by the ANZECC Guidelines; and
- Cl. B16 (e) as the proposed strategy is expected to improve the water quality in the creek for 357 days a year and therefore contributes towards the achievement of the water quality objectives over time, where they are not currently being achieved.

The ecological risk assessment found that:

- During dry weather, and during storms of short duration and low ARI, the level of treatment at the WTP will ensure meeting the nominated performance goals. If these are met, it would be reasonable to expect some improvement of the water quality of the receiving waterways, relative to its current ambient condition. Modelling indicates that this will occur on 357 days of the year.
- During storms of longer duration and higher ARI, bypass events will occur, up to 8 times a year, on average and depending on the storm intensity. Modelling indicates that the majority of discharges will be short term, for example, 5 minutes for a 1 year ARI storm (90 minute duration), < 0.75 hour for a 1 year ARI storm (4.5 hour duration) and around 1.5 hour for a 100 year ARI storm (2 hour duration).

The relatively short term bypasses align with Clause B16 of the Conditions of Approval, which requires that the potential impact of discharges on receiving waters be avoided or minimised. The duration of bypasses for storms of longer term ARI, such as 100 Year ARI, were found to be significant, however, due to the infrequency of these event such durations were not considered relevant.

The ecological risk assessment indicated elevated risks associated with the estimated concentrations of several potential contaminants (‘ecological stressors’). These are total suspended solids (TSS) and several metals and metalloids; i.e. Aluminium, Chromium, Copper, Lead and Zinc contaminants in the (untreated) WTP discharges, which may occur during wet weather conditions. The corresponding, estimated hazard quotient (HQ) values for the contaminants vary, depending on the location of the creek, the storm events assessed, and the underlying groundwater infiltration rates assumed for the modelling.

Overall, as discussed under each contaminant, water quality conditions in the urban creek are such that the solubility of all of the above 'stressors' are likely to be attenuated by neutral or slightly alkaline pH; alkalinity and water hardness (indicated by abundant Ca^{2+} and Mg^{2+} ions) and the likely occurrence of organic matter, which can be expected to form complexes with most of these ions.

Potential ecological effects are also mitigated by relatively fast flows through the creek in wet weather, and further dilution from catchment drainage, which are most likely to occur. Furthermore, as discussed, highly elevated concentrations of these contaminants have historically existed in the Blue Gum Creek.

Potential ecological effects are further mitigated by the frequency and duration of discharges, which are both relatively low, as discussed. As such, it would be reasonable to assume that the both animal and plant species present within this waterway would be somewhat adapted to the elevated adverse ecological conditions, which may occur in the natural case, or in the disturbed case, due to groundwater impacts and/or catchment drainage impacts, through urban development, added to by the unmitigated discharges from the NorthConnex works.

Overall, aquatic organisms in the downstream Blue Gum Creek environments, with short term exposure to the fast flowing and infrequent discharges are not likely to be adversely affected by slightly or moderately elevated concentrations of these stressors, as they are likely to be mostly transient exposures.

Based on these findings, it was concluded that

- As per Clause B16 (f) of the Conditions of Approval, the proposal demonstrates that any groundwater discharge water quality is consistent with supporting a 'slightly to moderately disturbed' level of aquatic ecosystem protection for receiving waters as defined by the ANZECC Guidelines.
- As per Clause B16 of the Conditions of Approval, the potential impact of discharges on receiving waters had been avoided or minimised…
- As per Clause B16 (e)(ii) of the Conditions of Approval, the Proposal contributes towards achievement of the water quality objectives over time, where they are not currently being achieved.

7.7.7. Water treatment testing regime - Operational Phase

i Commissioning

Commissioning of the operational WTP will involve treatment of batch quantities of water and sampling to determine the efficacy of the WTP. All of the parameters listed in Table 7.9 will be tested during this commissioning phase. Where water produced is outside of the said parameters it will be re-circulated through the WTP until the water meets discharge quality requirements. Recirculation is possible due to the twin treatment trains within the WTP. Water will then be discharged to the Council stormwater system or trade waste. The construction phase WTP's will not be decommissioned until the operational phase WTP is consistently producing within water specification.

ii Post-commissioning

Following commissioning of the operational WTP, discharge water will be laboratory analysed monthly during operations for the parameters listed in Table 7.9. Water quality results will be kept on file and will be available as requested to the Secretary (DP&E). Exceedance of the specifications during the operation of the WTP will trigger an investigation into the causes and implementation of measures so the design specifications will be achieved.

8. Ambient monitoring program

8.1. Monitoring objectives

The primary objective of this WQPMP is to identify analytes and sampling frequencies required to assess potential impacts of the Project on water quality, groundwater levels and GDEs in the surrounding environment.

Surface water, groundwater and GDE monitoring is undertaken to achieve this outcome. The monitoring locations, sampling parameters and frequency are outlined in this section. The information collected during the monitoring program will be used to inform project management responses aimed at preventing or reducing any adverse impacts detected.

8.2. Monitoring study design

The collection of repeat data over time will enable an assessment of changes in surface water quality, groundwater levels and GDEs that may result from the implementation of the Project. This type of program is described by the Australian guidelines for water quality monitoring and reporting as a 'study that measures change' (ANZECC/ARMCANZ 2000b). The basic premise of this methodology is that suitable spatial and temporal monitoring is built into the study design.

The construction and operational phase monitoring program involves repeat sample collection at some of the existing static locations within the catchment area surrounding the Project area (Figure 8.1). This monitoring program allows for measurement of trends in surface water quality and simple correlations between characteristics such as groundwater levels , rainfall and discharge qualities.

MCoA B15(f) requires that the time period for data collection includes the pre-construction period. Monitoring during the pre-construction project phase enables a 'BACI' (before-after/control-impact) guided monitoring approach.

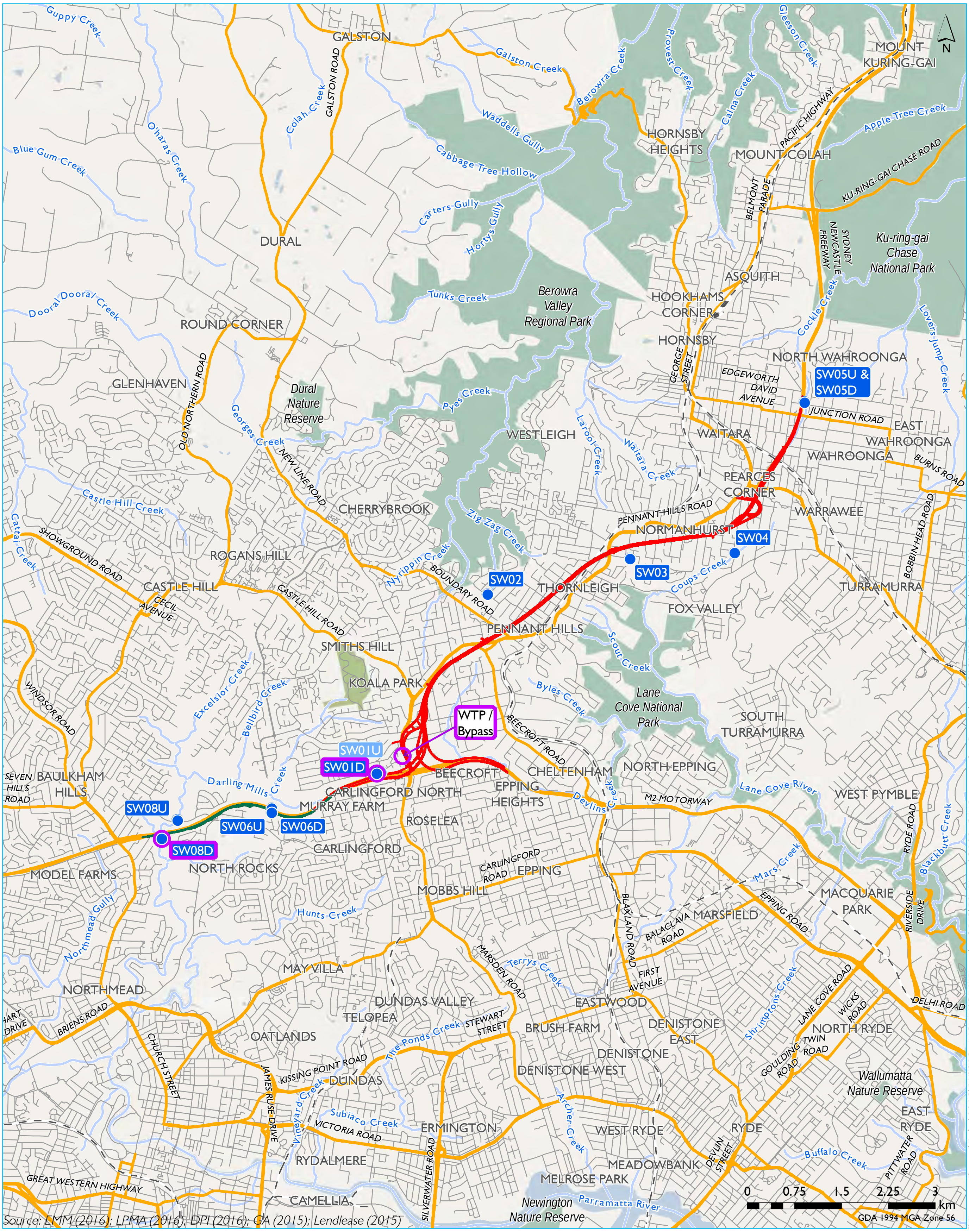
8.2.1. Surface water study design

Construction and operational phase monitoring is conducted at the surface water monitoring locations are shown in Figure 8.1 and listed in Table 8.1.

In addition to the rationale for selection of the surface water monitoring described in Section 3.8.1, monitoring locations incorporate an upstream (or control) site and a downstream (or impact) site (ANZECC/ARMCANZ 2000a), where possible.

Control and impact sites are monitored, where possible, to assist to differentiate between non-Project related variation (occurring at upstream and downstream sites) and Project-related variation (only occurring at downstream sites).

As the Project area is generally along a ridgeline, only downstream monitoring site are available in some locations.



\\Emmsvr1\emm\Jobs\2016\J16200 - NCX WQPMP update\GIS\02_Maps\G029_SWConstructionOperation_20180423_05.mxd 23/04/2018

KEY

- Surface water monitoring locations (construction)
- Surface water monitoring locations (monitoring dicontinued Oct 2016)
- Surface water monitoring location (operational phase)
- NorthConnex tunnel
- M2 integration works
- Rail line
- Major road
- Minor road
- Watercourse
- Waterbody
- NPWS reserve
- State forest

Surface water monitoring locations during construction and operation

NorthConnex

Water Quality and Monitoring Plan

Figure 8.1

EMM

Table 8.1 Construction and operational phase surface water monitoring locations

Site name	Comments	Construction phase[1]	Operation phase
SW02	Downstream location only – Tedbury Creek	ü	
SW03	Downstream location only – Unnamed Creek	ü	
SW04	Downstream location only – Coups Creek	ü	
SW05U	Upstream location – Cockle Creek	ü[2]	
SW05D	Downstream location – Cockle Creek	ü	
SW01U	Upstream location – Blue Gum Creek	ü[3]	
SW01D	Downstream location – Blue Gum Creek	ü	ü
SW06U	Upstream location – Yale Close drainage line	ü[4]	
SW06D	Downstream location –Yale Close drainage line	ü[5]	
SW08U	Upstream location – Darling Mills Creek	ü	
SW08D	Downstream location – Darling Mills Creek	ü	ü
WTP Outlet	Outlet of the WTP		ü
Bypass	WTP bypass outlet when system is in bypass mode		ü

Notes: 1. Construction phase monitoring commenced in July 2015 (unless stated otherwise).
2. Monitoring commenced in August 2015.
3. Monitoring discontinued in October 2016 due to location being found to be downstream of the Project.
4. Monitoring commenced in January 2016.
5. Additional monitoring was undertaken downstream at the Yale Close drainage line between August and October 2015.

Monitoring site SW01U was planned as an upstream monitoring location. Monitoring was discontinued when it was found that this site is in fact located downstream of the stormwater discharge that would receive treated water from the Southern Interchange WTP (as SW01D) and was downstream of the Southern Interchange Compound via the Council Stormwater system. No alternative upstream location could be identified.

During the operational phase the Motorway Operations Complex WTP will discharge into an existing stormwater system which eventually discharges to Blue Gum Creek. Water quality at *WTP Outlet* will reflect WTP discharge (when it is operating). Surface water monitoring location *Bypass will reflect water that* bypasses the WTP in high rainfall events. The surface water monitoring location SW01D is located as far up the catchment as possible and represents the receiving environment which is made up of stormwater flows from the surrounding suburb. As the Blue Gum Creek flows in a westerly direction numerous other non NorthConnex inflows enter the creek. Surface monitoring locations SW08D are location at Darling Mills Creek below the confluence with Blue Gum Creek is also proposed.

8.2.2. Groundwater study design

Groundwater monitoring bores targeting both the Ashfield Shale and Hawkesbury Sandstone formations have been selected across the Project area as a means to capture groundwater level behaviour within the two different hydrogeological systems. Monitoring bores in the shale and sandstone within close lateral proximity to each other were selected to provide information on potential vertical gradient between the shale and the underlying sandstone. This is important in considering the conceptualisation of the groundwater system, including recharge into deeper groundwater system.

Monitoring bores with screen sections intercepting the corresponding alignment depth of the tunnel have been selected to improve the understanding of the possible impacts and the extent of localised dewatering through tunnel inflows during the construction and operational phase of the Project.

Monitoring bores have also been spatially selected to understand the groundwater flow direction.

The current construction and operational phase monitoring is conducted at the monitoring sites listed in Table 8.2 and shown in Figure 8.2.

Table 8.2 Construction and operational groundwater monitoring locations

Bore ID	Aquifer formation	Construction phase[1]	Operational phase
BH004	Shale	ü	ü
BH005	Sandstone	ü[2] (replacement of BH1009)	ü
BH008	N/A	ü[2,3]	ü
BH012	Sandstone	√[2](Appendix E recommendation BH-A3)	ü
BH014	Sandstone	ü (Appendix E recommendation BH-A2)	ü
BH021	Sandstone	ü	ü
BH023	Sandstone	ü[4]	
BH025	Shale	ü	ü
BH111	Sandstone	ü[5]	ü
BH112	N/A	ü[4]	
BH116	Sandstone	ü[2] (replacement of BH023)	ü
BH1009	Sandstone	ü[4]	
BH1017	Sandstone	ü[4,6](Appendix E recommendation BH-A1)	ü
BH9004	Sandstone	ü[2]	ü

Table 8.2	Construction and operational groundwater monitoring locations		
Bore ID	Aquifer formation	Construction phase[1]	Operational phase
Nelson	Sandstone	ü[2]	ü
BH104	Sandstone	ü[7] (Appendix E recommendation BH-A4)	ü

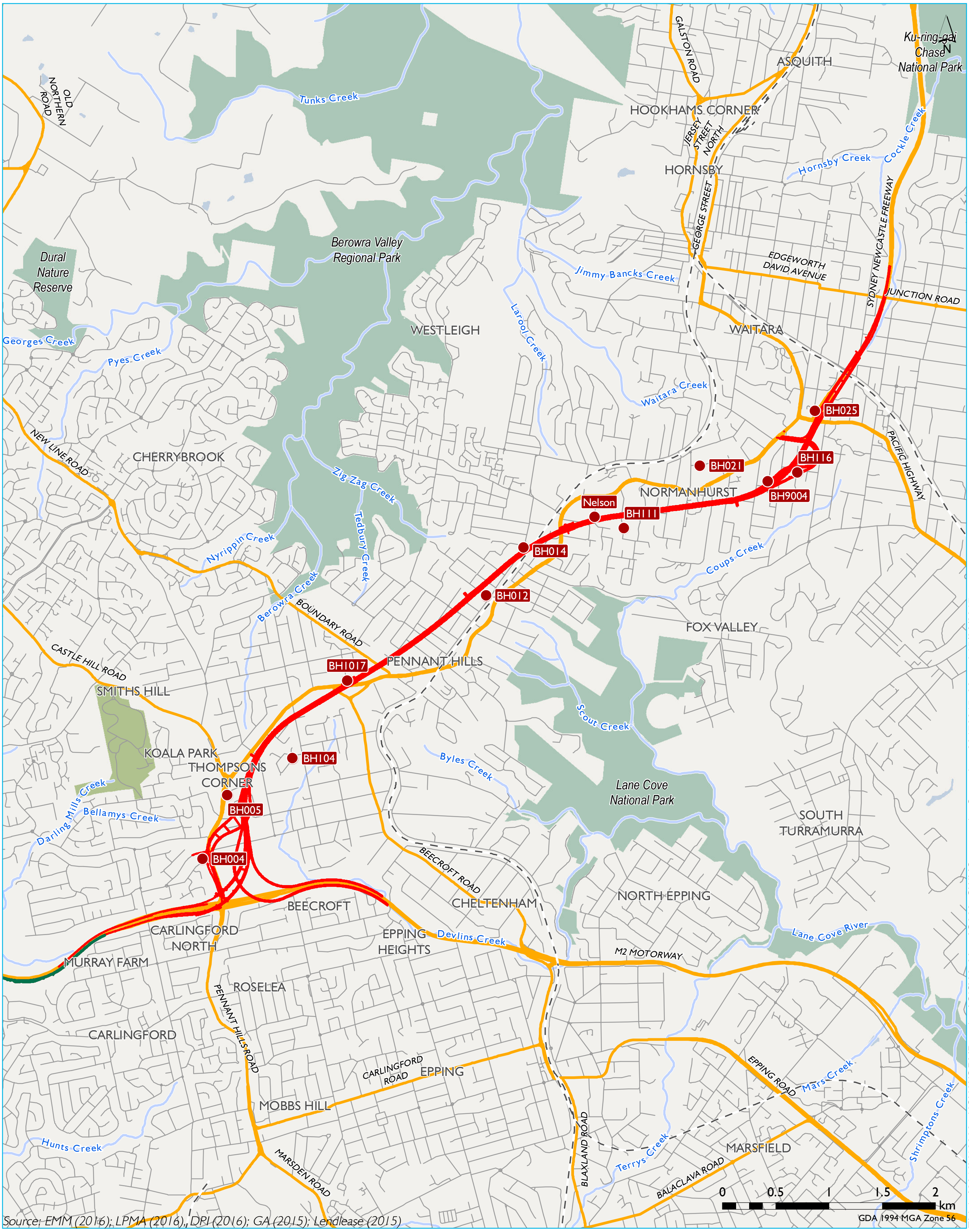
Notes:
1. Construction phase monitoring commenced in April 2015.
2. Construction phase monitoring commenced in September 2016.
3. Monitoring discontinued in December 2016.
4. Monitoring discontinued in July 2016.
5. Construction phase monitoring commenced in June 2016.
6. Monitoring recommenced in December 2016
7. Monitoring Commenced in June 2017

Monitoring bores that were impacted during construction activities (BH023 and BH1009) were replaced by similar designed monitoring bores located as close as practically possible to the original monitoring bores. In addition the monitoring schedule has been updated to respond to the recommendation made in the Groundwater Model Report (Appendix E) including the commencement of monitoring at a new well (BH104).

Details of the replacement monitoring bores are listed in Table 8.3.

Table 8.3	Replacement monitoring bore details						
Location	Easting	Northing	Elevation (m AHD)	Aquifer formation	Borehole depth (m)	Screened interval (m AHD)	Approximate horizontal distance from tunnel alignment (m)
BH005	319353	6263921	N/A	Sandstone	57	38-41	125
BH008	320725	6264970	N/A	N/A	80	70-73	105
BH012	321785	6265796	N/A	Sandstone	44	41-44	81
BH111	323076	6266429	N/A	Sandstone	16	13-16	112
BH116	324707	6266952	N/A	Sandstone	40	16-19	18
BH9004	324430	6266869	N/A	Sandstone	48	39-45	10
Nelson	322801	6266535	N/A	Sandstone	40	36-40	120
BH104	319967	6264267	140.7	Sandstone	57	18	273

Construction and operational phase monitoring data for the replacement monitoring bores (Table 8.3) will be compared to the ambient site specific trigger values defined in Section 7.5 for the respective monitoring bores they replace.



T:\Jobs\2016\J16200 - NCX WQPMP update\GIS\02_Maps\G028_GWMConstructionOperation_20170615_03.mxd 15/06/2017

KEY

- Groundwater monitoring locations
- NorthConnex tunnel
- M2 integration works
- Rail line
- Major road
- Minor road
- Watercourse
- Waterbody
- NPWS reserve
- State forest

Groundwater monitoring locations during construction and operation

NorthConnex

Water Quality and Monitoring Program

Figure 8.2

EMM

8.3. Monitoring parameters

8.3.1. Water quality

In accordance with the requirements of MCoAB15(g), the water quality monitoring parameters included in the WQPMP have been chosen based on the:

- RMS Guideline for Construction Water Quality Monitoring (RTA undated);
- the Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC Monitoring Guidelines) (ANZECC/ARMCANZ 2000b); and
- site-specific baseline data.

A review of the data collected to date has indicated that some parameters are consistently below the LOR, and hence below the trigger values or ANZECC/ARMCANZ (2000a) guideline values listed in Table 7.2 to 7.4. Based on this, a review of the suite of analysis and sampling frequency was undertaken by reviewing the risk assessment completed for the project. A conservative approach was used, and all the potential water quality impacts identified in the pre-mitigation risk assessment (Table 5.4) as having ‘significant’ or ‘high’ risk have been considered in the preparation of the suite of analysis detailed in Table 8.4. Analytes found not to be present could be removed from the analytical suite after an initial screening period.

The review of the analytical suite has been conducted in consideration of MCoA B15 g) whereby monitoring should be carried out in a manner that is representative of the potential extent of the impacts of the SSI.

Table 8.4 Review of analytical suite based on risk assessment

Component	Potential impact	Receptor	Risk analysis		Surface water	Groundwater
			Pre-mitigation	Post mitigation		
Construction phase						
Vegetation clearing	Erosion and sedimentation of disturbed areas including surrounding waterways.	Surface water	High (A3)	Low (E3)	Turbidity monitoring	N/A
	Increased nutrient load in waterways causing algal growth and eutrophication.	Surface water	Significant (C3)	Low (E3)	N/A	N/A
	Transport of vegetation in waterways resulting in flow disruption.	Surface water	High (B3)	Low (E3)	N/A	N/A
Earthworks	Spills of hydrocarbons leaching/running into waterway.	Surface water	Significant (C3)	Low (E3)	TPH & BTEX	N/A
Culvert and drainage works	Disruption to flow and increased turbulence.	Surface water	High (A3)	Medium (D3)	Turbidity monitoring Multi-probe monitoring	N/A
	River/creek bed and bank scouring.	Surface water	High (B3)	Low (E3)	Visual Inspection during fortnightly Environmental Representative (ER) Inspections	N/A
	Direct impacts on streambeds through	Surface water	High (B3)	Medium (D3)	Visual Inspection during fortnightly	N/A

Table 8.4 Review of analytical suite based on risk assessment

	excavation works.				Environmental Representative (ER) Inspections	
Material stockpiling	Leaching or mobilised contaminants.	Surface Water	High (B3)	Low (E3)	Turbidity monitoring Multi-probe monitoring	N/A
Tunnelling activities	Altering the local groundwater flow system through local depressurisation of groundwater resources.	Groundwater	Significant (C3)	Significant (C3)	N/A	Groundwater level monitoring.
	Contaminated groundwater drawn into tunnel.	Groundwater	Significant (C3)	Medium (C2)	N/A	Treated at WTP
WTP discharge	Increased flow and increased turbulence in creek/drainage channel.	Surface water	High (B3)	Low (E3)	Turbidity monitoring Multi-probe monitoring	N/A
	Creek/drainage channel bed or bank scouring.	Surface water	High (B3)	Low (E3)	Turbidity monitoring Multi-probe monitoring	N/A
	Changes to baseline water quality.	Surface water	Significant (B4)	Low (E3)	· Turbidity monitoring · Multi-probe monitoring · WTP performance standards (Table 7.9) · TPH and BTEX monitoring	N/A

Table 8.4 Review of analytical suite based on risk assessment

					· Major cations (CA^{2+},Mg^{2+}, K^{+}, Na^{+}) · Nutrients (Ammonia, Nitrite, Nitrate, Phosphate, Total Nitrogen, Total Phosphorous) · Metals (As,Cd,Cr,Cu,Fe, Pb,Mn,Ni,Zn)	
Operational phase						
Tunnel operation	Altering the local groundwater flow system through local depressurisation of groundwater resources.	Groundwater	High (B3)	Significant (C3)	N/A	Groundwater level monitoring through the installation of borehole data loggers
	Contaminated groundwater drawn into tunnel.	Groundwater	Significant (C3)	Medium (C2)	N/A	WTP will remove contaminants to the performance specifications detailed in Tables 7.6 and 7.9.
WTP discharge	Increased flow and increased turbulence in creek/drainage channel.	Surface water	High (B3)	Medium (D3)	· Turbidity monitoring · Multi-probe monitoring · WTP performance	N/A
	Creek/drainage channel bed or bank	Surface water	High (B3)	Low (E3)		N/A

Table 8.4 Review of analytical suite based on risk assessment

	scouring.				standards (Table 7.9) · TPH and BTEX monitoring · Major cations (CA^{2+},Mg^{2+}, K^{+}, Na^{+}) · Nutrients (Ammonia, Nitrite, Nitrate, Phosphate, Total Nitrogen, Total Phosphorous) · Metals (As,Cd,Cr,Cu,Fe, Pb,Mn,Ni,Zn)	
	Changes to baseline water quality.	Surface water	Significant (B4)	Low (E3)		N/A
	WTP malfunction	Surface water	High (C3)	Medium (D3)		N/A
Contamination from chemical or fuel spills from surface roads	Contamination of waterways from chemical or fuel spills from traffic accident on surface roads	Surface water	High (A3)	Significant (A2)		N/A

8.3.2. Rainfall records

Rainfall within the catchment can influence the surface quality parameters and groundwater levels. Three weather stations were installed across the Project area designed to measure daily rainfall. These stations are situated at:

- Northern Interchange Compound;
- Wilson Road Support Facility; and
- Barclay Road, Northmead.

Comparisons of rainfall to water quality and groundwater level data will be carried out during six-monthly compliance monitoring reporting (see Table 10.1).

Meteorological monitoring will be discontinued at the end of the construction phase. BoM data will be used when assessing operational phase monitoring results.

8.4. Monitoring duration

The baseline monitoring program was completed between August 2014 and construction commencement in June 2015. The construction monitoring program commenced in July 2015 and will continue for about three years until the start of the operational phase.

In accordance with the requirements of MCoAB15(h), the operational monitoring program will run for a minimum period of three years following the completion of construction (or until any affected waterways and/or groundwater resources are certified by an independent expert as being rehabilitated to an 'acceptable' condition). An 'acceptable condition' will be determined if groundwater level and surface water quality monitoring data (in consideration seasonal factors) are found to be consistent with expected impacts as defined by the EIS and this plan.

8.5. Sampling frequency

8.5.1. Surface water sampling frequency

The surface water sampling analytical suite and frequency of monitoring is presented in Table 8.5 for the construction and operational phases of the Project.

The frequency of surface water sampling has been designed in line with the RMS Guidelines for Construction Water Quality Monitoring (RTA undated). The program includes surface water sampling following 'wet weather events' when sediment and contaminants in the Project area are most likely to be mobilised. A wet weather event for north and south of Loftus Road, West Pennant Hills is when >38 mm and >25 mm of rain has fallen within a 24 hour period (80^{th} percentile, 5 day rain event) respectively. Wet weather sampling will be undertaken independently of the dry weather sampling events as indicated in Table 8.5.

The monitoring frequency could be reviewed after an initial period if results indicate stable water quality in line with the impacts described in the EIS.

Table 8.5 Surface water analytical suite and sampling frequency

Project phase	Frequency – Dry sampling	Frequency – Wet weather sampling
Construction Phase	Monthly	Quarterly
Operational Phase (In accordance with CoA B15 h)	Watercourse Sampling Quarterly	Watercourse Sampling Quarterly / 4 times per year during wet weather events defined as >25mm in 24hours.
	WTP Sampling Monthly	WTP Sampling The “bypass” sampling location will be sampled each time the system is in bypass mode for more than 1 hour.

8.5.2. Groundwater sampling frequency

Groundwater level sampling is through the use of automated loggers, as such the monitoring of groundwater levels is occurring constantly. During the construction phase the data from the loggers will be downloaded bimonthly and the results reviewed. During the operational phase the data from the loggers will be downloaded quarterly and the results reviewed.

8.6. Field measurements and observations

8.6.1. Field measurements

i Water quality parameters

Multi-probe monitoring involves the collection of data in relation to electrical conductivity, pH, dissolved oxygen and temperature will be measured in the surface water and groundwater samples in the field as they can change rapidly following sampling. Turbidity will be measured in surface water samples in the field to enable timely management responses should trigger values be exceeded, rather than waiting for laboratory results to be returned.

At the start of each day of monitoring, appropriately trained water quality monitoring personnel will calibrate field equipment according to the manufacturer’s instructions. An appropriate calibration solution will be used and a record of the calibration kept on file.

All in-field monitoring equipment will be calibrated annually in accordance with manufacturer’s recommendations by a National Association of Testing Authorities (NATA) accredited provider as required.

ii Groundwater level measurements

The standing groundwater level will be measured manually using an electronic dip meter prior the time of any logger downloads. The measurement will be read from the same surveyed reference point on the uPVC casing so that it can be related back to metres Australian Height Datum (mAHD). Recorded groundwater levels will be tabulated in both metres below top of uPVC casing (mbTOC) and mAHD.

The total depth of the borehole will be measured periodically to ensure there has not been a build-up of fines in the slotted screen.

Data loggers will be downloaded in accordance with the manufacturer's guidelines. It will be ensured that the logger is located in the groundwater column at a depth below expected natural fluctuations (or near the base of the monitoring bore and within the range of the logging device) and that the hanger cable is not tangled or damaged.

8.6.2. Field observations

The following information will be recorded on a fieldsheet at each sampling location:

- site ID;
- date and time, weather conditions;
- condition of bore headworks (ie absent end-caps) or the condition of creeks (eg increased visual observation of weeds potentially signifying eutrophic conditions at surface water sites);
- name of the sampler; and
- whether the waterbody was moving or still.

8.7. Replicate samples

Replicate samples are two or more samples collected simultaneously to establish the reproducibility of sampling (ANZECC/ARMCANZ 2000b). One blind replicate water sample will be collected for every 10 samples.

8.8. Sampling protocol

The sampling protocols outlined in this section follow the Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ 2000b).

8.8.1. Sample collection

Samples will be collected by methods that obtain a representative water sample and avoid contamination.

The sampling methods employed for both surface and groundwater measurements will observe the following requirements:

- use of disposal nitrile gloves;
- the sample container, bailer or pumping equipment will be rinsed before use and between sampling locations;
- sample bottles suitable for each parameter will be used (generally containers supplied by the analytical laboratory will be used);
- excess of water should be disposed, downhill (or downstream) of the monitoring location;
- sample bottles will be labelled with Project reference, sampler initials, site ID and the date and time of collection. Sample bottles will be filled according to laboratory instructions (eg no headspace for TPH samples);
- samples will be kept chilled while in transit to the laboratory, and will be delivered within holding times and under chain of custody protocols; and
- sampling staff will be trained and use standard industry techniques to avoid contamination when handling sample containers.

Table 8.6 summarises the information that will to be captured at each point in the monitoring and analysis process.

Table 8.6 Quality assurance procedure	
Process step	**Quality assurance procedure**
Field sampling	field register of sample number, site, type/technique, time and date, field technician, field parameters
Sample storage and transport	field register of transport, container number and sample numbers, time and date
Laboratory receipt of samples	laboratory register of transport containers number and sample numbers, time and date
Laboratory storage of samples	laboratory register of storage location, type, temperature, time and date
Sample preparation	analysis register of sample (laboratory) number, pre-treatment, time and date, laboratory technician
Sample analysis	analysis register of instrument, calibration, laboratory technician, sampling method, time and date, result

Quality control samples will be submitted to the laboratory as individual samples without any indication of which sample they replicate.

The sections below detail the correct sampling procedure for groundwater and surface water.

i Surface water

Where possible, samples should be obtained from moving water. A sample should be obtained at a minimum distance of 1 m from the bank (or further if possible). Sample collection should be obtained through the use of a 10 L rinsed bucket, connected to a cable. During each site visit, the sampler should record the quality of the sampling point, by estimating flow and indicating the condition of the surrounding vegetation (eg inundated with weed).

8.8.2. Chain of custody information

Chain of custody information will be recorded at all points in the sampling process (ie in-field, during transport and during laboratory analysis) to enable tracing of any errors during the sampling process or to identify potential improvements.

8.8.3. Sample preservation

The time between sampling and analysis will be minimised wherever possible. Ideally, the samples will be cooled to $4^{o}C$ and stored in an esky or vehicle refrigerator for delivery to the laboratory (ANZECC/ARMCANZ 2000b).

8.9. Laboratory analysis

Samples will be analysed by a NATA accredited laboratory.

9. Management actions

As with environmental values, the management goals need to be defined according to community needs and values. They need to relate to particular parts of the environment that are potentially impacted and that can be measured. Management goals should reflect the desired levels of protection for ecosystems while also considering economic and social values.

ANZECC/ARMCANZ (2000a) describes the purpose of trigger and guideline values as an early warning mechanism to indicate a potential problem due to the inherent variability of water quality data.

A singular exceedance of a guideline value and/or site specific trigger value does not to warrant implementation of management measures as the result could be a statistical outlier within the 'normal' range. It is more useful to consider trends against trigger values, with additional monitoring and possible further investigation and assessment of management measures if continued exceedance of the trigger value occurs.

This section provides the impact triggers and their management responses in accordance with the requirements of MCoAB15(i) and B16(e). This report has identified that the Project's potential impacts to groundwater are likely going to be limited to changes in level and flow and potential hydrocarbon contamination, while potential impacts to surface water are likely going to be limited to increased turbidity and potential hydrocarbon contamination.

Triggers for chronic impacts (ie those occurring at low levels but exceeding trigger values) are provided in this section. Management responses will also be instigated for acute events associated with the Project (ie impacts that occur as a result of an incident over a short-time, such as a spill) or where routine environmental inspections indicate that impacts may be occurring. These management responses are described in the incident response sections of the CEMP.

9.1. Surface water

9.1.1. Management response triggers

A management response will be instigated within 24 hours based on the following surface waters monitoring triggers:

1. exceedances of site specific trigger values for three consecutive sampling events, or where they are not available, trigger values for slightly to moderately disturbed aquatic ecosystems; or
2. exceedances outside of site specific trigger values for over half of the sampling events in any twelve month period, or where they are not available, trigger values for slightly to moderately disturbed aquatic ecosystems; or
3. a single exceedance greater than 50% beyond the site-specific trigger values, or where they are not available, trigger values for slightly to moderately disturbed aquatic ecosystems; or
4. a turbidity result in a downstream monitoring location higher than the result of the upstream monitoring location by more than 20%.

These triggers are based on a minimum of four sampling events per calendar year and apply to the analytes that provide the best indicators of potential Project impacts (turbidity and TPH/BTEX).

9.1.2. Management responses

If triggered, management responses will include:

1. an assessment of the monitoring results from the WTP and Bypass (if system had been in bypass mode during relevant period) monitoring locations to determine whether the surface water data could be attributed to the tunnel water treatment systems;

2. if the WTP facility is found to be ineffective at achieving the water quality objectives then discharge to the environment would cease and the alternate WTP treatment trains would be utilised or offsite disposal at a registered waste facility would be undertaken until the onsite water treatment facility was again operating at the required water quality objectives; and

4. if the water quality treatment facility is found to be effective and the discharge practices are compliant with management objectives, a wider review of Project and non-Project related potential contamination sources will be completed to confirm that the trigger value exceedance is not Project related.

9.2. Groundwater levels

Localised depressurisation of the aquifer will be monitored with data loggers installed in all monitoring bores to ascertain potential of the Project to impact on local groundwater (see section 8.6).

During detailed design, the groundwater model has been reviewed and revised to define the predicted zone of groundwater drawdown (Golder Associates 2016). The model considered:

- variable measured hydraulic conductivity values obtained during the development of the EIS;
- groundwater level data obtained during the collection of baseline monitoring;
- GDE locations; and
- groundwater users.

The review of the groundwater model during detailed design (Golder Associates 2016) resulted in this revision of the WQPMP. As significant and non-administrative revisions are required, the WQPMP will be re-issued for consultation with EPA, CLWD and councils.

The model validation will be completed in line with the six-monthly compliance reporting as detailed in Table 10.1.

9.2.1. Management response triggers

A management response will be triggered if local groundwater level data contradicts the Golder Associates (2016) groundwater model predictions by indicating groundwater drawdown beyond the modelled predictions.

9.2.2. Management responses

If the recorded decline is determined to be Project-related, then the additional groundwater level data will be used in the predictive groundwater model to validate and revise the predicted zone of impact model predictions. The measures that will be implemented to determine if groundwater users are being impacted are defined in Section 9.4.

9.3. Existing groundwater users

9.3.1. Management response triggers

A hydrocensus (condition) survey of local groundwater users (Table 3.3) has been undertaken prior to tunnelling to ascertain bore condition and current status of third party bores. As detail in Section 3.5.2, a revised 3D groundwater model has been completed (Appendix E). A further hydrocensus has been completed in December 2016 to assess potential impacts from construction activities on the larger drawdown area.

The findings of the hydrocensus, which involved consultation with the owners of the registered bores, are listed in Table 9.1.

Table 9.1 Hydrocensus results

Works number	Contact with owner	Bore in use	Bore inspection	Future monitoring	Additional comments
Groundwater users in original drawdown prediction					
GW028366	Yes	No	Not able to locate bore	N/A	Numerous attempts have been made with owner to allow the Project team to monitor the well.
Groundwater users in proximity of revised 3D drawdown prediction					
GW022935	Yes	No	No	No	The resident was unaware that there was a borehole on the property and does not want further groundwater investigation.
GW100435	Yes	No	No	No	As of February 2017 the principle of Karonga School was unaware of a ground water borehole on the schools property and does not request any further investigations into this matter.
GW102434	Yes	Yes	Permanent water extraction infrastructure installed on bore	Unlikely, due to access restrictions	Offer remains open if the owner wants monitoring in the future.
GW102946	Yes	No, “too salty”	No	No	The resident does not want his bore to be monitored.
GW106518	Yes	Yes, irrigation	Yes	Data logger installed	Consider collecting a water quality sample.
GW105743	Yes	No	No	No	A letter has been sent out to the resident but to date no reply. During a visit to the property the owner was unaware that there was a borehole on the property.
GW105750	Yes	Unknown	No	No	A letter has been sent out to the resident in December 2016 as well as a visit to the resident in February 2017

Table 9.1 Hydrocensus results

Works number	Contact with owner	Bore in use	Bore inspection	Future monitoring	Additional comments
					where an additional letter was left in the letter box, but to date no reply.
GW107347	Yes	Yes	No	No	December 2016 - A letter has been sent out to the resident. In February 2017 LLBJV visited the property where the resident was informed us that will consider future groundwater monitoring. To date the resident has not requested monitoring.

Changes to groundwater levels measured within a given bore may be the result of one or a combination of factors including changes to the bore (eg partial collapse), changes to the surface environment (eg large excavations), groundwater loss to the tunnel, rainfall events, seasonal variations and climatic variations (eg drought).

The AIP defines a minimal impact within an existing bore as being less than 2 m drawdown as a result of the Project. Therefore in areas where a greater than 2 m drawdown is predicted as a result of the Project, 'make good' provisions may be required for actively used bores.

Routine analysis of measured groundwater levels at each bore will include comparisons to baseline and previous construction monitoring results (to determine temporal trends). If this routine monitoring detects a change in the average baseline level of greater than 2 m, the potential causes will be investigated to determine if the drawdown is Project-related.

9.3.2. Management responses

The baseline data will be used when investigating drawdown. Groundwater level data from across the Project area and the groundwater model data would be used to determine whether the drawdown is localised to a section or all of the Project area. The investigation would also consider the wider area using data sourced in consultation with other construction projects, CLWD, Councils and the Bureau of Meteorology. An understanding of these temporal and spatial trends would be used to determine, to greatest level of confidence possible, whether the drawdown is Project-related.

The Project Team are committed to implementing ‘make good’ provisions for active licensed boreholes when it is found the drawdown is Project related, in accordance with the requirements of MCoAB15(j). Management responses will be implemented in consultation with the borehole licensee.

Make good provisions will be considered in consultation with the bore licensee where less than 2 m change in groundwater level occurs in actively used bores and is demonstrated to be caused by construction activities and not influenced by seasonal weather/localised conditions.

Make good provisions management responses may include the deepening of the existing bore or pump, replacement of the bore and associated pumping infrastructure, or a replacement of the supply to the equivalent volume and quality.

9.4. Groundwater dependent ecosystems and springs

9.4.1. Management response triggers

Quarterly GDE and spring surveys will continue to be undertaken during the construction phase. The surveys will be undertaken in summer and spring and are designed to capture the ecosystem condition during wet and dry periods.

The condition of the ecosystems will be assessed against a Rapid Assessment of Riparian Condition (RARC) assessment collected in November 2014 during the baseline monitoring period. The assessment considers functions and components of riparian ecosystems and use key indicators to categorise the condition of the ecosystem. A visual estimate of spring flows is recorded as part of the spring surveys.

Tracking the condition of the GDEs with comparisons against baseline conditions assist in identifying any seasonal changes in ecosystem condition or impacts from groundwater dewatering.

During operation, quarterly GDE and spring survey will be undertaken up until the requirements under CoA B15 h) are satisfied.

9.4.2. Management responses

If the quarterly GDE or spring surveys determine there is a declining trend in the discharge of springs or health of GDEs, management response would include:

1. investigation of the cause of the decline to determine if it is 'natural' (eg due to seasonal weather), not related to the Project (eg as a result of other activities in the catchment) or if it is likely to be Project-related.

2. if the decline is Project-related, potential management measures will be determined based on the severity of the impact, and the cost, practicality and likely efficacy of the potential measures. Management measures that will be considered will include reducing groundwater inflow to the tunnel through measures such as grouting, provision of additional water to GDEs, and other measures to improve the quality and resilience of the GDEs.

10. Reporting

10.1. Reporting schedule

The results of the monitoring program described in this WQPMP will be reported to the Secretary of the Department of Planning and Environment, EPA, OEH, DPI Water, DPI (Fisheries) and the relevant Council as required. The reporting schedule in Table 10.1 is based on the reporting requirements outlined in the Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ 2000b).

Table 10.1 WQPMP proposed reporting schedule

Project phase	Report timing	Report requirements	Recipients
Prior to tunnelling	This plan	Raw water quality and groundwater level monitoring results from the preceding month. Water quality data will be tabulated and provided in excel format. Trigger value and ANZECC 2000 guideline values will be applied to the dataset and exceedances will be highlighted.	RMS, Project Co, DP&E, EPA, ER, Hornsby Shire Council, Hills Shire Council, Ku-ring-gai Council, DPI Water and DPI (Fisheries)
	This plan	A detailed report on all results obtained during the baseline monitoring period (including the data presented in this document). This report will establish baseline records of water quality and groundwater levels at each monitoring location.	RMS, Project Co, DP&E, EPA, ER, Hornsby Shire Council, Hills Shire Council, Ku-ring-gai Council, DPI Water and DPI (Fisheries)
Construction	Six monthly	Raw water quality and groundwater level monitoring results from the preceding two sampling event. Water quality data will be tabulated and provided in Excel format. Trigger value and ANZECC 2000 guideline values will be applied to the dataset and exceedances will be highlighted.	RMS, Project Co, DP&E, EPA, ER, Hornsby Shire Council, Hills Shire Council, Ku-ring-gai Council, DPI Water and DPI (Fisheries)
	Six monthly	A brief section in the report on validation of the groundwater model.	RMS, Project Co, DP&E, EPA, ER, Hornsby Shire Council, Hills Shire Council, Ku-ring-gai Council, DPI Water and

Table 10.1 WQPMP proposed reporting schedule

Project phase	Report timing	Report requirements	Recipients
			DPI (Fisheries)
	Six monthly	Tabulated discharge volumes from each WTP.	RMS, Project Co, DP&E, EPA, ER, Hornsby Shire Council, Hills Shire Council, Ku-ring-gai Council, DPI Water and DPI (Fisheries)
	Six monthly	A detailed section in the report on results obtained during the construction monitoring period. This report will also provide advice regarding ongoing monitoring and management of water quality and groundwater levels.	RMS, Project Co, DP&E, EPA, ER, Hornsby Shire Council, Hills Shire Council, Ku-ring-gai Council, DPI Water and DPI (Fisheries)
	Six monthly	A brief section in the report will be provided on all data associated with WTP discharge.	RMS, Project Co, DP&E, EPA, ER, Hornsby Shire Council, Hills Shire Council, Ku-ring-gai Council, DPI Water and DPI (Fisheries)
	Annual	A detailed section of the report on ecosystem condition of SCO-01, SCO-02, COU-01, COU-02 and COU-03 obtained from data collected during the quarterly GDE and spring surveys. The report will include discussion on ecosystem condition, spring flow and regional groundwater levels. Ecosystem condition will	RMS, Project Co, DP&E, EPA, ER, Hornsby Shire Council, Hills Shire Council, Ku-ring-gai

Table 10.1 WQPMP proposed reporting schedule

Project phase	Report timing	Report requirements	Recipients
		be assessed against the baseline results which were assessed in the rapid assessment of riparian condition.	Council, DPI Water and DPI (Fisheries)
	Annual	A brief section in the report on the appropriateness of construction discharge locations and design. The report will consider the potential impacts that were identified in Table 5.4.	RMS, Project Co, DP&E, EPA, ER, Hornsby Shire Council, Hills Shire Council, Ku-ring-gai Council, DPI Water and DPI (Fisheries)
Operation	Annual	Reporting in accordance with MCoA B15 h) on water quality and groundwater level monitoring results. Water quality data obtained with compared to the trigger values and exceedances will be highlighted along with groundwater levels compared to that of the drawdown predictions.	RMS, DP&E, EPA, ER, Hills Shire Council, DPI Water and DPI (Fisheries)

11. Document review

This report was revised following more than 18 months of construction monitoring. It considers construction phase monitoring and provides details of the approach and monitoring during the operational phase.

This document may be further reviewed in response to major incidents where environmental management responses are initiated in the event of a trigger value exceedance, or in response to environmental audits, or otherwise reviewed on an annual basis as part of the review of the Construction / Operational Environmental Management Plan and relevant sub-plans.

12. Consultation

This revision of the WQPMP was provided to the Parramatta City Council, the Hills Shire Council, Hornsby Shire Council, Ku-ring-gai Council, the Crown Lands & Water Division, the EPA and DPI (Fisheries) for comment and the document has been updated in response to the comments provided..

References

ANZECC/ARMCANZ 2000a, Australian and New Zealand Guidelines for Fresh and Marine Water Quality: Volume 1 – The Guidelines, Australian and New Zealand Environment and Conservation Council (ANZECC) and the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ), accessed online, 16 January 2015, at https://www.environment.gov.au/system/files/resources/53cda9ea-7ec2-49d4-af29-d1dde09e96ef/files/nwqms-guidelines-4-vol1.pdf

ANZECC/ARMCANZ 2000b, Australian Guidelines for Water quality Monitoring and Reporting, Australian and New Zealand Environment and Conservation Council (ANZECC) and the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ), accessed online, 16 January 2015, at http://www.environment.gov.au/system/files/resources/0b71dfb9-8fea-44c7-a908-826118d403c8/files/nwqms-monitoring-reporting.pdf

AECOM Australia Pty Ltd. 2014, Environmental Impact Assessment – Volume 1B: Section 7.8 Hydrogeology and soils.

Australian Water Resources Council 1998, Guidelines for preparation of Australian hydrogeological maps. Department of Primary Industries and Energy, no 13.

Bureau of Meteorology, North Parramatta – Masons Drive (BoM: 066124).

Bureau of Meteorology, Turramurra – Kissing Point Road (BoM: 066158).

EMM 2014, NorthConnex Tunnel – Groundwater spring census, J14109_Northconnex Spring Identification V2, dated 11 December 2014.

Ferdowsian R and McCarron C 2001, Hartt Manual, Hydrograph Analysis: Rainfall and Time Trends, Department of Agriculture and Lote-Tree Software, July 2001.

Golder Associates 2016, NORTHCONNEX Groundwater Impact Modelling, Report Number: 1536023-700-01-R-Rev1, dated 29 September 2016.

GHD Pty Ltd 2016, Memo - Ecological Assessment of WTS Discharges

Hydro Tasmania Consulting 2010, Hornsby Shire Council – Groundwater Sustainable Yields Study, Revision No. 2, Hornsby LGA Council.

NSW Government 2006, NSW Water Quality and River Flow Objectives, accessed online, 19 February 2015, at http://www.rms.nsw.gov.au/ieo/index/htm

NSW Office of Water 2011a. Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources – Background document. NSW Office of Water, dated July 2011.

NSW Office of Water 2011b. Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources – Background document. NSW Office of Water, dated July 2011.

NSW Office of Water 2012, NSW Aquifer Interference Policy – NSW Government policy for the licensing and assessment of aquifer interference activities, dated September 2012. NSW Office of Water 2014, Groundwater Monitoring and Modelling Plans - Information for prospective mining and petroleum exploration activities.

Perrochet, P. & Musy, A. 1992, Irrigation and Drainage Systems 6: 69. doi:10.1007/BF01102867

RTA undated, RTA Water Policy, Roads and Traffic Authority (RTA), accessed online 19 February 2015, athttp://www.rms.nsw.gov.au/about/environment/index.html

RTA 1999, Code of practice for Water Management, Road Development and Management, dated April 1999, accessed online 19/02/2015, at http://www.rms.nsw.gov.au/documents/about/environment/code-of-practice-water-management.pdf

Yesertener C 2007, Assessment of the Declining Groundwater Levels in the Gnangara Groundwater Mound, Department of Water, Government of Western Australia, Hydrogeological Record Series Report No. HG14.

Appendix A Background monitoring data

Site ID	004								
DATE	06/10/1994	03/11/1994	07/12/1994	07/12/1994	06/01/1995	02/02/1995	07/03/1995	06/04/1995	04/05/1995
Temperature (oC)	12.4	14.1	19.9	19.9	20.5	17.7	20.4	13.9	15.4
Electrical Conductivity (ms/cm)	0.41	0.21	0.17	0.17	0.23	0.32	0.32	0.55	0.31
Electrical Conductivity (µS/cm)	410	210	170	170	230	320	320	550	310
Turbidity (NTU)	2.0	25.0	75.0	75.0	4.0	1.0	9.0	2.0	17.0
Dissolved oxygen (mg/L)	8.7	9.1	4.5	4.5	8.0	6.1	7.6	8.1	9.4
Dissolved oxygen (%sat)									
pH (x.xx)	7.30	7.82	7.74	7.74	7.31	7.35	7.41	7.50	7.53
Salinity (ppt)	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.1
Suspended Solids (mg/L)	2	8	2	2	2	2	5	2	36
Ammonium-Nitrogen (mg/L)	0.01	0.03	0.01	0.04	0.02	0.01	0.01	0.01	0.01
Oxidised Nitrogen (mg/L)	0.13	0.3	0.09	0.11	0.13	0.07	0.74	0.07	0.28
TKN (mg/L)									
Total Nitrogen (mg/L)	0.32	0.71	0.52	0.48	0.6	0.36	1.12	0.32	0.63
Total Phosphorus(mg/L)	0.01	0.06	0.06	0.06	0.03	0.02	0.04	0.01	0.07
Faecal Coliforms (CFU/100ml)	29	3300	14	24	73	34	950	30	37000
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	004								
DATE	07/06/1995	05/07/1995	03/08/1995	05/09/1995	05/09/1995	04/10/1995	07/11/1995	05/12/1995	05/12/1995
Temperature (oC)	11.6	7.3	6.6	11.4	11.4	14	16.5	18.9	18.9
Electrical Conductivity (ms/cm)	0.36	0.57	0.20	0.30	0.30	0.50	0.20	0.30	0.30
Electrical Conductivity (µS/cm)	360	570	200	300	300	500	200	300	300
Turbidity (NTU)	2.0	2.8	0.0	16.0	16.0	0.3	62.7	11.2	11.2
Dissolved oxygen (mg/L)	10.6	11.2	11.3	10.4	10.4	9.6	8.5	8.4	8.4
Dissolved oxygen (%sat)									
pH (x.xx)	7.58	7.50	7.60	7.40	7.40	7.36	6.84	7.45	7.45
Salinity (ppt)	0.1	0.2	0.1	0.2	0.2	0.2	0.1	0.2	0.2
Suspended Solids (mg/L)	2	2	2	6	6	2	22	5	5
Ammonium-Nitrogen (mg/L)	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.01
Oxidised Nitrogen (mg/L)	0.28	0.28	0.14	0.35	0.35	0.42	0.35	0.25	0.25
TKN (mg/L)									
Total Nitrogen (mg/L)	0.38	0.46	0.4	0.7	0.68	0.57	0.6	0.62	0.56
Total Phosphorus(mg/L)	0.04	0.01	0.01	0.04	0.04	0.02	0.06	0.03	0.03
Faecal Coliforms (CFU/100ml)	50	82	110	500	600	220	6000	500	700
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	004								
DATE	04/01/1996	06/02/1996	06/02/1996	05/03/1996	02/04/1996	02/05/1996	05/06/1996	03/07/1996	05/08/1996
Temperature (oC)	18.9	20.6	20.6	19.7	15.5	16.7	11.2	8.4	10
Electrical Conductivity (ms/cm)	0.20	0.40	0.40	0.00	0.30	0.00	0.30	0.40	0.60
Electrical Conductivity (µS/cm)	200	400	400		300		300	400	600
Turbidity (NTU)	15.8	2.5	2.5	76.5	2.3	62.1	3.5	1.9	3.1
Dissolved oxygen (mg/L)	9.3	8.2	8.2	10.3	8.0	9.9	15.6	13.3	10.6
Dissolved oxygen (%sat)							141.6	113.3	93.9
pH (x.xx)	7.22	7.95	7.95	8.19	7.56	6.92	7.42	7.55	7.77
Salinity (ppt)	0.1	0.2	0.2	0.0	0.1	0.0	0.2	0.2	0.3
Suspended Solids (mg/L)	7	2	2	26	2	26	2	3	2
Ammonium-Nitrogen (mg/L)	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01
Oxidised Nitrogen (mg/L)	0.3	0.15	0.15	0.27	0.08	0.17	0.14	0.15	0.4
TKN (mg/L)									
Total Nitrogen (mg/L)	0.58	0.57	0.55	0.51	0.26	0.68	0.33	0.36	0.59
Total Phosphorus(mg/L)	0.04	0.03	0.03	0.08	0.02	0.1	0.01	0.01	0.01
Faecal Coliforms (CFU/100ml)	3000	52	88	18000	42	17000	170	48	44
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	004								
DATE	04/09/1996	01/10/1996	05/11/1996	06/12/1996	07/01/1997	06/02/1997	05/03/1997	07/04/1997	06/05/1997
Temperature (oC)	11.5	14.3	14.7	19.6	19.1	19.7	20.3	15.1	15.6
Electrical Conductivity (ms/cm)	0.30	0.20	0.00	0.20	0.10	0.40	0.50	0.20	0.40
Electrical Conductivity (µS/cm)	300	200		200	100	400	500	200	400
Turbidity (NTU)	15.6	17.1	45.0	3.0	52.9	13.6	42.1	4.2	2.0
Dissolved oxygen (mg/L)	11.0	10.1	10.9	7.3	8.7	9.3	8.1	10.3	9.0
Dissolved oxygen (%sat)	101.0	98.5	107.3	79.7	93.8	101.0	89.4	102.8	90.5
pH (x.xx)	7.33	7.57	7.53	7.17	6.95	7.28	7.44	7.28	7.09
Salinity (ppt)	0.1	0.1	0.0	0.1	0.0	0.2	0.3	0.1	0.2
Suspended Solids (mg/L)	2	4	14	2	26	2	2	2	2
Ammonium-Nitrogen (mg/L)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01
Oxidised Nitrogen (mg/L)	0.99	0.9	0.33	0.08	0.2	0.15	0.07	0.13	0.07
TKN (mg/L)									
Total Nitrogen (mg/L)	1.28	1.17	0.55	0.19	0.97	0.39	0.29	0.35	0.25
Total Phosphorus(mg/L)	0.02	0.04	0.01	0.02	0.13	0.02	0.01	0.03	0.01
Faecal Coliforms (CFU/100ml)	170	1000	11000	30	18000	40	24	44	160
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	004								
DATE	04/06/1997	02/07/1997	05/08/1997	04/09/1997	01/10/1997	05/11/1997	03/12/1997	07/01/1998	04/02/1998
Temperature (oC)	10.2	10.6	8.5	12.5	12.85	17.3	19.2	20.7	23.9
Electrical Conductivity (ms/cm)	0.30	0.10	0.60	0.10	0.30	0.10	0.30	0.10	0.40
Electrical Conductivity (µS/cm)	300	100	600	100	300	100	300	100	400
Turbidity (NTU)	1.6	20.8	0.0	19.5	3.2	74.4	3.7	6.1	0.0
Dissolved oxygen (mg/L)	10.5	11.0	12.8	10.5	13.6	11.0	5.2	7.5	8.0
Dissolved oxygen (%sat)	93.4	98.5	109.4	98.3	128.3	113.4	58.8	83.9	95.2
pH (x.xx)	7.04	7.19	6.85	7.41	7.45	7.46	7.03	7.65	7.20
Salinity (ppt)	0.1	0.1	0.3	0.0	0.1	0.1	0.1	0.1	0.2
Suspended Solids (mg/L)	2	5	11	5	2	51	2	3	3
Ammonium-Nitrogen (mg/L)	0.01	0.02	0.01	0.02	0.01	0.02	0.02	0.02	0.01
Oxidised Nitrogen (mg/L)	0.09	0.27	0.15	0.24	0.37	0.44	0.01	0.19	0.21
TKN (mg/L)									
Total Nitrogen (mg/L)	0.27	0.54	0.3	0.45	0.55	1.47	0.36	0.44	0.45
Total Phosphorus(mg/L)	0.01	0.04	0.01	0.03	0.02	0.1	0.04	0.04	0.03
Faecal Coliforms (CFU/100ml)	28	3600	63	980	180	17000	88	340	250
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	004								
DATE	04/03/1998	02/04/1998	04/05/1998	04/06/1998	02/07/1998	05/08/1998	08/09/1998	06/10/1998	03/11/1998
Temperature (oC)	21.8	18.3	16.1	15.2	9.6	10.4	12.8	16.3	14.1
Electrical Conductivity (ms/cm)	0.10	0.30	0.30	0.10	0.30	0.40	0.30	0.40	0.40
Electrical Conductivity (µS/cm)	100	300	300	100	300	400	300	400	400
Turbidity (NTU)	2.7	1.1	9.8	114.7	13.6	2.7	3.0	0.0	2.3
Dissolved oxygen (mg/L)	8.5	9.5	9.7	8.1	12.1	13.1	10.5	9.2	10.3
Dissolved oxygen (%sat)	95.9	100.0	98.3	80.1	105.9	116.4	98.9	93.5	99.6
pH (x.xx)	7.00	7.43		7.62	6.86	7.73	7.36	7.50	6.82
Salinity (ppt)	0.1	0.1	0.2	0.1	0.1	0.2	0.2	0.2	0.2
Suspended Solids (mg/L)	2	2	9	132	4	2	2	2	2
Ammonium-Nitrogen (mg/L)	0.01	0.01	0.02	0.01	0.01	0.01	0.08	0.01	0.01
Oxidised Nitrogen (mg/L)	0.17	0.04	0.34	0.21	0.39	0.33	0.3	0.19	0.12
TKN (mg/L)									
Total Nitrogen (mg/L)	0.41	0.27	1.2	0.56	0.62	0.51	0.54	0.36	0.64
Total Phosphorus(mg/L)	0.02	0.01	0.02	0.06	0.03	0.01	0.01	0.02	0.02
Faecal Coliforms (CFU/100ml)	180	19	1800	29000	1000	70	29	54	80
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	004								
DATE	09/12/1998	06/01/1999	01/02/1999	01/03/1999	07/04/1999	05/05/1999	03/06/1999	06/07/1999	04/08/1999
Temperature (oC)	19.35	22.3	20.3	19.4	17.6	12.9	11.5	9.5	8.7
Electrical Conductivity (ms/cm)	0.20	0.20	0.20	0.40	0.30	0.30	0.50	0.40	0.50
Electrical Conductivity (µS/cm)	200	200	200	400	300	300	500	400	500
Turbidity (NTU)	26.2	0.0	7.2	5.7	10.0	8.7	2.2	5.4	6.5
Dissolved oxygen (mg/L)		8.4		9.1	8.4	10.9	10.0	8.3	11.6
Dissolved oxygen (%sat)		96.5		100.0	87.4	103.1	92.3	73.4	99.4
pH (x.xx)	7.31	6.57	7.20	7.57	7.28	7.20	7.13	7.51	7.22
Salinity (ppt)	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2
Suspended Solids (mg/L)	8	5	1	3	2	1	1	1	1
Ammonium-Nitrogen (mg/L)	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Oxidised Nitrogen (mg/L)	0.19	0.08	0.28	0.22	0.52	0.19	0.11	0.6	0.3
TKN (mg/L)									
Total Nitrogen (mg/L)	0.49	0.42	0.5	0.53	0.87	0.38	0.43	0.74	0.43
Total Phosphorus(mg/L)	0.04	0.03	0.03	0.02	0.03	0.02	0.02	0.02	0.01
Faecal Coliforms (CFU/100ml)	13000	38	3900	480	1100	48	96	130	260
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	004								
DATE	07/09/1999	06/10/1999	03/11/1999	08/12/1999	05/01/2000	02/02/2000	07/03/2000	04/04/2000	01/05/2000
Temperature (oC)	12.47	15.33	15.33	18.84	18.09	18.99	18.91	18.11	14.69
Electrical Conductivity (ms/cm)	0.50	0.20	0.40	0.40	0.30	0.30	0.00	0.50	0.30
Electrical Conductivity (µS/cm)	500	200	400	400	300	300		500	300
Turbidity (NTU)	4.3	26.0	5.5	14.7	2.4	1.5	18.0	2.1	3.3
Dissolved oxygen (mg/L)	11.6	10.8	10.7	9.8	9.4	8.1	9.7	9.4	9.0
Dissolved oxygen (%sat)	108.2	107.4	107.2	104.6	99.6	87.5	103.9	99.0	88.2
pH (x.xx)	7.41	7.28	7.40	7.24	7.07	6.92	7.06	7.43	6.97
Salinity (ppt)	0.2	0.1	0.2	0.2	0.2	0.1	0.0	0.2	0.1
Suspended Solids (mg/L)	1	9	1	3	1	1	16	1	1
Ammonium-Nitrogen (mg/L)	0.01	0.01	0.01	0.01	0.03	0.01	0.01	0.01	0.02
Oxidised Nitrogen (mg/L)	0.24	0.29	0.48	0.11	0.16	0.01	0.22	0.18	0.14
TKN (mg/L)									
Total Nitrogen (mg/L)	0.43	0.53	0.68	0.29	0.36	0.11	0.5	0.4	0.31
Total Phosphorus(mg/L)	0.01	0.06	0.03	0.02	0.03	0.01	0.05	0.02	0.02
Faecal Coliforms (CFU/100ml)	150	4700	130	8	63	10	7800	1000	140
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	004								
DATE	07/06/2000	06/07/2000	04/08/2000	05/09/2000	06/10/2000	09/11/2000	06/12/2000	04/01/2001	07/02/2001
Temperature (oC)	7.27	5.4	7.77	10.07	14.14	15.39	19.45	20.16	21.41
Electrical Conductivity (ms/cm)	0.50	0.30	0.30	0.30	0.30	0.30	0.50	0.40	0.40
Electrical Conductivity (µS/cm)	500	300	300	300	300	300	500	400	400
Turbidity (NTU)	16.3	5.4	3.1	19.1	5.6	2.2	17.8	10.5	10.0
Dissolved oxygen (mg/L)	12.3	11.8	12.0	10.8	9.5	9.3	9.4	7.9	9.2
Dissolved oxygen (%sat)	101.6	104.4	100.6	95.6	92.9	92.7	102.6	87.3	104.0
pH (x.xx)	7.46	7.22	7.17	7.28	7.06	7.15	7.42	7.14	7.39
Salinity (ppt)	0.3	0.2	0.2	0.1	0.1	0.2	0.3	0.2	0.2
Suspended Solids (mg/L)	1	1	1	6	1	1	5	1	2
Ammonium-Nitrogen (mg/L)	0.01	0.02	0.01	0.01	0.01	0.02	0.03	0.03	0.01
Oxidised Nitrogen (mg/L)	0.12	0.17	0.28	0.2	0.17	0.16	0.29	0.09	1.04
TKN (mg/L)									
Total Nitrogen (mg/L)	0.26	0.31	0.42	0.41	0.36	0.33	0.6	0.34	1.32
Total Phosphorus(mg/L)	0.01	0.02	0.02	0.03	0.03	0.03	0.03	0.02	0.03
Faecal Coliforms (CFU/100ml)	52	63	35	52	9	12	100	16	540
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	004								
DATE	06/03/2001	05/04/2001	09/05/2001	06/06/2001	03/07/2001	09/08/2001	04/09/2001	02/10/2001	05/11/2001
Temperature (oC)	19.97	16.59	15.84	10.18	8.43	9.04	11.25	15.08	15.81
Electrical Conductivity (ms/cm)	0.20	0.50	0.30	0.50	0.50	0.60	0.40	0.40	0.30
Electrical Conductivity (µS/cm)	200	500	300	500	500	600	400	400	300
Turbidity (NTU)	57.4	10.9	18.0	16.4	15.2	12.8	17.2	27.0	22.5
Dissolved oxygen (mg/L)	9.0	9.2	10.3	11.4	12.1	11.4	11.1	10.6	8.5
Dissolved oxygen (%sat)	99.4	94.4	104.1	101.5	103.4	98.7	101.5	105.0	85.5
pH (x.xx)	7.17	7.32	7.29	7.42	7.37	7.38	7.39	7.35	6.98
Salinity (ppt)	0.0	0.3	0.2	0.2	0.3	0.3	0.2	0.2	0.1
Suspended Solids (mg/L)	23	1	3	1	1	1	1	3	1
Ammonium-Nitrogen (mg/L)	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01
Oxidised Nitrogen (mg/L)	0.11	0.19	1.41	0.26	0.16	0.26	0.32	0.2	0.09
TKN (mg/L)									
Total Nitrogen (mg/L)	0.34	0.39	1.62	0.42	0.31	0.43	0.49	0.46	0.32
Total Phosphorus(mg/L)	0.05	0.02	0.04	0.01	0.01	0.01	0.02	0.03	0.02
Faecal Coliforms (CFU/100ml)	24000	120	920	120	60	110	65	1100	13
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	004								
DATE	04/12/2001	09/01/2002	07/02/2002	06/03/2002	08/04/2002	02/05/2002	05/06/2002	02/07/2002	06/08/2002
Temperature (oC)	21.31	20.95	19.33	20.16	16.17	14.34	10.59	6.42	8.17
Electrical Conductivity (ms/cm)	0.20	0.20	0.40	0.30	0.40	0.40	0.30	0.40	0.20
Electrical Conductivity (µS/cm)	200	200	400	300	400	400	300	400	200
Turbidity (NTU)	20.0	18.8	15.4	38.2	1.4	1.1	2.4	3.1	4.9
Dissolved oxygen (mg/L)	7.1	7.2	9.1	8.9	10.2	9.0	10.3	11.6	9.7
Dissolved oxygen (%sat)	79.9	80.4	99.1	98.2	103.4	87.5	92.5	93.7	82.1
pH (x.xx)	7.02	7.08	7.46	7.38	7.39	7.22	7.22	7.18	7.13
Salinity (ppt)	0.1	0.1	0.2	0.2	0.2	0.2	0.1	0.2	0.1
Suspended Solids (mg/L)	8	3	3	9	1	1	1	5	5
Ammonium-Nitrogen (mg/L)	0.02	0.02	0.02	0.01	0.02	0.02	0.01	0.01	0.02
Oxidised Nitrogen (mg/L)	0.42	0.2	0.97	0.54	0.18	0.09	0.17	0.16	0.28
TKN (mg/L)									
Total Nitrogen (mg/L)	0.9	0.51	1.21	0.96	0.4	0.26	0.38	0.28	0.46
Total Phosphorus(mg/L)	0.07	0.05	0.03	0.05	0.02	0.02	0.03	0.02	0.02
Faecal Coliforms (CFU/100ml)	7000	150	1800	2000	74	58	100	64	50
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	004								
DATE	04/09/2002	09/10/2002	12/11/2002	03/12/2002	15/01/2003	05/02/2003	03/03/2003	11/04/2003	08/05/2003
Temperature (oC)	11.18	14.18	16.87	19.56	19.28	19.53	17.76	14.93	14.6
Electrical Conductivity (ms/cm)	0.30	0.40	0.40	0.30	0.30	0.40	0.40	0.40	0.40
Electrical Conductivity (µS/cm)	300	400	400	300	300	400	400	400	400
Turbidity (NTU)	1.5	2.5	15.0	0.0	8.5	0.0	0.6	0.0	1.8
Dissolved oxygen (mg/L)	11.3	8.7	5.7	7.2	6.9	4.4	6.5	7.9	10.0
Dissolved oxygen (%sat)	103.3	84.5	58.5	78.8	74.6	48.2	68.0	77.1	98.1
pH (x.xx)	7.22	7.42	6.79	7.16	7.18	7.08	7.10	7.33	7.38
Salinity (ppt)	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Suspended Solids (mg/L)	2	1	1	1	2	2	1	1	1
Ammonium-Nitrogen (mg/L)	0.01	0.01	0.01	0.02	0.02	0.01	0.03	0.01	0.02
Oxidised Nitrogen (mg/L)	0.25	0.12	0.01	0.19	0.02	0.01	0.05	0.05	0.42
TKN (mg/L)									
Total Nitrogen (mg/L)	0.39	0.3	0.25	0.56	0.24	0.26	0.35	0.24	0.63
Total Phosphorus(mg/L)	0.02	0.02	0.02	0.05	0.05	0.03	0.03	0.02	0.03
Faecal Coliforms (CFU/100ml)	54	5	48	250	20	20	24	190	270
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)		2240.00	10.00	20.00	10.00				
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	004								
DATE	05/06/2003	04/07/2003	14/08/2003	05/09/2003	08/10/2003	13/11/2003	11/12/2003	13/01/2004	04/02/2004
Temperature (oC)	13.85	11.01	9.74	9.5					
Electrical Conductivity (ms/cm)	0.40	0.40	0.50	0.30					
Electrical Conductivity (µS/cm)	400	400	500	300					
Turbidity (NTU)	6.4	10.3	1.2	3.6					
Dissolved oxygen (mg/L)	10.2	11.2	11.9	11.4					
Dissolved oxygen (%sat)	99.2	100.9	104.2	99.4					
pH (x.xx)	7.43	7.47	7.43	7.29					
Salinity (ppt)	0.2	0.2	0.2	0.2					
Suspended Solids (mg/L)	1	2	3	1	3	17	3	1	1
Ammonium-Nitrogen (mg/L)	0.03	0.02	0.01	0.01	0.02	0.03	0.02	0.03	0.03
Oxidised Nitrogen (mg/L)	0.69	0.87	0.33	0.2	0.2	1.5	0.66	0.26	0.05
TKN (mg/L)									
Total Nitrogen (mg/L)	0.9	0.99	0.44	0.33	0.43	1.67	0.84	0.59	0.29
Total Phosphorus(mg/L)	0.05	0.04	0.02	0.02	0.04	0.07	0.05	0.04	0.08
Faecal Coliforms (CFU/100ml)	2600	660	120	34	740	16	36	26	60
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	004								
DATE	08/03/2004	31/03/2004	05/05/2004	31/05/2004	08/07/2004	03/08/2004	06/09/2004	07/10/2004	02/11/2004
Temperature (oC)		17.105	11.355	9.39	8.25	8.285	10.68	14.39	
Electrical Conductivity (ms/cm)		0.40	0.30	0.90	0.30	0.30	0.30	0.40	
Electrical Conductivity (µS/cm)		400	300	900	300	300	300	400	
Turbidity (NTU)		1.6	9.6	30.3	4.6	0.2	3.8	2.8	
Dissolved oxygen (mg/L)		8.9	6.5	6.6	10.4	9.9	11.0	9.4	
Dissolved oxygen (%sat)		92.2	59.1	56.8	87.6	83.8	99.0	91.6	
pH (x.xx)		7.12	7.15	8.00	7.25	7.24	7.38	7.34	
Salinity (ppt)		0.2	0.2	0.4	0.1	0.1	0.1	0.2	
Suspended Solids (mg/L)	3	1	1	1	2	1	1	1	1
Ammonium-Nitrogen (mg/L)	0.02	0.02	0.02	0.01	0.01	0.01	0.005	0.01	0.005
Oxidised Nitrogen (mg/L)	0.13	0.05	0.06	0.19	0.07	0.14	0.15	0.59	0.07
TKN (mg/L)									
Total Nitrogen (mg/L)	0.36	0.19	0.22	0.44	0.19	0.3	0.35	0.75	0.22
Total Phosphorus(mg/L)	0.04	0.02	0.02	0.02	0.012	0.018	0.024	0.021	0.016
Faecal Coliforms (CFU/100ml)	330	12	22	20	45	20	230	68	180
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)		53							
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	004								
DATE	29/11/2004	11/01/2005	10/02/2005	09/03/2005	06/04/2005	10/05/2005	08/06/2005	08/07/2005	10/08/2005
Temperature (oC)	18.315	17.8	19.27	17.81		14.95	10.54	10.61	8.49
Electrical Conductivity (ms/cm)	0.30	0.20	0.25	0.30		0.30	0.30	0.40	0.40
Electrical Conductivity (µS/cm)	300	200	250	300		300	300	400	400
Turbidity (NTU)	0.6	1.9	2.0	1.0		2.9	5.5	1.9	2.2
Dissolved oxygen (mg/L)	8.1	6.5	5.7	6.7		8.4	9.7	10.7	10.7
Dissolved oxygen (%sat)	86.0	67.9	60.8	70.3		82.8	86.7	95.7	91.2
pH (x.xx)	7.23	7.09	7.11	7.00		7.20	7.18	7.37	7.40
Salinity (ppt)	0.2	0.1	0.1	0.2		0.2	0.1	0.2	0.2
Suspended Solids (mg/L)	2	1	4	1	1	1	1	2	0.5
Ammonium-Nitrogen (mg/L)	0.01	0.02	0.02	0.02	0.01	0.01	0.02	0.01	0.01
Oxidised Nitrogen (mg/L)	0.08	0.06	0.08	0.09	0.18	0.06	0.1	0.37	0.224
TKN (mg/L)									0.3
Total Nitrogen (mg/L)	0.32	0.34	0.39	0.31	0.3	0.19	0.23	0.62	0.5
Total Phosphorus(mg/L)	0.037	0.057	0.039	0.027	0.024	0.016	0.017	0.019	0.005
Faecal Coliforms (CFU/100ml)	68	72	34	24	72	18	14	70	73
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	004								
DATE	05/09/2005	07/10/2005	04/11/2005	05/12/2005	11/01/2006	01/02/2006	02/03/2006	10/04/2006	04/05/2006
Temperature (oC)	11.125	14.405		18.12	21.52	21.49	20.16	13.61	
Electrical Conductivity (ms/cm)	0.30	0.20		0.10	0.20	0.40	0.30	0.30	
Electrical Conductivity (µS/cm)	300	200		100	200	400	300	300	
Turbidity (NTU)	25.8	7.5		5.4	4.7	4.5	7.5	0.3	
Dissolved oxygen (mg/L)	10.5	7.3		8.4	7.3	6.5	7.8	5.3	
Dissolved oxygen (%sat)	97.6	71.5		89.2	82.4	73.4	86.4	50.3	
pH (x.xx)	7.11	7.02		7.10	6.94	6.96	6.57	7.14	
Salinity (ppt)	0.1	0.1		0.1	0.1	0.2	0.2	0.1	
Suspended Solids (mg/L)	10	2	2	3	0.5	2		2	5
Ammonium-Nitrogen (mg/L)	0.005	0.035	0.013	0.044	0.041	0.032		0.016	0.048
Oxidised Nitrogen (mg/L)	0.371	0.129	0.115	0.208	0.098	0.055		0.047	0.053
TKN (mg/L)	0.5	0.2	0.6	0.2	0.2	0.16		0.16	0.15
Total Nitrogen (mg/L)	0.9	0.3	0.7	0.42	0.3	0.21		0.21	0.2
Total Phosphorus(mg/L)	0.04	0.05	0.005	0.049	0.053	0.016		0.037	0.0025
Faecal Coliforms (CFU/100ml)	4100	14	15	76	48	8		5	29
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	004								
DATE	16/06/2006	13/07/2006	08/08/2006	05/09/2006	12/10/2006	09/11/2006	04/12/2006	02/01/2007	09/02/2007
Temperature (oC)		6.56	10.21	11.41		15.09	16.8	18.67	20.09
Electrical Conductivity (ms/cm)		0.20	0.40	0.20		0.20	0.10	0.20	0.20
Electrical Conductivity (µS/cm)		200	400	200		200	100	200	200
Turbidity (NTU)		1.9	20.8	2.2		2.2	5.4	1.6	4.8
Dissolved oxygen (mg/L)		11.0	12.0	9.1		8.7	8.4	6.8	4.6
Dissolved oxygen (%sat)		89.5	106.2	83.2		86.7	85.7	72.9	51.0
pH (x.xx)		7.10	7.41	7.14		7.04	7.40	7.20	6.79
Salinity (ppt)		0.1	0.2	0.1		0.1	0.1	0.1	0.1
Suspended Solids (mg/L)	0.5	0.5	2	0.5	2	1	4	1	2
Ammonium-Nitrogen (mg/L)	0.005	0.005	0.02	0.005	0.015	0.019	0.023	0.005	0.005
Oxidised Nitrogen (mg/L)	0.143	0.18	0.798	0.217	0.058	0.169	0.079	0.104	0.018
TKN (mg/L)	0.17	0.24	0.17	0.25	0.34	0.25	0.28	1.17	0.31
Total Nitrogen (mg/L)	0.31	0.42	0.97	0.5	0.4	0.42	0.36	1.27	0.33
Total Phosphorus(mg/L)	0.025	0.04	0.012	0.0025	0.0025	0.029	0.024	0.073	0.016
Faecal Coliforms (CFU/100ml)	76	42	540	20	10	86	2900	50	370
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	004								
DATE	30/04/2007	06/06/2007	19/07/2007	13/08/2007	12/09/2007	05/10/2007	15/11/2007	14/12/2007	10/01/2008
Temperature (oC)		9.51	6.67	8.98	11.45	12.06	16.67	17.12	19.9
Electrical Conductivity (ms/cm)		0.30	0.45	0.50	0.20	0.26	0.48	0.38	0.42
Electrical Conductivity (µS/cm)		300	450	500	200	260	480	380	420
Turbidity (NTU)		1.5	10.0	0.8	17.2	19.8	2.4	3.3	0.0
Dissolved oxygen (mg/L)		9.6	12.4	11.0	10.5	9.4	8.4	9.4	6.9
Dissolved oxygen (%sat)		84.0	101.2	95.2	96.2	87.4	85.8	97.5	75.6
pH (x.xx)		7.05	7.34	7.68	7.20	7.34	7.29	7.37	7.31
Salinity (ppt)		0.1	0.2	0.2	0.1	0.1	0.2	0.2	0.2
Suspended Solids (mg/L)	3	1	0.5	0.5	0.5	5	1	2	1
Ammonium-Nitrogen (mg/L)	0.005	0.025	0.106	0.022	0.005	0.005	0.005	0.019	0.005
Oxidised Nitrogen (mg/L)	0.251	0.112	0.753	0.275	0.242	0.143	0.206	0.279	0.127
TKN (mg/L)	0.2	0.21	0.23	0.2	0.2	0.16	0.22	0.23	0.19
Total Nitrogen (mg/L)	0.46	0.32	0.98	0.47	0.44	0.3	0.4	0.5	0.3
Total Phosphorus(mg/L)	0.0025	0.015	0.02	0.0025	0.0025	0.0025	0.005	0.02	0.01
Faecal Coliforms (CFU/100ml)	690	26	44	4	200	10	80	450	55
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	004								
DATE	04/02/2008	28/02/2008	10/04/2008	07/05/2008	29/05/2008	08/07/2008	04/08/2008	16/09/2008	16/09/2008
Temperature (oC)	21.1	19.18	15.75	10.7	10.0	9.4	7.6	13.0	
Electrical Conductivity (ms/cm)	0.14	0.16	0.10	0.34	0.34	0.42	0.28	0.32	
Electrical Conductivity (µS/cm)	140	160	100	340	340	422.83999	283.55922	320	
Turbidity (NTU)	22.0	30.6	7.0	1.2	1.7	0.7	3.9	5.6	
Dissolved oxygen (mg/L)	9.1	8.6	9.8	10.8	10.2	11.25	11.62	10.17	
Dissolved oxygen (%sat)	101.8	92.5	98.0	97.2	90.9	98.1	97.0	96.5	
pH (x.xx)	7.57	7.27	7.57	7.42	7.17	7.31	7.45	7.41	
Salinity (ppt)	0.1	0.1	0.1	0.17	0.17	0.21	0.14	0.16	
Suspended Solids (mg/L)	6	14	2	1	1	1	0.5	2	2
Ammonium-Nitrogen (mg/L)	0.022	0.005	0.005	0.015	0.005	0.005	0.005	0.005	0.005
Oxidised Nitrogen (mg/L)	0.579	0.236	0.195	0.165	0.15	0.252	0.316	0.25	0.25
TKN (mg/L)	0.27	0.26	0.13	0.05	0.13	0.13	0.07	0.18	0.18
Total Nitrogen (mg/L)	0.85	0.5	0.32	0.22	0.28	0.38	0.38	0.42	0.43
Total Phosphorus(mg/L)	0.055	0.056	0.016	0.008	0.017	0.0025	0.0025	0.0025	0.008
Faecal Coliforms (CFU/100ml)	5100	19000	2100	40	15	45	70	370	330
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	004								
DATE	16/10/2008	10/11/2008	10/12/2008	08/01/2009	13/02/2009	13/03/2009	07/04/2009	07/05/2009	09/06/2009
Temperature (oC)	14.77	15.9	19.21	19.6	17.81	18.4	17.37	12.13	11.07
Electrical Conductivity (ms/cm)	0.18	0.3	0.2	0.33	0.16	0.28	0.29	0.34	0.41
Electrical Conductivity (µS/cm)	180	300	200	330	160	280	290	340	410
Turbidity (NTU)	12.7	2.6	28.7	2.8	108	3.5	0.9	0.8	1.6
Dissolved oxygen (mg/L)	8.47	7.19	7.9	8.16	9.61	8.6	8.69	9.92	10.5
Dissolved oxygen (%sat)	83.8	76	85.1	89.1	101	91.9	90.6	92.2	90
pH (x.xx)	7.16	7.18	7.12	7.35	7.32	7.24	7.24	7.43	7.45
Salinity (ppt)	0.09	0.15	0.1	0.16	0.08	0.14	0.14	0.17	0.21
Suspended Solids (mg/L)	7	1	1	2	112	2	1	1	1
Ammonium-Nitrogen (mg/L)	0.005	0.005	0.026	0.0025	0.009	0.008	0.0025	0.0025	0.013
Oxidised Nitrogen (mg/L)	0.11	0.13	0.142	0.117	0.142	0.13	0.179	0.129	0.258
TKN (mg/L)	0.39	0.26	0.34	0.25	0.46	0.18	0.23	0.15	0.16
Total Nitrogen (mg/L)	0.5	0.39	0.48	0.36	0.6	0.31	0.41	0.28	0.42
Total Phosphorus(mg/L)	0.027	0.02	0.035	0.0025	0.1	0.023	0.018	0.007	0.006
Faecal Coliforms (CFU/100ml)	1200	20	470	630	12000	420	170	60	42
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	004								
DATE	09/06/2009	22/07/2009	21/08/2009	17/09/2009	14/10/2009	17/11/2009	17/12/2009	19/01/2010	09/02/2010
Temperature (oC)		8.47	8.25	12.23	12.55	18.58	19.84	17.74	21.64
Electrical Conductivity (ms/cm)		0.22	0.3	0.34	0.33	0.28	0.27	0.23	0.37
Electrical Conductivity (µS/cm)		220	300	340	330	280	270	230	370
Turbidity (NTU)		4	4.3	5.9	1.9	0.3	0.8	1	4
Dissolved oxygen (mg/L)		10.89	10.94	10	9.59	6.4	5.42	5.56	8.71
Dissolved oxygen (%sat)		98	92.4	96	90	67.9	59.5	58.4	99
pH (x.xx)		7.35	7.24	7.2	7.34	7.2	7.2	7	7.33
Salinity (ppt)		0.11	0.15	0.17	0.17	0.14	0.13	0.11	0.19
Suspended Solids (mg/L)	2	2	1	1	1	1	1	1	1
Ammonium-Nitrogen (mg/L)	0.008	0.005	0.01	0.01	0.01	0.01	0.02	0.005	0.08
Oxidised Nitrogen (mg/L)	0.252	0.15	0.17	0.14	0.24	0.12	0.09	0.06	0.79
TKN (mg/L)	0.16								
Total Nitrogen (mg/L)	0.41	0.28	0.31	0.29	0.48	0.37	0.34	0.33	1.29
Total Phosphorus(mg/L)	0.012	0.015	0.014	0.013	0.025	0.034	0.048	0.045	0.041
Faecal Coliforms (CFU/100ml)	26	86	8	38	72	78	63	30	3800
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)				50.1					
Chloride (mg/L)				74					
Sulphate as SO_4^{2-}(mg/L)				12					
Fluoride (mg/L)				0.27			0.22		
Sodium (mg/L)				39					
Potassium (mg/L)				2.12					
Magnesium (mg/L)				7.27					
Calcium (mg/L)				18					
Aluminium (ug/L)				12					
Arsenic (ug/L)				0.5					
Cadmium (ug/L)				0.5					
Chromium (ug/L)				0.5					
Copper (ug/L)				0.5					
Lead (ug/L)				0.5					
Manganese (ug/L)				11					
Molybdenum (ug/L)				0.5					
Nickel (ug/L)				0.5					
Selenium (ug/L)				1.5					
Silver (ug/L)				0.5					
Uranium (ug/L)				0.5					
Zinc (ug/L)				6					
Boron (ug/L)				8					
Iron (ug/L)				489					
Mercury (ug/L)				0.05					
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	004								
DATE	18/03/2010	15/04/2010	11/05/2010	16/06/2010	13/07/2010	10/08/2010	06/09/2010	06/10/2010	03/11/2010
Temperature (oC)	16.48	14.71	11.63	8.26	10.21	8.66	12.58	15.21	15.8
Electrical Conductivity (ms/cm)	0.3	0.18	0.27	0.46	0.29	0.3		0.18	0.16
Electrical Conductivity (µS/cm)	300	180	270	460	290	300		180	160
Turbidity (NTU)	0.7	1.5	0.8	0	1.7	8	3.5	3.0	8.7
Dissolved oxygen (mg/L)	8.46	8.83	9.74	11.2	10.56	10.69	9.19	9.33	9.26
Dissolved oxygen (%sat)	86.6	86.9	89.5	95	93.9	92.7	86.3	92.7	93.4
pH (x.xx)	7.18	7.26	7.3	7.45	7.08	6.96	7.15	6.96	7.15
Salinity (ppt)	0.15	0.09	0.13	0.23	0.14	0.15		0.09	0.06
Suspended Solids (mg/L)	1	1	1	1	1	4	1	1	2
Ammonium-Nitrogen (mg/L)	0.01	0.01	0.01	0.005	0.05	0.01	0.02	0.01	0.01
Oxidised Nitrogen (mg/L)	0.09	0.11	0.09	0.32	0.71	1.44	0.56	0.61	0.38
TKN (mg/L)									
Total Nitrogen (mg/L)	0.28	0.27	0.22	0.54	0.93	1.66	0.68	0.85	0.66
Total Phosphorus(mg/L)	0.022	0.026	0.014	0.016	0.049	0.079	0.08	0.07	0.072
Faecal Coliforms (CFU/100ml)	48	21	34	220	250	480	710	190	2600
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)								32.1	
Chloride (mg/L)								74	
Sulphate as SO_4^{2-}(mg/L)								26	
Fluoride (mg/L)		0.14	0.23	0.13				0.13	
Sodium (mg/L)					29.9			20.6	
Potassium (mg/L)								1.86	
Magnesium (mg/L)								3.76	
Calcium (mg/L)					14.7			11.9	
Aluminium (ug/L)					57				
Arsenic (ug/L)					0.5				
Cadmium (ug/L)					0.5				
Chromium (ug/L)					0.5				
Copper (ug/L)					3				
Lead (ug/L)					0.5				
Manganese (ug/L)					7				
Molybdenum (ug/L)					0.5				
Nickel (ug/L)					0.5				
Selenium (ug/L)					1.5				
Silver (ug/L)					0.5				
Uranium (ug/L)					0.5				
Zinc (ug/L)					2.5				
Boron (ug/L)					32				
Iron (ug/L)					378				
Mercury (ug/L)									
BOD5/CBOD5(mg/L)		1							
Total Organic Carbon(mg/L)									

Site ID	004								
DATE	09/12/2010	10/01/2011	14/02/2011	25/03/2011	21/04/2011	21/04/2011	20/05/2011	15/06/2011	04/08/2011
Temperature (oC)	19.82	21.49	19.96	18.81	14.88		9.83	13.41	8.9
Electrical Conductivity (ms/cm)	0.4	0.15	0.22	0.35	0.38		0.44	0.26	0.45
Electrical Conductivity (µS/cm)	400	150	220	350	380		440	260	450
Turbidity (NTU)	0.3	8.1	2.1	2.1	1.5		1.6	37.2	4.6
Dissolved oxygen (mg/L)	7.75	8.6	8.02	8.38	9.71		10.41	11.6	11.2
Dissolved oxygen (%sat)	84.9	97.6	88.2	89.9	95.9		91.9	110.4	96.7
pH (x.xx)	7.1	7.35	7.16	7.01	7.3		7.2	7.1	6.95
Salinity (ppt)	0.2	0.08	0.11	0.17	0.19		0.22	0.09	0.22
Suspended Solids (mg/L)	1	3	2	1	1	1	1	15	1
Ammonium-Nitrogen (mg/L)	0.01	0.01	0.02	0.01	0.03	0.02	0.01	0.01	0.01
Oxidised Nitrogen (mg/L)	0.81	0.13	0.06	0.31	0.4	0.4	0.17	0.54	0.31
TKN (mg/L)									
Total Nitrogen (mg/L)	1.11	0.37	0.39	0.62	0.63	0.64	0.35	0.9	0.46
Total Phosphorus(mg/L)	0.079	0.06	0.063	0.027	0.017	0.017	0.013	0.07	0.013
Faecal Coliforms (CFU/100ml)	36	610	610	110	87	81	17	6000	80
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)	52.1								
Chloride (mg/L)	74								
Sulphate as SO_4^{2-}(mg/L)	15								
Fluoride (mg/L)	0.21								
Sodium (mg/L)	37.3		23.6						
Potassium (mg/L)	2.9		3.42						
Magnesium (mg/L)	6.29		4.4						
Calcium (mg/L)	18.3		12.9						
Aluminium (ug/L)	49		140						
Arsenic (ug/L)	0.5		0.5						
Cadmium (ug/L)	0.5		0.5						
Chromium (ug/L)	0.5		0.5						
Copper (ug/L)	2		3						
Lead (ug/L)	0.5		2						
Manganese (ug/L)	13		12						
Molybdenum (ug/L)	0.5		0.5						
Nickel (ug/L)	0.5		0.5						
Selenium (ug/L)	1.5		1.5						
Silver (ug/L)	0.5		0.5						
Uranium (ug/L)	0.5		0.5						
Zinc (ug/L)	31		18						
Boron (ug/L)	33		37						
Iron (ug/L)	468		974						
Mercury (ug/L)	0.05		0.05						
BOD5/CBOD5(mg/L)			1						
Total Organic Carbon(mg/L)		6		7.6					

Site ID	004								
DATE	07/10/2011	26/10/2011	22/11/2011	15/12/2011	13/01/2012	09/02/2012	13/03/2012	13/04/2012	09/05/2012
Temperature (oC)	12.58	15.72	18.31	16.82	17.22	18.9	18.44	14.49	11.24
Electrical Conductivity (ms/cm)	0.4	0.44	0.22	0.29	0.33	0.28	0.34	0.25	0.41
Electrical Conductivity (µS/cm)	400	440	220	290	330	280	340	250	410
Turbidity (NTU)	0	4	3.4	5.3	2.2	3.1	5.6	3.6	0.7
Dissolved oxygen (mg/L)	9.17	9.24	7.82	10.65	7.79	9.08	9.58	9.29	10.23
Dissolved oxygen (%sat)	86.1	94.2	83.5	109.7	81	97.8	102.1	91.1	93.1
pH (x.xx)	7.57	7.25	7	7.25	6.9	7.37	7.47	7.01	7.4
Salinity (ppt)	0.2	0.22	0.11	0.15	0.16	0.14	0.17	0.12	0.20
Suspended Solids (mg/L)	1	2	4	1	1	1	1	2	1
Ammonium-Nitrogen (mg/L)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.005
Oxidised Nitrogen (mg/L)	0.19	0.22	0.11	0.41	0.14	0.17	0.24	0.34	0.14
TKN (mg/L)									
Total Nitrogen (mg/L)	0.37	0.59	0.36	0.66	0.37	0.4	0.55	0.58	0.31
Total Phosphorus(mg/L)	0.016	0.035	0.049	0.025	0.023	0.025	0.023	0.026	0.014
Faecal Coliforms (CFU/100ml)	210	1700	150	230	75	78	89	320	190
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)	49.6			44.8					
Chloride (mg/L)	76			65					
Sulphate as SO_4^{2-}(mg/L)	23			22					
Fluoride (mg/L)	0.13			0.08					
Sodium (mg/L)	39.8			45.1					
Potassium (mg/L)	2.43			2.34					
Magnesium (mg/L)	7.34			6.44					
Calcium (mg/L)	19.5			17.5					
Aluminium (ug/L)	111			365					
Arsenic (ug/L)	0.5			0.5					
Cadmium (ug/L)	0.5			0.5					
Chromium (ug/L)	0.5			0.5					
Copper (ug/L)	1			4					
Lead (ug/L)	0.5			0.5					
Manganese (ug/L)	10			9					
Molybdenum (ug/L)	0.5			0.5					
Nickel (ug/L)	1			1					
Selenium (ug/L)	1.5			1.5					
Silver (ug/L)	0.5			0.5					
Uranium (ug/L)	0.5			0.5					
Zinc (ug/L)	18			20					
Boron (ug/L)	19			47					
Iron (ug/L)	500			710					
Mercury (ug/L)	0.005			0.005					
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)		8.1							

Site ID	004								
DATE	04/06/2012	03/07/2012	22/08/2012	20/09/2012	16/10/2012	13/11/2012	10/12/2012	09/01/2013	15/02/2013
Temperature (oC)	13.81	8.28	8.09	11.64	12.34	15.75	17.34	20.73	18.83
Electrical Conductivity (ms/cm)	0.12	0.36	0.45	0.33	0.19	0.3	0.28	0.26	0.27
Electrical Conductivity (µS/cm)	120	360	450	330	190	300	280	260	270
Turbidity (NTU)	18.7	2	1.9	10.1	5.8	4.3	4.9	1.4	1.8
Dissolved oxygen (mg/L)	9.98	11.09	11.5	9.77	9.98	7.45	6.03	5.47	8.06
Dissolved oxygen (%sat)	96.3	94.2	97	88.9	93	74.8	62.8	61.1	86.60
pH (x.xx)	7.44	7.36	7.54	7.34	7.25	7.13	7.05	7.21	7.25
Salinity (ppt)	0.06	0.18	0.22	0.16	0.09	0.15	0.14	0.13	0.13
Suspended Solids (mg/L)	7	1	1	4	3	1	1	1	2
Ammonium-Nitrogen (mg/L)	0.01	0.005	0.005	0.01	0.01	0.01	0.01	0.01	0.01
Oxidised Nitrogen (mg/L)	0.13	0.21	0.21	0.23	0.08	0.1	0.1	0.05	0.12
TKN (mg/L)									
Total Nitrogen (mg/L)	0.35	0.36	0.45	0.61	0.3	0.48	0.38	0.31	0.39
Total Phosphorus(mg/L)	0.056	0.013	0.009	0.044	0.04	0.04	0.046	0.037	0.027
Faecal Coliforms (CFU/100ml)	16000	28	5	600	380	25	47	40	53
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	004								
DATE	15/03/2013	09/04/2013	29/05/2013	24/06/2013	23/07/2013	23/08/2013	17/09/2013	31/10/2013	21/11/2013
Temperature (oC)	19.06	16.07	13.03	12.19	8.79	8.72	14.80	14.60	17.70
Electrical Conductivity (ms/cm)	0.45	0.22	0.19	0.26	0.43	0.43	0.18	0.29	0.34
Electrical Conductivity (µS/cm)	450	220	190	260	430	430	180	290	340
Turbidity (NTU)	1.2	1.8	8.6	26.5	5.4	1.6	7.9	2.9	7.4
Dissolved oxygen (mg/L)	6.79	6.94	9.74	11.05	10.23	11.27	9.94	6.71	9.11
Dissolved oxygen (%sat)	73.10	70.4	92.40	102.9	88.00	96.80	98.30	73.44	95.60
pH (x.xx)	7.19	7.31	7.32	7.52	7.39	7.53	7.96	6.85	7.36
Salinity (ppt)	0.22	0.11	0.09	0.13	0.22	0.22	0.09	0.14	0.14
Suspended Solids (mg/L)	1	3	5	7	6	2	9	1	1
Ammonium-Nitrogen (mg/L)	0.01	0.01	0.005	0.01	0.01	0.01	0.005	0.02	0.005
Oxidised Nitrogen (mg/L)	0.08	0.07	0.05	1.06	0.21	0.18	0.12	0.07	0.51
TKN (mg/L)									
Total Nitrogen (mg/L)	0.32	0.3	0.28	1.38	0.42	0.36	0.54	0.36	0.77
Total Phosphorus(mg/L)	0.018	0.027	0.026	0.058	0.017	0.014	0.069	0.033	0.024
Faecal Coliforms (CFU/100ml)	5	200	2200	2800	110	180	9500	280	240
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	004								
DATE	16/12/2013	14/01/2014	11/02/2014	26/03/2014	15/04/2014	12/05/2014	20/06/2014	16/07/2014	21/08/2014
Temperature (oC)	18.68	18.70	19.60	19.13	16.73	12.32	10.48	8.49	11.65
Electrical Conductivity (ms/cm)	0.37	0.33	0.21	0.10	0.23	0.26	0.20	0.22	0.27
Electrical Conductivity (µS/cm)	370	330	210	100	230	260	200	220	270
Turbidity (NTU)	1.8	1.4	0.3	4.7	3.3	0.3	0.4	0.8	7.5
Dissolved oxygen (mg/L)	6.37	4.83	5.23	7.65	7.98	9.71	9.47	11.28	10.96
Dissolved oxygen (%sat)	69.20	51.70	56.90	82.60	82.10	90.70	84.70	95.90	100.80
pH (x.xx)	7.19	7.16	7.00	7.04	7.21	7.29	7.24	7.28	7.56
Salinity (ppt)	0.19	0.16	0.10	0.05	0.11	0.13	0.10	0.11	0.13
Suspended Solids (mg/L)	1	1	1	1	1	1	1	1	1
Ammonium-Nitrogen (mg/L)	0.01	0.02	0.01	0.02	0.01	0.005	0.01	0.005	0.17
Oxidised Nitrogen (mg/L)	0.07	0.02	0.04	0.1	0.16	0.09	0.09	0.12	0.97
TKN (mg/L)									
Total Nitrogen (mg/L)	0.35	0.25	0.29	0.32	0.41	0.26	0.25	0.27	1.44
Total Phosphorus(mg/L)	0.029	0.023	0.032	0.033	0.025	0.016	0.02	0.009	0.035
Faecal Coliforms (CFU/100ml)	13	2	11	210	160	35	13	26	3600
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)				27.2			36.1		
Chloride (mg/L)				21			37		
Sulphate as SO_4^{2-}(mg/L)				5			7.3		
Fluoride (mg/L)				0.11			0.17		
Sodium (mg/L)				13.3			20.7		
Potassium (mg/L)				1.41			1.78		
Magnesium (mg/L)				2.6			4.12		
Calcium (mg/L)				8.36			12.1		
Aluminium (ug/L)				278			40		
Arsenic (ug/L)				0.5			0.5		
Cadmium (ug/L)				0.5			0.5		
Chromium (ug/L)				0.5			0.5		
Copper (ug/L)				4			1		
Lead (ug/L)				0.5			0.5		
Manganese (ug/L)				17			11		
Molybdenum (ug/L)				0.5			0.5		
Nickel (ug/L)				0.5			0.5		
Selenium (ug/L)				1.5			1.5		
Silver (ug/L)				0.5			0.5		
Uranium (ug/L)				0.5			0.5		
Zinc (ug/L)				13			15		
Boron (ug/L)				24			25		
Iron (ug/L)				649			745		
Mercury (ug/L)				0.005			0.005		
BOD5/CBOD5(mg/L)			1						
Total Organic Carbon(mg/L)									

Site ID	004							
DATE	11/09/2014	09/10/2014	03/11/2014	08/12/2014	19/01/2015	18/02/2015	17/03/2015	17/03/2015
Temperature (oC)	12.83	14.40	14.88	20.28	20.65	19.95	16.66	
Electrical Conductivity (ms/cm)	0.24	0.37	0.43	0.32	0.32	0.26	0.23	
Electrical Conductivity (µS/cm)	240	370	430	320	320	260	230	
Turbidity (NTU)	4.3	2.2	0.8	26.6	1.9	1.3	1.0	
Dissolved oxygen (mg/L)	10.34	7.04	7.37	9.11	5.93	6.56	7.75	
Dissolved oxygen (%sat)	87.55	68.80	72.60	100.60	66.10	72.20	79.40	
pH (x.xx)	7.41	7.22	7.28	7.42	7.25	7.17	7.25	
Salinity (ppt)	0.12	0.19	0.22	0.16	0.16	0.13	0.11	
Suspended Solids (mg/L)	3	3	1	4	1	1	1	1
Ammonium-Nitrogen (mg/L)	0.65	0.2	0.03	0.01	0.01	0.01	0.02	0.02
Oxidised Nitrogen (mg/L)	0.19	0.26	0.08	1.25	0.08	0.2	0.08	0.08
TKN (mg/L)								
Total Nitrogen (mg/L)	1.08	0.67	0.31	1.69	0.33	0.48	0.33	0.33
Total Phosphorus(mg/L)	0.073	0.064	0.028	0.06	0.039	0.027	0.047	0.046
Faecal Coliforms (CFU/100ml)	1200	47	11	5400	26	71	220	220
Enterococci (CFU/100ml)						90	47	40
Bicarbonate Alkalinity (mg/CaCO3/L)	40			30.8			37.5	38.1
Chloride (mg/L)	45			51			36	36
Sulphate as SO_4^{2-}(mg/L)	13			18			6.6	6.7
Fluoride (mg/L)	0.12			0.09			0.2	0.21
Sodium (mg/L)	26.8			32.6			27	25.3
Potassium (mg/L)	1.8			3.26			3.72	3.48
Magnesium (mg/L)	4.82			4.27			5.87	5.41
Calcium (mg/L)	13.3			16.6			17.3	16.4
Aluminium (ug/L)	339			2100			66	61
Arsenic (ug/L)	0.5			2			0.5	0.5
Cadmium (ug/L)	0.5			0.5			0.5	0.5
Chromium (ug/L)	1			2			0.5	0.5
Copper (ug/L)	1			3			4	4
Lead (ug/L)	0.5			2			0.5	0.5
Manganese (ug/L)	16			17			15	14
Molybdenum (ug/L)	0.5			0.5			0.5	0.5
Nickel (ug/L)	0.5			1			0.5	0.5
Selenium (ug/L)	1.5			1.5			1.5	1.5
Silver (ug/L)	0.5			0.5			0.5	0.5
Uranium (ug/L)	0.5			0.5			0.5	0.5
Zinc (ug/L)	15			19			26	17
Boron (ug/L)	27			38			57	57
Iron (ug/L)	714			1470			1920	1870
Mercury (ug/L)	0.005			0.005			0.005	0.005
BOD5/CBOD5(mg/L)								
Total Organic Carbon(mg/L)								

Site ID	008								
DATE	05/10/1994	01/11/1994	05/12/1994	04/01/1995	01/02/1995	06/03/1995	06/03/1995	04/04/1995	03/05/1995
Temperature (oC)	18.9	20.3	22.7	22.5	20.3	21.7	21.7	17	17.2
Electrical Conductivity (ms/cm)	0.51	0.45	0.39	0.25	0.36	0.39	0.39	0.58	0.35
Electrical Conductivity (µS/cm)	510	450	390	250	360	390	390	580	350
Turbidity (NTU)	8.0	4.0	12.0	28.0	7.0	18.0	18.0	3.0	3.0
Dissolved oxygen (mg/L)	7.6	7.0	6.1	8.0	6.2	9.2	9.2	9.8	8.6
Dissolved oxygen (%sat)									
pH (x.xx)	7.40	7.28	7.34	7.28	7.13	7.35	7.35	7.37	7.25
Salinity (ppt)	0.2	0.1	0.1	0.0	0.1	0.1	0.1	0.2	0.1
Suspended Solids (mg/L)	2	3	3	7	8	6	5	2	4
Ammonium-Nitrogen (mg/L)	0.01	0.04	0.06	0.03	0.54	0.02	0.02	0.03	0.02
Oxidised Nitrogen (mg/L)	0.04	0.07	0.07	0.7	0.02	0.83	0.71	0.12	0.36
TKN (mg/L)									
Total Nitrogen (mg/L)	0.46	0.49	0.46	1.17	1.05	1.62	0.99	0.41	0.67
Total Phosphorus(mg/L)	0.03	0.05	0.06	0.05	0.16	0.04	0.03	0.02	0.03
Faecal Coliforms (CFU/100ml)	80	62	400	7000	1000	7000	4400	440	5300
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	008								
DATE	06/06/1995	04/07/1995	01/08/1995	01/08/1995	04/09/1995	05/10/1995	06/11/1995	04/12/1995	03/01/1996
Temperature (oC)	12.7	10.5	10.3	10.3	15.4	17.9	20.6	25.4	20.3
Electrical Conductivity (ms/cm)	0.61	1.19	0.60	0.60	0.20	0.60	0.20	0.40	0.30
Electrical Conductivity (µS/cm)	610	1190	600	600	200	600	200	400	300
Turbidity (NTU)	1.0	19.2	0.9	0.9	26.5	75.0	242.5	37.6	50.0
Dissolved oxygen (mg/L)	12.1	12.2	12.3	12.3	11.2	9.7	8.3	8.8	8.9
Dissolved oxygen (%sat)									
pH (x.xx)	7.37	7.70	7.57	7.57	7.24	7.47	6.77	7.26	6.67
Salinity (ppt)	0.2	0.5	0.3	0.3	0.1	0.3	0.1	0.2	0.1
Suspended Solids (mg/L)	4	10	2	2	12	36	108	12	21
Ammonium-Nitrogen (mg/L)	0.06	0.34	0.04	0.03	0.02	0.02	0.02	0.07	0.02
Oxidised Nitrogen (mg/L)	0.44	0.4	0.28	0.28	0.38	0.44	0.64	0.34	0.73
TKN (mg/L)									
Total Nitrogen (mg/L)	0.66	0.92	0.52	0.62	0.86	0.86	1.35	0.67	1.22
Total Phosphorus(mg/L)	0.03	0.02	0.02	0.02	0.07	0.06	0.1	0.05	0.05
Faecal Coliforms (CFU/100ml)	300	700	180	82	1800	700	7500	240	6000
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									

Site ID	008								
DATE	03/01/1996	05/02/1996	04/03/1996	01/04/1996	01/04/1996	01/05/1996	03/06/1996	02/07/1996	06/08/1996
Temperature (oC)	20.3	27.4	20.6	20	20	16.5	13.9	11.2	11.5
Electrical Conductivity (ms/cm)	0.30	0.60	0.10	0.60	0.60	0.50	0.50	0.70	0.50
Electrical Conductivity (µS/cm)	300	600	100	600	600	500	500	700	500
Turbidity (NTU)	50.0	1.9	405.1	2.5	2.5	3.3	40.4	10.6	416.8
Dissolved oxygen (mg/L)	8.9	9.5	8.4	10.6	10.6	9.6	9.0	10.7	10.9
Dissolved oxygen (%sat)							86.6	97.3	99.6
pH (x.xx)	6.67	7.38	7.57	7.76	7.76	8.07	8.36	7.48	8.02
Salinity (ppt)	0.1	0.3	0.0	0.3	0.3	0.2	0.2	0.3	0.2
Suspended Solids (mg/L)	21	2	222	6	6	3	12	2	153
Ammonium-Nitrogen (mg/L)	0.01	0.03	0.01	0.03	0.03	0.03	0.14	0.2	0.01
Oxidised Nitrogen (mg/L)	0.71	0.19	0.4	0.35	0.35	0.38	0.75	0.38	0.47
TKN (mg/L)									
Total Nitrogen (mg/L)	1.23	0.61	0.99	0.67	0.67	0.86	1.46	0.78	0.67
Total Phosphorus(mg/L)	0.05	0.03	0.13	0.02	0.01	0.03	0.05	0.11	0.03
Faecal Coliforms (CFU/100ml)	3000	64	31000	430	420	2400	3000	330	170
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	008								
DATE	03/09/1996	03/10/1996	04/11/1996	02/12/1996	06/01/1997	05/02/1997	06/03/1997	06/03/1997	09/04/1997
Temperature (oC)	13.4	17.8	19.2	20.7	24.1	24	21.2	21.2	17.7
Electrical Conductivity (ms/cm)	0.40	0.40	0.40	0.40	0.20	0.70	0.40	0.40	0.70
Electrical Conductivity (µS/cm)	400	400	400	400	200	700	400	400	700
Turbidity (NTU)	278.3	25.1	6.0	20.0	16.5	3.2	24.6	24.6	1.6
Dissolved oxygen (mg/L)	10.7	10.3	10.8	11.4	9.3	13.4	8.1	8.1	14.4
Dissolved oxygen (%sat)	102.1	113.0	121.5	127.7	110.4	159.0	91.5	91.5	152.7
pH (x.xx)	7.38	7.84	7.33	7.65	7.64	7.64	7.68	7.68	7.58
Salinity (ppt)	0.2	0.2	0.2	0.2	0.1	0.3	0.2	0.2	0.4
Suspended Solids (mg/L)	80	12	3	11	8	3	7	9	5
Ammonium-Nitrogen (mg/L)	0.03	0.01	0.04	0.04	0.03	0.05	0.02	0.01	0.13
Oxidised Nitrogen (mg/L)	1.33	0.69	0.27	0.24	0.2	0.19	0.32	0.32	0.5
TKN (mg/L)									
Total Nitrogen (mg/L)	1.73	1.06	0.52	0.61	0.52	0.58	0.85	0.81	0.94
Total Phosphorus(mg/L)	0.06	0.04	0.02	0.04	0.04	0.03	0.06	0.06	0.04
Faecal Coliforms (CFU/100ml)	1500	1300	46	1900	80	70	7800	10000	170
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	008								
DATE	05/05/1997	03/06/1997	03/06/1997	03/07/1997	04/08/1997	02/09/1997	02/10/1997	04/11/1997	01/12/1997
Temperature (oC)	18.8	11.9	11.9	11.7	11.1	15.1	19.9	18.3	25.5
Electrical Conductivity (ms/cm)	0.60	0.40	0.40	0.30	0.80	0.10	0.40	0.50	0.40
Electrical Conductivity (µS/cm)	600	400	400	300	800	100	400	500	400
Turbidity (NTU)	21.4	8.8	8.8	24.6	6.3	54.8	1.8	2.0	4.5
Dissolved oxygen (mg/L)	7.5	9.7	9.7	11.7	12.5	10.1	14.9	4.9	7.4
Dissolved oxygen (%sat)	79.6	90.4	90.4	108.0	114.1	102.3	165.7	51.9	89.5
pH (x.xx)	7.07	7.06	7.06	7.20	7.62	7.42	7.66	7.24	7.19
Salinity (ppt)	0.3	0.2	0.2	0.1	0.4	0.0	0.2	0.3	0.2
Suspended Solids (mg/L)	6	3	2	9	6	20	2	4	3
Ammonium-Nitrogen (mg/L)	0.04	0.6	0.6	0.02	0.02	0.1	0.02	0.08	0.06
Oxidised Nitrogen (mg/L)	0.16	0.66	0.67	0.59	0.28	0.4	0.22	0.09	0.17
TKN (mg/L)									
Total Nitrogen (mg/L)	0.66	1.42	1.47	0.87	0.49	0.95	0.56	0.22	0.54
Total Phosphorus(mg/L)	0.04	0.06	0.06	0.04	0.02	0.08	0.03	0.04	0.04
Faecal Coliforms (CFU/100ml)	2500	7100	6100	1800	39	27000	40	94	92
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	008								
DATE	08/01/1998	03/02/1998	03/02/1998	03/03/1998	03/04/1998	05/05/1998	04/06/1998	01/07/1998	06/08/1998
Temperature (oC)	23.4	29.2	29.2	25.3	21.75	17.4	16.1	11.3	12.7
Electrical Conductivity (ms/cm)	0.30	0.50	0.50	0.20	0.50	0.20	0.20	0.30	0.20
Electrical Conductivity (µS/cm)	300	500	500	200	500	200	200	300	200
Turbidity (NTU)	125.6	0.0	0.0	0.0	2.1	33.0	38.8	30.3	97.1
Dissolved oxygen (mg/L)	7.6	15.3	15.3	11.2	8.7	9.7	7.5	13.1	11.7
Dissolved oxygen (%sat)	89.7	200.0	200.0	141.0	99.4	99.9	76.6	120.4	110.0
pH (x.xx)	7.53	7.91	7.91	7.62	7.36		7.52	7.32	7.27
Salinity (ppt)	0.1	0.3	0.3	0.1	0.2	0.1	0.1	0.2	0.1
Suspended Solids (mg/L)	24	2	2	2	2	20	26	15	90
Ammonium-Nitrogen (mg/L)	0.05	0.03	0.03	0.02	0.01	0.05	0.02	0.02	0.05
Oxidised Nitrogen (mg/L)	0.14	0.02	0.02	0.06	0.07	1.9	0.47	0.47	1.07
TKN (mg/L)									
Total Nitrogen (mg/L)	0.51	0.6	0.6	0.4	0.4	2.61	0.7	0.75	1.63
Total Phosphorus(mg/L)	0.05	0.03	0.03	0.03	0.02	0.09	0.02	0.02	0.12
Faecal Coliforms (CFU/100ml)	140	14	32	44	88	8800	28000	4400	11000
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	008								
DATE	07/09/1998	07/10/1998	02/11/1998	08/12/1998	05/01/1999	05/01/1999	02/02/1999	02/03/1999	08/04/1999
Temperature (oC)	16.3	17.7	16.5	20.95	29.6	29.6	22.3	21.8	18.6
Electrical Conductivity (ms/cm)	0.40	0.40	0.50	0.40	0.30	0.30	0.30	0.30	0.50
Electrical Conductivity (µS/cm)	400	400	500	400	300	300	300	300	500
Turbidity (NTU)	8.5	18.2	6.6	33.8	1.6	1.6	30.3	12.7	8.9
Dissolved oxygen (mg/L)	10.1	7.0	8.6		6.8	6.8	8.7	8.6	11.7
Dissolved oxygen (%sat)	103.1	73.6	88.3		89.7	89.7	100.4	98.7	124.0
pH (x.xx)	7.58	7.08	7.05	7.63	7.17	7.17	7.52	7.55	7.66
Salinity (ppt)	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.2
Suspended Solids (mg/L)	4	8	5	17	1	1	5	2	4
Ammonium-Nitrogen (mg/L)	0.02	0.04	0.02	0.07	0.03	0.04	0.02	0.01	0.03
Oxidised Nitrogen (mg/L)	0.42	0.4	0.13	0.23	0.03	0.06	0.81	0.37	0.81
TKN (mg/L)									
Total Nitrogen (mg/L)	0.68	1.36	0.68	0.89	0.53	0.48	1.33	0.68	1.19
Total Phosphorus(mg/L)	0.03	0.11	0.05	0.08	0.05	0.05	0.06	0.04	0.03
Faecal Coliforms (CFU/100ml)	1400	35000	160	17000	150	150	4400	4600	2200
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	008								
DATE	03/05/1999	03/06/1999	03/06/1999	08/07/1999	05/08/1999	08/09/1999	06/10/1999	04/11/1999	04/11/1999
Temperature (oC)	15.6	13.2	13.2	10.5	10.9	14.91	17.11	17.22	17.22
Electrical Conductivity (ms/cm)	0.40	0.70	0.70	0.60	0.80	0.40	0.30	0.50	0.50
Electrical Conductivity (µS/cm)	400	700	700	600	800	400	300	500	500
Turbidity (NTU)	8.9	5.3	5.3	8.0	5.5	128.5	35.2	5.5	5.5
Dissolved oxygen (mg/L)	11.1	9.7	9.7	11.3	11.2	10.8	10.3	10.5	10.5
Dissolved oxygen (%sat)	110.8	92.4	92.4	101.2	101.4	107.0	107.0	106.9	106.9
pH (x.xx)	7.50	7.33	7.33	7.35	7.54	7.42	7.45	7.57	7.57
Salinity (ppt)	0.2	0.3	0.3	0.3	0.4	0.2	0.2	0.3	0.3
Suspended Solids (mg/L)	3	2	2	2	1	36	14	1	2
Ammonium-Nitrogen (mg/L)	0.02	0.03	0.03	0.03	0.05	0.02	0.03	0.02	0.02
Oxidised Nitrogen (mg/L)	0.44	0.31	0.36	0.57	0.58	0.24	0.62	0.7	0.7
TKN (mg/L)									
Total Nitrogen (mg/L)	0.65	0.57	0.7	0.91	0.74	0.49	0.98	0.93	1.22
Total Phosphorus(mg/L)	0.03	0.02	0.02	0.02	0.01	0.03	0.07	0.03	0.03
Faecal Coliforms (CFU/100ml)	520	1100	1100	2200	540	350	5700	260	210
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	008								
DATE	07/12/1999	04/01/2000	03/02/2000	06/03/2000	05/04/2000	02/05/2000	06/06/2000	03/07/2000	02/08/2000
Temperature (oC)	22.37	21.96	24	20.3	20.25	18.74	8.28	12.02	10.96
Electrical Conductivity (ms/cm)	0.70	0.40	0.50	0.60	0.20	0.20	0.70	0.40	0.40
Electrical Conductivity (µS/cm)	700	400	500	600	200	200	700	400	400
Turbidity (NTU)	2.0	2.3	0.7	2.1	32.8	51.1	3.8	5.6	1.9
Dissolved oxygen (mg/L)	8.4	8.7	6.6	4.5	10.2	10.0	9.8	10.4	10.8
Dissolved oxygen (%sat)	96.8	99.7	78.4	49.9	111.5	107.5	83.5	96.6	97.4
pH (x.xx)	7.36	7.40	7.05	7.09	7.31	7.31	7.18	7.29	7.17
Salinity (ppt)	0.3	0.2	0.2	0.8	0.1	0.1	0.4	0.2	0.2
Suspended Solids (mg/L)	1	1	1	1	15	26	3	1	1
Ammonium-Nitrogen (mg/L)	0.04	0.06	0.03	0.04	0.02	0.02	0.41	0.03	0.02
Oxidised Nitrogen (mg/L)	0.07	0.18	0.06	0.13	0.44	0.34	0.37	0.27	0.19
TKN (mg/L)									
Total Nitrogen (mg/L)	0.34	0.45	0.38	0.54	0.68	0.74	1.16	0.53	0.37
Total Phosphorus(mg/L)	0.03	0.04	0.04	0.04	0.05	0.08	0.04	0.03	0.02
Faecal Coliforms (CFU/100ml)	100	180	44	440	13000	10000	450	220	18
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	008								
DATE	07/09/2000	04/10/2000	07/11/2000	08/12/2000	05/01/2001	05/01/2001	06/02/2001	08/03/2001	06/04/2001
Temperature (oC)	12.05	18.65	17.97	22.67	24.21	24.21	22.86		21.04
Electrical Conductivity (ms/cm)	0.50	0.50	0.50	0.30	0.70	0.70	0.30		0.60
Electrical Conductivity (µS/cm)	500	500	500	300	700	700	300		600
Turbidity (NTU)	0.8	3.8	7.2	49.4	1.6	1.6	35.1		0.0
Dissolved oxygen (mg/L)	9.7	7.0	6.6	8.9	10.9	10.9	8.9		11.9
Dissolved oxygen (%sat)	89.9	74.7	69.5	103.4	129.9	129.8	103.2		133.4
pH (x.xx)	7.37	6.99	7.11	7.35	7.76	7.76	7.29		7.95
Salinity (ppt)	0.3	0.2	0.2	0.1	0.3	0.3	0.1		0.3
Suspended Solids (mg/L)	1	1	4	17	1	1	18	9	1
Ammonium-Nitrogen (mg/L)	0.02	0.03	0.04	0.03	0.01	0.01	0.02	0.02	0.01
Oxidised Nitrogen (mg/L)	0.08	0.04	0.42	0.56	0.02	0.02	0.58	0.43	0.12
TKN (mg/L)									
Total Nitrogen (mg/L)	0.43	0.4	0.87	1.09	0.35	0.37	1.05	0.81	0.37
Total Phosphorus(mg/L)	0.02	0.06	0.07	0.07	0.03	0.02	0.08	0.04	0.02
Faecal Coliforms (CFU/100ml)	14	1000	880	9000	130	120	9600	5200	89
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	008								
DATE	08/05/2001	07/06/2001	04/07/2001	10/08/2001	07/09/2001	04/10/2001	04/10/2001	08/11/2001	06/12/2001
Temperature (oC)	16.47	12.58	11	11.95	12.74	18.63	18.63	17.49	19.02
Electrical Conductivity (ms/cm)	0.10	0.70	0.70	0.70	0.70	0.30	0.30	0.20	0.40
Electrical Conductivity (µS/cm)	100	700	700	700	700	300	300	200	400
Turbidity (NTU)	32.8	6.5	10.9	14.0	10.4	9.0	9.0	13.2	5.2
Dissolved oxygen (mg/L)	9.6	11.7		11.3	11.2	7.3	7.3	8.0	4.0
Dissolved oxygen (%sat)	98.5	109.7		104.9	105.9	78.2	78.2	83.9	43.3
pH (x.xx)	7.41	7.61	7.27	7.31	7.27	7.05	7.05	6.91	7.01
Salinity (ppt)	0.1	0.3	0.3	0.3	0.4	0.2	0.2	0.1	0.2
Suspended Solids (mg/L)	11	3	1	1	2	5	4	6	4
Ammonium-Nitrogen (mg/L)	0.04	0.06	0.02	0.02	0.03	0.05	0.05	0.02	0.12
Oxidised Nitrogen (mg/L)	1.97	0.64	0.34	0.36	0.24	0.21	0.2	1.02	0.05
TKN (mg/L)									
Total Nitrogen (mg/L)	2.4	0.88	0.54	0.62	0.48	0.62	0.62	1.42	0.49
Total Phosphorus(mg/L)	0.06	0.02	0.01	0.02	0.02	0.05	0.06	0.06	0.09
Faecal Coliforms (CFU/100ml)	5000	260	140	110	28	160	150	3300	62
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	008								
DATE	10/01/2002	08/02/2002	04/03/2002	09/04/2002	06/05/2002	06/05/2002	04/06/2002	03/07/2002	05/08/2002
Temperature (oC)	24.92	22.16	20.62	18.67	17.04	17.04	13	7.98	10.08
Electrical Conductivity (ms/cm)	0.30	0.50	0.20	0.50	0.60	0.60	0.40	0.50	0.50
Electrical Conductivity (µS/cm)	300	500	200	500	600	600	400	500	500
Turbidity (NTU)	3.3	20.4	49.0	1.5	9.3	9.3	5.6	8.2	3.2
Dissolved oxygen (mg/L)	6.8	8.9	8.8	8.9	9.2	9.2	10.2	10.4	9.2
Dissolved oxygen (%sat)	81.7	102.4	98.5	95.4	95.1	95.1	96.8	87.6	80.9
pH (x.xx)	7.19	7.58	7.42	7.46	7.43	7.43	7.32	7.24	7.26
Salinity (ppt)	0.2	0.3	0.1	0.2	0.3	0.3	0.2	0.2	0.2
Suspended Solids (mg/L)	1	4	22	1	1	1	3	3	4
Ammonium-Nitrogen (mg/L)	0.03	0.03	0.01	0.02	0.01	0.01	0.03	0.18	0.05
Oxidised Nitrogen (mg/L)	0.04	1.1	0.3	0.15	0.09	0.09	0.3	0.35	0.2
TKN (mg/L)									
Total Nitrogen (mg/L)	0.49	1.32	0.74	0.43	0.35	0.34	0.5	0.7	0.49
Total Phosphorus(mg/L)	0.08	0.03	0.07	0.02	0.02	0.02	0.03	0.03	0.03
Faecal Coliforms (CFU/100ml)	68	7000	18000	290	270	270	150	500	76
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	008								
DATE	02/09/2002	08/10/2002	07/11/2002	07/11/2002	05/12/2002	14/01/2003	06/02/2003	06/03/2003	09/04/2003
Temperature (oC)	13.19	20.39	17.24		19.91	20.06	21.59	19.57	16.81
Electrical Conductivity (ms/cm)	0.50	0.50	0.60		0.40	0.70	0.70	0.60	0.40
Electrical Conductivity (µS/cm)	500	500	600		400	700	700	600	400
Turbidity (NTU)	0.5	2.0	4.5		2.2	1.6	1.3	0.6	3.1
Dissolved oxygen (mg/L)	9.1	6.5	9.2		4.1	7.2	5.1	9.2	7.7
Dissolved oxygen (%sat)	86.5	74.3	96.1		45.0	78.5	58.0	100.5	78.8
pH (x.xx)	7.22	7.72	7.46		7.24	7.44	7.29	7.51	7.32
Salinity (ppt)	0.2	0.2	0.3		0.2	0.3	0.4	0.3	0.2
Suspended Solids (mg/L)	12	2	1	1	3	1	1	1	1
Ammonium-Nitrogen (mg/L)	0.03	0.06	0.02	0.02	0.04	0.02	0.01	0.02	0.01
Oxidised Nitrogen (mg/L)	0.14	0.06	0.04	0.04	0.05	0.02	0.01	0.02	0.17
TKN (mg/L)									
Total Nitrogen (mg/L)	0.6	0.44	0.38	0.39	0.51	0.31	0.34	0.27	0.43
Total Phosphorus(mg/L)	0.05	0.04	0.03	0.03	0.08	0.03	0.03	0.02	0.02
Faecal Coliforms (CFU/100ml)	130	230	100	76	600	62	38	96	100
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)		1580.00	140.00	40.00	90.00	10.00			
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	008								
DATE	08/05/2003	05/06/2003	03/07/2003	11/08/2003	04/09/2003	08/10/2003	10/11/2003	09/12/2003	14/01/2004
Temperature (oC)	16.23	15.49	13.11		11.58	16.78	20.68		
Electrical Conductivity (ms/cm)	0.50	0.30	0.30		0.60	0.30	0.60		
Electrical Conductivity (µS/cm)	500	300	300		600	300	600		
Turbidity (NTU)	4.3	31.6	24.1		4.9	12.5	4.8		
Dissolved oxygen (mg/L)	10.5	10.1	10.6		9.9	8.4	6.9		
Dissolved oxygen (%sat)	106.8	100.6	100.3		91.0	86.1	76.4		
pH (x.xx)	7.55	7.42	7.55		7.33	7.20	7.28		
Salinity (ppt)	0.3	0.2	0.1		0.3	0.1	0.3		
Suspended Solids (mg/L)	1	11	6	1	2	3	1	3	25
Ammonium-Nitrogen (mg/L)	0.02	0.02	0.02	0.03	0.03	0.04	0.06	0.04	0.02
Oxidised Nitrogen (mg/L)	0.48	0.6	1.31	0.26	0.12	0.25	0.06	0.49	0.2
TKN (mg/L)									
Total Nitrogen (mg/L)	0.71	0.85	1.6	0.46	0.31	0.57	0.38	0.81	1.4
Total Phosphorus(mg/L)	0.02	0.04	0.05	0.02	0.02	0.04	0.03	0.04	0.17
Faecal Coliforms (CFU/100ml)	80	2900	830	54	36	120	38	52	400000
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	008								
DATE	04/02/2004	12/03/2004	31/03/2004	06/05/2004	02/06/2004	05/07/2004	06/08/2004	01/09/2004	07/10/2004
Temperature (oC)			18.45	13.75	11.075	10.305	9.685	13.51	17.2
Electrical Conductivity (ms/cm)			0.50	0.70	0.50	0.30	0.60	0.45	0.50
Electrical Conductivity (µS/cm)			500	700	500	300	600	450	500
Turbidity (NTU)			2.7	2.9	4.0	245.1	8.6	2.0	5.7
Dissolved oxygen (mg/L)			8.4	5.0	7.8	7.8	9.4	10.0	10.1
Dissolved oxygen (%sat)			89.5	48.2	70.9	69.5	82.5	96.1	104.6
pH (x.xx)			7.42	7.27	7.27	7.27	7.17	7.43	7.43
Salinity (ppt)			0.3	0.4	0.3	0.2	0.3	0.2	0.3
Suspended Solids (mg/L)	6	1	1	1	1	54	2	1	5
Ammonium-Nitrogen (mg/L)	0.02	0.03	0.02	0.02	0.05	0.05	0.03	0.05	0.03
Oxidised Nitrogen (mg/L)	0.23	0.09	0.06	0.03	0.09	0.32	0.17	0.11	0.48
TKN (mg/L)									
Total Nitrogen (mg/L)	0.63	0.37	0.26	0.34	0.36	0.55	0.38	0.43	0.84
Total Phosphorus(mg/L)	0.06	0.03	0.02	0.02	0.025	0.45	0.018	0.026	0.03
Faecal Coliforms (CFU/100ml)	500	210	500	560	120	180	150	34	80
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	008								
DATE	02/11/2004	30/11/2004	11/01/2005	07/02/2005	09/03/2005	22/03/2005	04/04/2005	10/05/2005	07/06/2005
Temperature (oC)	20.51	24.655	19.515	23.825	19.205	17.4	18.7	15.59	11.47
Electrical Conductivity (ms/cm)	0.70	0.60	0.40	0.30	0.45	0.30	0.10	0.50	0.60
Electrical Conductivity (µS/cm)	700	600	400	300	450	300	100	500	600
Turbidity (NTU)	13.9	1.1	1.5	1.8	1.4	1.5	18.2	2.5	2.7
Dissolved oxygen (mg/L)	9.5	9.2	5.6	8.3	8.5	6.6	8.5	8.5	9.9
Dissolved oxygen (%sat)	105.0	110.3	60.3	97.8	92.0	69.0	90.8	85.6	90.4
pH (x.xx)	7.57	7.45	7.20	7.55	7.29	7.36	7.56	7.42	7.31
Salinity (ppt)	0.3	0.3	0.2	0.2	0.2	0.2	0.0	0.2	0.3
Suspended Solids (mg/L)	1	1	3	2	7		5	1	5
Ammonium-Nitrogen (mg/L)	0.02	0.02	0.02	0.03	0.02		0.05	0.01	0.04
Oxidised Nitrogen (mg/L)	0.29	0.1	0.02	0.11	0.13		0.3	0.1	0.4
TKN (mg/L)									
Total Nitrogen (mg/L)	0.61	0.47	0.38	0.49	0.42		0.73	0.32	0.6
Total Phosphorus(mg/L)	0.032	0.03	0.051	0.044	0.026		0.064	0.016	0.01
Faecal Coliforms (CFU/100ml)	2100	290	51	28	150		7500	220	52
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	008								
DATE	08/07/2005	08/08/2005	05/09/2005	07/10/2005	03/11/2005	05/12/2005	11/01/2006	01/02/2006	02/03/2006
Temperature (oC)	11.7	9.415	12.215	15.4		19.7	23.27	22.08	21.17
Electrical Conductivity (ms/cm)	0.60	0.60	0.40	0.50		0.40	0.30	0.50	0.40
Electrical Conductivity (µS/cm)	600	600	400	500		400	300	500	400
Turbidity (NTU)	11.0	14.4	17.0	0.0		20.0	4.0	3.5	5.2
Dissolved oxygen (mg/L)	10.4	8.9	9.5	4.1		7.0	4.5	2.8	7.3
Dissolved oxygen (%sat)	95.6	77.4	87.7	41.3		79.2	52.2	31.7	82.6
pH (x.xx)	7.43	7.29	7.18	7.09		7.33	6.97	7.04	6.80
Salinity (ppt)	0.3	0.3	0.2	0.2		0.2	0.1	0.3	0.2
Suspended Solids (mg/L)	4	1	12	3	3	3	2	2	0.5
Ammonium-Nitrogen (mg/L)	0.03	0.031	0.005	0.043	0.089	0.048	0.014	0.081	0.005
Oxidised Nitrogen (mg/L)	0.67	0.188	0.526	0.032	0.152	0.564	0.119	0.176	0.363
TKN (mg/L)		0.3	0.6	0.5	1.5	0.3	0.31	0.31	0.29
Total Nitrogen (mg/L)	1	0.5	1.1	0.5	1.7	0.84	0.43	0.49	0.65
Total Phosphorus(mg/L)	0.028	0.005	0.07	0.09	0.005	0.055	0.064	0.031	0.044
Faecal Coliforms (CFU/100ml)	230	266	1530	140	66	92	24	46	240
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	008								
DATE	10/04/2006	02/05/2006	15/06/2006	11/07/2006	10/08/2006	05/09/2006	11/10/2006	06/11/2006	04/12/2006
Temperature (oC)	14.37		8.47	7.44	9.79	12.42		17.12	17.09
Electrical Conductivity (ms/cm)	0.50		0.40	0.50	0.60	0.50		0.20	0.20
Electrical Conductivity (µS/cm)	500		400	500	600	500		200	200
Turbidity (NTU)	199.2		3.1	3.7	5.4	7.6		29.9	13.2
Dissolved oxygen (mg/L)	7.2		9.1	8.8	10.8	6.3		9.7	7.2
Dissolved oxygen (%sat)	70.6		77.8	73.5	95.3	59.0		100.2	74.5
pH (x.xx)	7.28		7.00	7.07	7.25	7.05		7.30	7.41
Salinity (ppt)	0.3		0.2	0.2	0.3	0.2		0.1	0.1
Suspended Solids (mg/L)	45	8	2	3	2	1	4	13	4
Ammonium-Nitrogen (mg/L)	0.031	0.005	0.026	0.058	0.005	0.032	0.019	0.019	0.005
Oxidised Nitrogen (mg/L)	0.256	0.085	0.463	0.462	1.17	0.111	0.112	0.372	0.17
TKN (mg/L)	0.21	0.32	0.26	0.64	0.12	0.35	0.4	0.38	0.4
Total Nitrogen (mg/L)	0.47	0.4	0.72	1.1	1.29	0.5	0.51	0.75	0.57
Total Phosphorus(mg/L)	0.011	0.0025	0.025	0.021	0.01	0.0025	0.0025	0.057	0.031
Faecal Coliforms (CFU/100ml)	1300	96	120	32	70	28	12	5800	1200
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	008								
DATE	02/01/2007	09/02/2007	08/03/2007	03/04/2007	30/04/2007	06/06/2007	05/07/2007	13/08/2007	12/09/2007
Temperature (oC)	20.42	21.17	19.95	17.14		10.28	11.35	11.75	12.53
Electrical Conductivity (ms/cm)	0.20	0.40	0.30	0.50		0.40	0.60	0.50	0.40
Electrical Conductivity (µS/cm)	200	400	300	500		400	600	500	400
Turbidity (NTU)	9.2	1.4	66.0	1.4		1.8	4.7	3.5	11.4
Dissolved oxygen (mg/L)	8.0	4.3	6.7	6.7		8.3	10.7	9.1	9.7
Dissolved oxygen (%sat)	88.1	48.5	73.4	69.7		74.2	97.7	83.3	90.7
pH (x.xx)	7.34	7.00	7.32	7.06		7.18	7.23	7.40	7.17
Salinity (ppt)	0.1	0.2	0.2	0.2		0.2	0.3	0.2	0.2
Suspended Solids (mg/L)	3	2	10	2	3	0.5	2	2	2
Ammonium-Nitrogen (mg/L)	0.047	0.005	0.025	0.017	0.005	0.005	0.005	0.005	0.005
Oxidised Nitrogen (mg/L)	0.134	0.048	0.332	0.102	0.519	0.113	0.882	0.343	0.422
TKN (mg/L)	0.35	0.38	0.41	0.3	0.21	0.29	0.54	0.3	0.29
Total Nitrogen (mg/L)	0.48	0.42	0.74	0.3	0.73	0.4	1.42	0.64	0.71
Total Phosphorus(mg/L)	0.103	0.014	0.041	0.005	0.023	0.016	0.015	0.0025	0.0025
Faecal Coliforms (CFU/100ml)	5700	510	1100	640	1400	210	310	320	200
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	008								
DATE	05/10/2007	15/11/2007	14/12/2007	10/01/2008	04/02/2008	29/02/2008	10/04/2008	07/05/2008	29/05/2008
Temperature (oC)	14.49	19.76	17.7	22.12	22.19	17.48	17.7	13.6	11.9
Electrical Conductivity (ms/cm)	0.44	0.56	0.44	0.56	0.08	0.16	0.20	0.58	0.68
Electrical Conductivity (µS/cm)	440	560	440	560	80	160	200	580	680
Turbidity (NTU)	5.1	3.0	3.0	1.8	30.0	22.9	10.0	4.5	4.1
Dissolved oxygen (mg/L)	4.3	8.3	9.0	3.2	8.9	9.2	9.6	9.9	8.6
Dissolved oxygen (%sat)	41.9	90.4	94.0	37.0	101.2	95.8	100.7	95.0	80.0
pH (x.xx)	7.12	7.38	7.60	7.09	7.57	7.59	7.56	7.50	7.27
Salinity (ppt)	0.2	0.3	0.2	0.3	0.0	0.1	0.1	0.29	0.34
Suspended Solids (mg/L)	15	2	2	1	14	5	2	2	2
Ammonium-Nitrogen (mg/L)	0.005	0.005	0.024	0.005	0.033	0.005	0.005	0.04	0.005
Oxidised Nitrogen (mg/L)	0.094	0.308	0.526	0.065	0.433	0.464	0.596	0.437	0.278
TKN (mg/L)	0.41	0.26	0.34	0.35	0.3	0.07	0.15	0.19	0.26
Total Nitrogen (mg/L)	0.5	0.6	0.9	0.4	0.74	0.53	0.75	0.62	0.53
Total Phosphorus(mg/L)	0.025	0.005	0.02	0.02	0.068	0.022	0.025	0.022	0.017
Faecal Coliforms (CFU/100ml)	180	640	630	65	10000	3800	1900	135	140
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	008								
DATE	08/07/2008	08/08/2008	08/08/2008	17/09/2008	16/10/2008	10/11/2008	10/12/2008	08/01/2009	13/02/2009
Temperature (oC)	11.5	9.6		12.5	15.56	18.7	21.07	21.48	18.91
Electrical Conductivity (ms/cm)	0.54	0.50		0.40	0.3	0.51	0.3	0.65	0.1
Electrical Conductivity (µS/cm)	541.32258	501.91260		400	300	510	300	650	100
Turbidity (NTU)	6.5	8.3		6	14.2	4.9	28.1	3.2	35
Dissolved oxygen (mg/L)	10.84	10.84		9.12	6.9	4.82	4.7	1.18	9.24
Dissolved oxygen (%sat)	99.1	95.3		85.1	69.5	57	53.4	13.4	99.3
pH (x.xx)	7.43	7.29		7.05	7.13	7.13	7.07	7.03	7.32
Salinity (ppt)	0.27	0.25		0.2	0.15	0.28	0.15	0.32	0.05
Suspended Solids (mg/L)	2	2		2	6	3	3	5	10
Ammonium-Nitrogen (mg/L)	0.019	0.02	0.02	0.03	0.03	0.07	0.071	0.099	0.043
Oxidised Nitrogen (mg/L)	0.355	0.42	0.38	0.22	0.42	0.12	0.065	0.034	0.438
TKN (mg/L)	0.26	0.18		0.3	0.47	0.55	0.52	0.56	0.28
Total Nitrogen (mg/L)	0.61	0.6	0.6	0.52	0.88	0.66	0.59	0.6	0.71
Total Phosphorus(mg/L)	0.008	0.0025	0.024	0.011	0.033	0.06	0.052	0.099	0.061
Faecal Coliforms (CFU/100ml)	400	105	140	80	500	50	470	180	1200
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)		64							
Chloride (mg/L)		93							
Sulphate as SO_4^{2-}(mg/L)		26							
Fluoride (mg/L)									
Sodium (mg/L)		57							
Potassium (mg/L)		5							
Magnesium (mg/L)		9							
Calcium (mg/L)		25							
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)		0.5							
Carbonate Alkalinity as CaCO3(ug/L)		0.5							
Total Alkalinity as CaCO3(mg/L)		64							
Ionic Balance(%)		1.19							
Total Anions(meq/L)		4.46							
Total Cations(meq/L)		4.57							
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	008								
DATE	13/03/2009	07/04/2009	07/05/2009	09/06/2009	22/07/2009	21/08/2009	17/09/2009	14/10/2009	17/11/2009
Temperature (oC)	19.9	18.12	14.18	12.17	12.2	10.8	15.22	14.98	20.27
Electrical Conductivity (ms/cm)	0.45	0.53	0.52	0.61	0.41	0.57	0.57	0.51	0.68
Electrical Conductivity (µS/cm)	450	530	520	610	410	570	570	510	680
Turbidity (NTU)	4	1.7	2.4	3	2.6	2.1	2.5	2.1	1.8
Dissolved oxygen (mg/L)	9.15	8.86	6.77	10.6	9.5	8.14	5	7.56	3.1
Dissolved oxygen (%sat)	100	93.9	66.1	93	93	73.2	49	75.3	34.0
pH (x.xx)	7.4	7.5	7.24	7.7	7.36	7.17	6.9	7.27	7.1
Salinity (ppt)	0.22	0.26	0.26	0.29	0.2	0.28	0.29	0.25	0.34
Suspended Solids (mg/L)	2	2	1	1	1	1	3	2	1
Ammonium-Nitrogen (mg/L)	0.009	0.058	0.048	0.031	0.1	0.07	0.07	0.04	0.06
Oxidised Nitrogen (mg/L)	0.242	0.518	0.277	0.52	0.37	0.27	0.21	0.19	0.18
TKN (mg/L)	0.25	0.35	0.28	0.18					
Total Nitrogen (mg/L)	0.49	0.87	0.56	0.7	0.67	0.62	0.54	0.57	0.67
Total Phosphorus(mg/L)	0.035	0.04	0.019	0.01	0.029	0.03	0.052	0.048	0.05
Faecal Coliforms (CFU/100ml)	440	1500	380	110	280	62	240	140	12
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	008								
DATE	17/12/2009	19/01/2010	09/02/2010	17/03/2010	15/04/2010	13/05/2010	16/06/2010	13/07/2010	10/08/2010
Temperature (oC)	22.2	19.11	24.07	18.63	15.65	12.26	9.68	11.93	11.08
Electrical Conductivity (ms/cm)	0.65	0.45	0.46	0.52	0.44	0.55	0.67	0.49	0.14
Electrical Conductivity (µS/cm)	650	450	460	520	440	550	670	490	140
Turbidity (NTU)	5	3.7	3.4	5.4	2	1.9	4.1	3.4	36.5
Dissolved oxygen (mg/L)	2.92	0.13	8.6	6.12	5.04	5.5	11	9.53	10.92
Dissolved oxygen (%sat)	33	1.4	102	65.5	51.1	50.6	95.6	88.3	99
pH (x.xx)	7.1	6.74	7.71	7.1	7.05	7.2	7.5	7.12	7.15
Salinity (ppt)	0.32	0.23	0.26	0.26	0.22	0.28	0.34	0.24	0.1
Suspended Solids (mg/L)	1	6	1	1	2	1	1	2	19
Ammonium-Nitrogen (mg/L)	0.06	0.005	0.02	0.06	0.03	0.05	0.05	0.05	0.15
Oxidised Nitrogen (mg/L)	0.07	0.01	1.05	0.13	0.13	0.1	0.7	0.41	0.35
TKN (mg/L)									
Total Nitrogen (mg/L)	0.48	0.43	1.43	0.53	0.42	0.36	1.03	0.65	0.93
Total Phosphorus(mg/L)	0.064	0.098	0.036	0.043	0.046	0.026	0.022	0.023	0.096
Faecal Coliforms (CFU/100ml)	180	340	2900	320	62	40	330	85	6900
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)						0.19	0.16		
Sodium (mg/L)								58.6	
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)								25.3	
Aluminium (ug/L)								66	
Arsenic (ug/L)								0.5	
Cadmium (ug/L)								0.5	
Chromium (ug/L)								0.5	
Copper (ug/L)								3	
Lead (ug/L)								1	
Manganese (ug/L)								40	
Molybdenum (ug/L)								0.5	
Nickel (ug/L)								2	
Selenium (ug/L)								1.5	
Silver (ug/L)								0.5	
Uranium (ug/L)								0.5	
Zinc (ug/L)								15	
Boron (ug/L)								34	
Iron (ug/L)								1140	
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)		2							
Total Organic Carbon(mg/L)									

Site ID	008								
DATE	06/09/2010	06/10/2010	03/11/2010	09/12/2010	10/01/2011	14/02/2011	14/02/2011	25/03/2011	21/04/2011
Temperature (oC)	14.36	17.47	16.93	22.85	22.62	20.66		19.61	17.07
Electrical Conductivity (ms/cm)		0.3	0.3	0.59	0.2	0.4		0.58	0.55
Electrical Conductivity (µS/cm)		300	300	590	200	400		580	550
Turbidity (NTU)	8.5	4.2	10.8	1.6	15.2	2.1		3.1	8.5
Dissolved oxygen (mg/L)	9.53	8.82	9.47	7.23	8.93	7.05		7.7	9.37
Dissolved oxygen (%sat)	93	92.1	97.8	84.1	103.6	78.8		84.2	97.5
pH (x.xx)	7.29	7.23	7.41	7.22	7.6	7.19		7	7.46
Salinity (ppt)		0.18	0.15	0.3	0.1	0.2		0.29	0.27
Suspended Solids (mg/L)	7	2	4	1	5	1	2	1	1
Ammonium-Nitrogen (mg/L)	0.03	0.02	0.03	0.06	0.005	0.02	0.02	0.05	0.81
Oxidised Nitrogen (mg/L)	0.3	0.28	0.85	0.22	0.27	0.15	0.15	0.56	0.83
TKN (mg/L)									
Total Nitrogen (mg/L)	0.52	0.59	1.19	0.72	0.63	0.62	0.61	1.05	2.2
Total Phosphorus(mg/L)	0.037	0.041	0.052	0.052	0.064	0.074	0.075	0.045	0.081
Faecal Coliforms (CFU/100ml)	340	160	600	80	8100	1800	2200	550	72000
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)		52.1		78.3					
Chloride (mg/L)		95		110					
Sulphate as SO_4^{2-}(mg/L)		39		27					
Fluoride (mg/L)		0.2		0.19					
Sodium (mg/L)		33.6		56.3		37.4	38.1		
Potassium (mg/L)		2.52		4.3		5.07	5.09		
Magnesium (mg/L)		5.53		8.78		6.88	6.72		
Calcium (mg/L)		16.7		25.2		20.4	20.7		
Aluminium (ug/L)				45		106	90		
Arsenic (ug/L)				0.5		0.5	0.5		
Cadmium (ug/L)				0.5		0.5	0.5		
Chromium (ug/L)				0.5		0.5	0.5		
Copper (ug/L)				3		9	10		
Lead (ug/L)				0.5		2	2		
Manganese (ug/L)				31		33	30		
Molybdenum (ug/L)				0.5		2	2		
Nickel (ug/L)				1		1	1		
Selenium (ug/L)				1.5		1.5	1.5		
Silver (ug/L)				0.5		0.5	0.5		
Uranium (ug/L)				0.5		0.5	0.5		
Zinc (ug/L)				23		33	29		
Boron (ug/L)				38		50	52		
Iron (ug/L)				1160		1470	1490		
Mercury (ug/L)				0.05		0.05	0.05		
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)						1	1		
Total Organic Carbon(mg/L)					7.9			8.9	

Site ID	008								
DATE	20/05/2011	15/06/2011	30/06/2011	01/08/2011	07/10/2011	26/10/2011	22/11/2011	22/11/2011	15/12/2011
Temperature (oC)	11.87	13.67	12.1	10.45	15.37	16.84	19.78		18.34
Electrical Conductivity (ms/cm)	0.71	0.26	0.63	0.65	0.57	0.49	0.27		0.46
Electrical Conductivity (µS/cm)	710	260	630	650	570	490	270		460
Turbidity (NTU)	3.8	40.8	7	4.7	29.8	6.3	4.8		4.2
Dissolved oxygen (mg/L)	10.18	11.14	11.1	11.44	11.25	9.07	9.03		10.32
Dissolved oxygen (%sat)	94.5	106.6	103	102.9	111.7	94.3	100.5		109.2
pH (x.xx)	7.2	7.12		7.4	7.58	7.11	7.4		7.55
Salinity (ppt)	0.35	0.13	0.31	0.33	0.29	0.24	0.13		0.23
Suspended Solids (mg/L)	1	17	3	1	2	3	3	7	2
Ammonium-Nitrogen (mg/L)	0.06	0.02	0.03	0.04	0.08	0.26	0.06	0.06	0.03
Oxidised Nitrogen (mg/L)	0.22	0.73	0.47	0.82	0.49	0.53	0.13	0.14	0.82
TKN (mg/L)									
Total Nitrogen (mg/L)	0.52	1.08	0.82	1.08	0.86	1.46	0.55	0.56	1.11
Total Phosphorus(mg/L)	0.016	0.073	0.03	0.018	0.044	0.096	0.088	0.088	0.036
Faecal Coliforms (CFU/100ml)	220	2900	990	400	1500	6900	600	590	460
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)					65.2				65.2
Chloride (mg/L)					109				98
Sulphate as SO_4^{2-}(mg/L)					35				39
Fluoride (mg/L)					0.15				0.11
Sodium (mg/L)					58.6				47.6
Potassium (mg/L)					3.52				4.03
Magnesium (mg/L)					9.19				7.71
Calcium (mg/L)					25.4				28.4
Aluminium (ug/L)					122				322
Arsenic (ug/L)					0.5				0.5
Cadmium (ug/L)					0.5				0.5
Chromium (ug/L)					0.5				0.5
Copper (ug/L)					3				4
Lead (ug/L)					0.5				1
Manganese (ug/L)					20				20
Molybdenum (ug/L)					0.5				0.5
Nickel (ug/L)					1				1
Selenium (ug/L)					1.5				1.5
Silver (ug/L)					0.5				0.5
Uranium (ug/L)					0.5				0.5
Zinc (ug/L)					28				5
Boron (ug/L)					22				49
Iron (ug/L)					988				1100
Mercury (ug/L)					0.005				0.005
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)						12.4			

Site ID	008								
DATE	15/12/2011	13/01/2012	09/02/2012	13/03/2012	13/04/2012	09/05/2012	04/06/2012	03/07/2012	22/08/2012
Temperature (oC)		18.13	20.4	19.78	16.18	13.16	14.8	9.45	10.19
Electrical Conductivity (ms/cm)		0.46	0.32	0.33	0.49	0.65	0.24	0.57	0.64
Electrical Conductivity (µS/cm)		460	320	330	490	650	240	570	640
Turbidity (NTU)		2.2	9.2	19.2	13.3	3.1	22.9	6.4	7.7
Dissolved oxygen (mg/L)		9.94	9.23	9.44	9.6	10.38	9.92	11.28	9.21
Dissolved oxygen (%sat)		110	102	103.5	97.9	98.7	97.9	98.6	81.9
pH (x.xx)		7.1	7.39	7.82	7.51	7.68	7.63	7.69	7.52
Salinity (ppt)		0.23	0.16	0.16	0.24	0.33	0.12	0.29	0.32
Suspended Solids (mg/L)	1	1	5	7	4	1	7	1	1
Ammonium-Nitrogen (mg/L)	0.03	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.44
Oxidised Nitrogen (mg/L)	0.82	0.38	0.42	0.62	0.61	0.41	0.49	0.44	1.1
TKN (mg/L)									
Total Nitrogen (mg/L)	1.11	0.69	0.72	1.17	0.98	0.68	0.73	0.69	1.85
Total Phosphorus(mg/L)	0.036	0.031	0.045	0.068	0.032	0.019	0.061	0.017	0.03
Faecal Coliforms (CFU/100ml)	380	480	5000	1900	240	320	1900	110	290
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)	65.6								
Chloride (mg/L)	98								
Sulphate as SO_4^{2-}(mg/L)	38								
Fluoride (mg/L)	0.11								
Sodium (mg/L)	51.1								
Potassium (mg/L)	4.01								
Magnesium (mg/L)	8.42								
Calcium (mg/L)	28.3								
Aluminium (ug/L)	359								
Arsenic (ug/L)	0.5								
Cadmium (ug/L)	0.5								
Chromium (ug/L)	0.5								
Copper (ug/L)	3								
Lead (ug/L)	1								
Manganese (ug/L)	20								
Molybdenum (ug/L)	0.5								
Nickel (ug/L)	1								
Selenium (ug/L)	1.5								
Silver (ug/L)	0.5								
Uranium (ug/L)	0.5								
Zinc (ug/L)	5								
Boron (ug/L)	39								
Iron (ug/L)	1140								
Mercury (ug/L)	0.005								
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	008								
DATE	20/09/2012	20/09/2012	16/10/2012	13/11/2012	10/12/2012	09/01/2013	15/02/2013	15/03/2013	09/04/2013
Temperature (oC)	14.33		15.43	17.74	18.29	22.71	20.46	20.73	17.48
Electrical Conductivity (ms/cm)	0.44		0.36	0.59	0.33	0.57	0.37	0.49	0.38
Electrical Conductivity (µS/cm)	440		360	590	330	570	370	490	380
Turbidity (NTU)	5.7		8.6	4.2	11.3	5.3	5.6	29.8	6.8
Dissolved oxygen (mg/L)	7.74		7.97	3.36	6.59	0.76	7.29	8.29	7.69
Dissolved oxygen (%sat)	75.5		80	34.9	70	08.8	80.60	92.60	84.4
pH (x.xx)	7.33		7.37	7.14	7.2	7.15	7.33	7.48	7.14
Salinity (ppt)	0.22		0.18	0.29	0.17	0.28	0.18	0.24	0.19
Suspended Solids (mg/L)	3	3	8	37	5	9	6	12	5
Ammonium-Nitrogen (mg/L)	0.01	0.01	0.07	0.09	0.01	0.005	0.04	0.005	0.04
Oxidised Nitrogen (mg/L)	0.07	0.07	0.21	0.08	0.34	0.02	0.11	0.38	0.34
TKN (mg/L)									
Total Nitrogen (mg/L)	0.59	0.58	0.66	0.64	0.98	0.61	0.51	0.96	0.92
Total Phosphorus(mg/L)	0.078	0.076	0.054	0.069	0.112	0.094	0.054	0.076	0.079
Faecal Coliforms (CFU/100ml)	140	140	44	23	7500	83	840	45000	8900
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	008								
DATE	29/05/2013	24/06/2013	23/07/2013	23/08/2013	17/09/2013	25/10/2013	25/10/2013	21/11/2013	16/12/2013
Temperature (oC)	13.57	13.17	9.91	10.13	16.08	16.59		20.78	20.77
Electrical Conductivity (ms/cm)	0.31	0.38	0.49	0.56	0.23	0.59		0.48	0.63
Electrical Conductivity (µS/cm)	310	380	490	560	230	590		480	630
Turbidity (NTU)	8.4	25	5.3	2.6	20.4	2.9		4.7	2.5
Dissolved oxygen (mg/L)	9.78	10.65	10.74	9.82	9.39	3.16		9.09	4.34
Dissolved oxygen (%sat)	94.00	101.4	95.30	87.20	95.50	32.20		101.60	49.70
pH (x.xx)	7.40	7.54	7.34	7.35	7.19	7.14		7.69	6.98
Salinity (ppt)	0.15	0.19	0.24	0.28	0.11	0.30		0.24	0.31
Suspended Solids (mg/L)	5	8	1	1	7	1	1	2	1
Ammonium-Nitrogen (mg/L)	0.01	0.02	0.04	0.03	0.005	0.07	0.06	0.02	0.02
Oxidised Nitrogen (mg/L)	0.27	1.72	0.33	0.13	0.25	0.08	0.08	0.58	0.05
TKN (mg/L)									
Total Nitrogen (mg/L)	0.59	2.16	0.64	0.33	0.69	0.6	0.6	0.94	0.48
Total Phosphorus(mg/L)	0.033	0.068	0.025	0.02	0.072	0.099	0.1	0.041	0.039
Faecal Coliforms (CFU/100ml)	290	2600	30	64	4900	190	220	3600	91
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	008								
DATE	14/01/2014	11/02/2014	11/02/2014	26/03/2014	15/04/2014	12/05/2014	20/06/2014	16/07/2014	21/08/2014
Temperature (oC)	21.05	20.68		20.47	17.27	14.38	12.55	12.71	13.07
Electrical Conductivity (ms/cm)	0.65	0.31		0.21	0.40	0.44	0.67	0.39	0.53
Electrical Conductivity (µS/cm)	650	310		210	400	440	670	390	530
Turbidity (NTU)	3.9	69.5		5.0	6.8	15.2	3.2	102.3	17.1
Dissolved oxygen (mg/L)	3.13	7.22		7.81	9.09	6.79	6.49	9.05	10.95
Dissolved oxygen (%sat)	35.20	80.60		86.40	94.80	65.90	61.00	85.30	104.00
pH (x.xx)	7.19	7.29		7.33	7.31	7.03	6.93	7.60	7.86
Salinity (ppt)	0.32	0.16		0.10	0.20	0.22	0.34	0.19	0.26
Suspended Solids (mg/L)	5	14	17	1	1	1	4	50	6
Ammonium-Nitrogen (mg/L)	0.01	0.04	0.04	0.03	0.04	0.05	0.04	0.18	0.04
Oxidised Nitrogen (mg/L)	0.005	0.23	0.23	0.24	0.37	0.12	0.12	0.6	1.36
TKN (mg/L)									
Total Nitrogen (mg/L)	0.5	0.54	0.53	0.53	0.66	0.46	0.4	1.76	1.66
Total Phosphorus(mg/L)	0.052	0.034	0.034	0.038	0.036	0.044	0.029	0.133	0.036
Faecal Coliforms (CFU/100ml)	210	310	340	510	390	55	51	8000	2400
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)				50.5			78.5		
Chloride (mg/L)				39			146		
Sulphate as SO_4^{2-}(mg/L)				13			28		
Fluoride (mg/L)				0.12			0.21		
Sodium (mg/L)				26.8			95.9		
Potassium (mg/L)				2.59			4.82		
Magnesium (mg/L)				4.58			13.2		
Calcium (mg/L)				16.4			32.8		
Aluminium (ug/L)				241			80		
Arsenic (ug/L)				0.5			0.5		
Cadmium (ug/L)				0.5			0.5		
Chromium (ug/L)				0.5			0.5		
Copper (ug/L)				8			1		
Lead (ug/L)				1			1		
Manganese (ug/L)				19			47		
Molybdenum (ug/L)				0.5			0.5		
Nickel (ug/L)				1			2		
Selenium (ug/L)				1.5			1.5		
Silver (ug/L)				0.5			0.5		
Uranium (ug/L)				0.5			0.5		
Zinc (ug/L)				16			28		
Boron (ug/L)				36			36		
Iron (ug/L)				984			1570		
Mercury (ug/L)				0.005			0.005		
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)	3								
Total Organic Carbon(mg/L)									

Site ID	008						
DATE	11/09/2014	09/10/2014	03/11/2014	08/12/2014	19/01/2015	18/02/2015	17/03/2015
Temperature (oC)	14.30	17.00	16.64	22.23	22.22	22.11	18.07
Electrical Conductivity (ms/cm)	0.36	0.90	1.17	0.41	0.97	0.74	0.46
Electrical Conductivity (µS/cm)	360	900	1170	410	970	740	460
Turbidity (NTU)	4.3	2.9	5.5	22.5	2.0	1.9	5.4
Dissolved oxygen (mg/L)	10.64	8.07	6.63	8.76	3.87	5.24	6.25
Dissolved oxygen (%sat)	94.10	83.60	67.20	100.90	44.50	60.40	66.60
pH (x.xx)	7.74	7.72	7.47	7.53	7.12	7.17	7.12
Salinity (ppt)	0.18	0.46	0.59	0.21	0.49	0.37	0.23
Suspended Solids (mg/L)	3	2	2	3	1	1	3
Ammonium-Nitrogen (mg/L)	0.37	0.04	0.11	0.02	0.04	0.03	0.04
Oxidised Nitrogen (mg/L)	0.29	0.09	0.1	1.34	0.09	0.2	0.2
TKN (mg/L)							
Total Nitrogen (mg/L)	0.95	0.48	0.6	1.79	0.45	0.56	0.53
Total Phosphorus(mg/L)	0.043	0.036	0.036	0.064	0.068	0.04	0.051
Faecal Coliforms (CFU/100ml)	1100	230	2400	4200	470	240	340
Enterococci (CFU/100ml)						95	160
Bicarbonate Alkalinity (mg/CaCO3/L)	50.5			49.3			42.1
Chloride (mg/L)	72			72			93
Sulphate as SO_4^{2-}(mg/L)	23			30			20
Fluoride (mg/L)	0.13			0.11			0.2
Sodium (mg/L)	42.6			49.5			63.6
Potassium (mg/L)	2.56			4.22			4.65
Magnesium (mg/L)	6.3			6.35			8.94
Calcium (mg/L)	18.6			24.6			21.5
Aluminium (ug/L)	353			1730			259
Arsenic (ug/L)	0.5			1			0.5
Cadmium (ug/L)	0.5			0.5			0.5
Chromium (ug/L)	0.5			1			0.5
Copper (ug/L)	6			4			5
Lead (ug/L)	1			3			1
Manganese (ug/L)	14			22			35
Molybdenum (ug/L)	0.5			0.5			0.5
Nickel (ug/L)	1			1			1
Selenium (ug/L)	1.5			1.5			1.5
Silver (ug/L)	0.5			0.5			0.5
Uranium (ug/L)	0.5			0.5			0.5
Zinc (ug/L)	23			26			24
Boron (ug/L)	38			42			56
Iron (ug/L)	718			1300			1030
Mercury (ug/L)	0.005			0.005			0.005
Hydroxide Alkalinity as CaCO3(mg/L)							
Carbonate Alkalinity as CaCO3(ug/L)							
Total Alkalinity as CaCO3(mg/L)							
Ionic Balance(%)							
Total Anions(meq/L)							
Total Cations(meq/L)							
BOD5/CBOD5(mg/L)			1				
Total Organic Carbon(mg/L)							

Site ID	010								
DATE	06/10/1994	17/10/1994	20/10/1994	03/11/1994	15/11/1994	07/12/1994	16/12/1994	06/01/1995	06/01/1995
Temperature (oC)	15.8	18.1	16.9	14.4	17.5	23.3	18.6	21.5	21.5
Electrical Conductivity (ms/cm)	1.06	0.37	0.18	0.87	1.25	2.32	0.91	0.53	0.53
Electrical Conductivity (µS/cm)	1060	370	180	870	1250	2320	910	530	530
Turbidity (NTU)	48.0	31.0	110.0	40.0	7.0	135.0	84.0	22.0	22.0
Dissolved oxygen (mg/L)	8.2	9.5	9.0	8.2	5.5	7.7	4.9	7.9	7.9
Dissolved oxygen (%sat)									
pH (x.xx)	7.60	7.59	7.01	7.36	7.20	11.50	7.32	7.18	7.18
Salinity (ppt)	0.4	0.1	0.0	0.3	0.5	1.1	0.4	0.3	0.3
Suspended Solids (mg/L)	83	17	22	32	5	95	46	24	22
Ammonium-Nitrogen (mg/L)	0.37	0.14	0.16	0.27	0.56	0.15	0.55	0.09	0.06
Oxidised Nitrogen (mg/L)	0.13	0.49	0.56	0.51	0.27	0.39	0.35	0.34	0.2
TKN (mg/L)									
Total Nitrogen (mg/L)	0.86	0.89	1.68	1.05	1.13	1.98	3.17	0.89	0.93
Total Phosphorus(mg/L)	0.14	0.06	0.21	0.01	0.84	0.06	0.86	0.05	0.05
Faecal Coliforms (CFU/100ml)	460	1900	90000	1100	5800	1	230000	6900	4300
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	17/01/1995	17/01/1995	02/02/1995	02/02/1995	15/02/1995	02/03/1995	07/03/1995	15/03/1995	06/04/1995
Temperature (oC)	21.9	21.9	20.4	20.4	22	19	21.8	19.2	16.1
Electrical Conductivity (ms/cm)	0.83	0.83	0.62	0.62	0.28	0.70	0.38	0.72	0.75
Electrical Conductivity (µS/cm)	830	830	620	620	280	700	380	720	750
Turbidity (NTU)	162.0	162.0	17.0	17.0	65.0	725.0	355.0	126.0	41.0
Dissolved oxygen (mg/L)	7.0	7.0	6.6	6.6	7.2	9.9	7.0	6.6	8.2
Dissolved oxygen (%sat)									
pH (x.xx)	8.18	8.18	7.14	7.14	7.15	7.80	7.15	6.97	8.75
Salinity (ppt)	0.3	0.3	0.2	0.2	0.1	0.0	0.1	0.3	0.3
Suspended Solids (mg/L)	66	72	19	18	32	284	133	45	15
Ammonium-Nitrogen (mg/L)	0.33	0.33	0.04	0.05	0.01	0.1	0.01	0.04	0.29
Oxidised Nitrogen (mg/L)	0.62	0.62	0.29	0.29	0.22	1.17	0.75	0.4	0.38
TKN (mg/L)									
Total Nitrogen (mg/L)	1.86	1.91	0.84	0.8	1.11	1.79	1.32	1.29	1.08
Total Phosphorus(mg/L)	0.15	0.17	0.09	0.09	0.13	0.12	0.16	0.1	0.78
Faecal Coliforms (CFU/100ml)	9000	8000	9000	8000	28000	6000	14000	32000	11000
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	20/04/1995	04/05/1995	17/05/1995	07/06/1995	19/06/1995	05/07/1995	14/07/1995	03/08/1995	16/08/1995
Temperature (oC)	18.5	17.7	16.2	14.8	13.6	11.5	12.8	10.5	12.7
Electrical Conductivity (ms/cm)	1.28	0.56	0.10	0.11	0.43	1.00	1.40	0.50	0.50
Electrical Conductivity (µS/cm)	1280	560	100	110	430	1000	1400	500	500
Turbidity (NTU)	156.0	37.0	60.0	21.0	577.1	264.6	45.8	20.0	56.2
Dissolved oxygen (mg/L)	8.7	7.3	10.4	7.9	11.1	9.6	9.1	8.4	7.6
Dissolved oxygen (%sat)									
pH (x.xx)	7.17	7.09	7.04	7.14	8.10	7.40	7.46	7.22	8.33
Salinity (ppt)	0.6	0.2	0.4	0.4	0.2	0.5	0.7	0.3	0.2
Suspended Solids (mg/L)	32	80	105	37	1390	176	3	19	37
Ammonium-Nitrogen (mg/L)	0.02	0.15	0.02	0.28	0.09	0.21	0.01	0.14	0.01
Oxidised Nitrogen (mg/L)	0.92	0.92	0.35	0.6	0.61	0.51	0.48	0.3	0.54
TKN (mg/L)									
Total Nitrogen (mg/L)	1.87	1.52	0.83	0.98	1.58	1.87	1.99	0.87	2.56
Total Phosphorus(mg/L)	0.2	0.17	0.15	5.77	0.22	0.51	2.37	0.39	0.38
Faecal Coliforms (CFU/100ml)	4300	16000	6000	600	1000	110	8	20	160
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	05/09/1995	19/09/1995	04/10/1995	04/10/1995	16/10/1995	07/11/1995	17/11/1995	21/11/1995	05/12/1995
Temperature (oC)	14.2	16	15.4	15.4	16.7	15.3	17.9	18.5	19.5
Electrical Conductivity (ms/cm)	0.70	0.60	0.60	0.60	0.90	0.30	0.90	0.50	0.60
Electrical Conductivity (µS/cm)	700	600	600	600	900	300	900	500	600
Turbidity (NTU)	52.9	69.7	14.2	14.2	7.7	173.1	106.2	283.8	83.9
Dissolved oxygen (mg/L)	6.5	8.3	6.2	6.2	7.7	9.0	5.7	8.7	8.1
Dissolved oxygen (%sat)									
pH (x.xx)	8.29	7.71	7.09	7.09	6.89	6.96	7.16	7.47	7.79
Salinity (ppt)	0.4	0.3	0.3	0.3	0.4	0.1	0.5	0.3	0.3
Suspended Solids (mg/L)	31	38	12	12	30	71	37	148	66
Ammonium-Nitrogen (mg/L)	0.19	0.15	0.23	0.23	0.12	0.03	0.02	0.05	0.33
Oxidised Nitrogen (mg/L)	0.23	0.7	0.41	0.41	0.4	0.31	0.01	0.96	0.7
TKN (mg/L)									
Total Nitrogen (mg/L)	1.83	1.4	1.54	1.62	1.3	0.68	1.74	1.8	3.77
Total Phosphorus(mg/L)	0.43	0.13	0.07	0.07	0.1	0.06	0.21	0.12	0.46
Faecal Coliforms (CFU/100ml)	8100	920	41000	20000	4500	720	1400	8000	110000
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	14/12/1995	04/01/1996	04/01/1996	18/01/1996	06/02/1996	16/02/1996	05/03/1996	18/03/1996	02/04/1996
Temperature (oC)	18.5	19.8	19.8	20.3	21.5	19.2	20.2	18.5	18.2
Electrical Conductivity (ms/cm)	0.80	0.40	0.40	0.80	0.30	0.60	0.40	0.60	0.50
Electrical Conductivity (µS/cm)	800	400	400	800	300	600	400	600	500
Turbidity (NTU)	29.4	184.5	184.5	25.8	61.5	77.9	178.5	115.4	26.1
Dissolved oxygen (mg/L)	8.4	8.9	8.9	7.4	7.7	8.6	10.3	8.2	7.9
Dissolved oxygen (%sat)									
pH (x.xx)	7.59	7.16	7.16	8.31	7.20	7.29	7.82	7.48	7.38
Salinity (ppt)	0.4	0.2	0.2	0.4	0.2	0.3	0.2	0.3	0.2
Suspended Solids (mg/L)	18	83	84	15	27	31	115	216	14
Ammonium-Nitrogen (mg/L)	0.12	0.05	0.05	0.18	0.05	0.09	0.13	0.03	0.1
Oxidised Nitrogen (mg/L)	0.52	0.61	0.61	0.81	0.36	0.57	0.59	0.46	0.46
TKN (mg/L)									
Total Nitrogen (mg/L)	1.2	1.2	1.11	1.22	1.78	1.32	0.97	1.2	1
Total Phosphorus(mg/L)	0.15	0.08	0.07	0.26	0.23	0.16	0.11	0.11	0.16
Faecal Coliforms (CFU/100ml)	1600	3000	1500	4700	20000	3600	5000	8000	2800
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	15/04/1996	02/05/1996	20/05/1996	05/06/1996	05/06/1996	18/06/1996	03/07/1996	03/07/1996	19/07/1996
Temperature (oC)	17.4	19.1	16.3	15.7	15.7	14.7	13.2	13.2	12.2
Electrical Conductivity (ms/cm)	0.30	0.00	0.50	0.60	0.60	0.40	0.80	0.80	0.90
Electrical Conductivity (µS/cm)	300		500	600	600	400	800	800	900
Turbidity (NTU)	600.0	275.7	69.8	75.2	75.2	119.9	46.2	46.2	280.5
Dissolved oxygen (mg/L)	8.5	9.3	8.4	9.4	9.4	9.7	11.4	11.4	9.4
Dissolved oxygen (%sat)				98.0	98.0	95.2	108.8	108.8	87.8
pH (x.xx)	7.22	7.35	6.65	7.15	7.15	7.06	7.26	7.26	7.26
Salinity (ppt)	0.1	0.0	0.2	0.3	0.3	0.2	0.4	0.4	0.5
Suspended Solids (mg/L)	385	24	20	30	29	45	32	33	94
Ammonium-Nitrogen (mg/L)	0.01	0.07	0.29	0.14	0.14	0.01	0.15	0.14	0.12
Oxidised Nitrogen (mg/L)	0.4	0.36	1.01	0.45	0.45	0.82	0.55	0.53	0.61
TKN (mg/L)									
Total Nitrogen (mg/L)	1.11	0.94	1.4	1.26	1.22	1.39	1.36	1.26	1.05
Total Phosphorus(mg/L)	0.66	0.3	0.16	0.08	0.08	0.09	0.12	0.12	0.14
Faecal Coliforms (CFU/100ml)	4400	18000	2400	2000	2000	1600	1	2	2400
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	05/08/1996	05/08/1996	19/08/1996	04/09/1996	16/09/1996	01/10/1996	16/10/1996	05/11/1996	20/11/1996
Temperature (oC)	13.3	13.3	11.7	14.1	15.8	15.3	17.2	15.8	18.1
Electrical Conductivity (ms/cm)	1.00	1.00	0.20	0.50	0.60	0.40	0.50	0.10	0.40
Electrical Conductivity (µS/cm)	1000	1000	200	500	600	400	500	100	400
Turbidity (NTU)	160.0	160.0	350.0	87.6	600.0	49.0	9.0	386.0	100.0
Dissolved oxygen (mg/L)	9.2	9.2	11.5	9.9	9.0	9.2	9.0	10.2	6.8
Dissolved oxygen (%sat)	88.4	88.4	105.7	94.7	91.3	92.0	93.9	102.8	72.7
pH (x.xx)	7.46	7.46	7.78	6.96	7.24	7.44	7.45	7.27	7.48
Salinity (ppt)	0.5	0.5	0.1	0.2	0.3	0.2	0.2	0.0	0.2
Suspended Solids (mg/L)	68	92	108	38	141	33	47	126	58
Ammonium-Nitrogen (mg/L)	0.2	0.22	0.54	0.14	0.28	0.1	0.17	0.02	0.01
Oxidised Nitrogen (mg/L)	0.59	0.58	0.81	1.1	0.72	0.84	0.65	0.7	0.89
TKN (mg/L)									
Total Nitrogen (mg/L)	1.1	1.26	3.29	1.55	2.07	1.38	1.72	1.12	2.37
Total Phosphorus(mg/L)	0.07	0.05	0.31	0.07	0.32	0.1	0.11	0.03	0.37
Faecal Coliforms (CFU/100ml)	110	120	30000	310	1100	3000	480	8000	2000
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	06/12/1996	17/12/1996	07/01/1997	20/01/1997	06/02/1997	18/02/1997	05/03/1997	18/03/1997	07/04/1997
Temperature (oC)	20	19.7	20.1	18.9	20.85	21.55	19.85	20.2	17.6
Electrical Conductivity (ms/cm)	0.50	0.20	0.10	0.40	0.40	0.60	0.50	0.30	0.30
Electrical Conductivity (µS/cm)	500	200	100	400	400	600	500	300	300
Turbidity (NTU)	96.0	133.0	236.5	161.5	29.6	31.7	0.0	89.5	15.1
Dissolved oxygen (mg/L)	5.5	11.0	8.6	8.9	9.5	17.7	7.2	9.7	9.1
Dissolved oxygen (%sat)	60.3	120.5	95.0	96.4	106.3	200.0	78.4	106.4	96.6
pH (x.xx)	7.46	7.44	7.36	10.15	7.57	7.13	7.76	7.87	7.63
Salinity (ppt)	0.3	0.1	0.1	0.2	0.2	0.3	0.3	0.2	0.1
Suspended Solids (mg/L)	46	166	117	270	72	27	1260	48	31
Ammonium-Nitrogen (mg/L)	0.01	0.01	0.01	0.16	0.05	0.03	0.12	0.01	0.25
Oxidised Nitrogen (mg/L)	0.01	0.4	0.87	0.55	0.6	0.33	0.01	0.58	0.3
TKN (mg/L)									
Total Nitrogen (mg/L)	2.74	1.86	2.09	1.68	1.04	1.67	3.19	1.38	1.14
Total Phosphorus(mg/L)	0.65	0.29	0.26	0.25	0.28	0.37	0.99	0.24	0.21
Faecal Coliforms (CFU/100ml)	40000	12000	78000	6000	6000	55000	80000	1100	40000
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	17/04/1997	06/05/1997	06/05/1997	19/05/1997	04/06/1997	18/06/1997	02/07/1997	18/07/1997	05/08/1997
Temperature (oC)	21.3	19.5	19.5	16.8	15	13.8	13.9	12.9	15.3
Electrical Conductivity (ms/cm)	0.60	0.70	0.70	0.10	0.70	0.90	1.00	0.70	0.80
Electrical Conductivity (µS/cm)	600	700	700	100	700	900	1000	700	800
Turbidity (NTU)	28.4	135.0	135.0	90.2	24.0	82.7	206.0	275.0	88.8
Dissolved oxygen (mg/L)	7.3	6.2	6.2	9.7	8.1	9.1	9.6	9.7	10.8
Dissolved oxygen (%sat)	82.5	67.6	67.6	98.9	81.0	87.8	92.7	91.6	108.2
pH (x.xx)	7.73	7.22	7.22	8.45	7.37	8.00	10.93	7.76	6.99
Salinity (ppt)	0.3	0.3	0.3	0.1	0.4	0.4	0.5	0.3	0.4
Suspended Solids (mg/L)	18	42	40	46	16	55	254	91	71
Ammonium-Nitrogen (mg/L)	0.38	0.04	0.05	0.06	0.1	0.02	0.99	0.28	0.03
Oxidised Nitrogen (mg/L)	0.63	0.46	0.46	17.9	0.78	0.44	0.86	0.6	0.63
TKN (mg/L)									
Total Nitrogen (mg/L)	1.87	1.24	1.2	22.2	1.55	1.3	3.49	1.84	1.97
Total Phosphorus(mg/L)	0.6	0.23	0.22	0.89	0.12	1.03	0.45	0.82	0.2
Faecal Coliforms (CFU/100ml)	1400	2400	1600	18000	360	780	140	1800	800
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	18/08/1997	04/09/1997	04/09/1997	18/09/1997	01/10/1997	20/10/1997	05/11/1997	05/11/1997	17/11/1997
Temperature (oC)	13.8	15.2	15.2	14.1	15.55	17.4	18.9	18.9	19.8
Electrical Conductivity (ms/cm)	0.70	0.90	0.90	0.70	0.70	0.80	0.30	0.30	0.80
Electrical Conductivity (µS/cm)	700	900	900	700	700	800	300	300	800
Turbidity (NTU)	38.7	42.0	42.0	23.7	25.6	17.9	480.4	480.4	42.3
Dissolved oxygen (mg/L)	9.5	9.2	9.2	10.0	12.5	8.3	10.0	10.0	13.3
Dissolved oxygen (%sat)	91.9	91.6	91.6	96.6	124.6	84.2	107.1	107.1	145.9
pH (x.xx)	7.74	7.32	7.32	7.72	7.24	7.31	7.35	7.35	7.14
Salinity (ppt)	0.4	0.4	0.4	0.3	0.4	0.4	0.2	0.2	0.4
Suspended Solids (mg/L)	44	30	29	25	46	12	394	294	30
Ammonium-Nitrogen (mg/L)	0.12	0.1	0.09	0.04	0.13	0.01	0.09	0.08	0.15
Oxidised Nitrogen (mg/L)	0.47	0.47	0.48	0.43	0.58	0.01	2.06	2.06	1.35
TKN (mg/L)									
Total Nitrogen (mg/L)	1.85	1.22	1.13	1.25	1.17	0.6	3.71	3.74	2.14
Total Phosphorus(mg/L)	0.24	0.2	0.17	0.32	0.07	0.04	0.2	0.23	0.12
Faecal Coliforms (CFU/100ml)	46	1000	1500	1300	1500	210	25000	19000	1100
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	03/12/1997	18/12/1997	06/01/1999	20/01/1999	01/02/1999	19/02/1999	01/03/1999	17/03/1999	07/04/1999
Temperature (oC)	20	22.3	27.2	21.8	21.7	19.9	21.1	20.7	19.4
Electrical Conductivity (ms/cm)	0.90	0.50	1.30	0.30	0.00	0.80	0.40	1.30	0.50
Electrical Conductivity (µS/cm)	900	500	1300	300		800	400	1300	500
Turbidity (NTU)	17.7	4.8	159.1	96.3	176.0	21.5	184.5	12.7	83.4
Dissolved oxygen (mg/L)	7.6	6.1	1.3	6.6		8.1	8.7	7.2	7.9
Dissolved oxygen (%sat)	83.5	69.9	15.9	73.7		89.1	98.0	80.6	85.5
pH (x.xx)	7.72	7.74	6.00	7.58	7.20	7.51	7.41	7.70	7.33
Salinity (ppt)	0.4	0.2	0.7	0.1	0.0	0.4	0.2	0.7	0.3
Suspended Solids (mg/L)	11	121	142	62	154	13	74	8	54
Ammonium-Nitrogen (mg/L)	0.05	0.05	0.03	0.01	0.11	0.14	0.02	0.01	0.08
Oxidised Nitrogen (mg/L)	1	0.61	0.04	0.4	0.3	0.69	0.33	0.55	1.16
TKN (mg/L)									
Total Nitrogen (mg/L)	2.45	1.48	0.36	4.68	1.92	1.58	0.87	0.99	1.95
Total Phosphorus(mg/L)	0.12	0.09	0.02	0.74	0.56	0.13	0.16	0.08	0.23
Faecal Coliforms (CFU/100ml)	10000	30000	2000000	30000	38000	2500	26000	2900	790
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	20/04/1999	05/05/1999	24/05/1999	03/06/1999	16/06/1999	06/07/1999	19/07/1999	04/08/1999	19/08/1999
Temperature (oC)	19.1	18	17.7	15.6	13.2	14.3	14.7	13.5	13.99
Electrical Conductivity (ms/cm)	0.80	0.70	0.30	0.40	0.90	0.80	0.70	0.80	0.60
Electrical Conductivity (µS/cm)	800	700	300	400	900	800	700	800	600
Turbidity (NTU)	28.1	38.3	394.0	331.5	24.5	124.0	32.1	55.4	272.5
Dissolved oxygen (mg/L)	9.8	8.8	9.7	8.5	8.5	5.2	9.8	8.6	8.7
Dissolved oxygen (%sat)	105.6	91.2	102.5	84.8	81.0	51.0	94.1	82.4	84.0
pH (x.xx)	7.44	7.32	7.32	7.52	7.37	7.35	7.16	7.39	7.33
Salinity (ppt)	0.4	0.4	0.1	0.2	0.4	0.4	0.3	0.4	0.3
Suspended Solids (mg/L)	16	28	170	283	16	107	18	25	107
Ammonium-Nitrogen (mg/L)	0.08	0.04	0.08	0.01	0.53	1.14	0.3	0.01	0.7
Oxidised Nitrogen (mg/L)	0.57	0.45	1.24	1.19	0.84	0.06	1.34	1.14	0.87
TKN (mg/L)									
Total Nitrogen (mg/L)	0.98	0.79	1.86	2.36	1.89	4.5	1.95	1.68	3.25
Total Phosphorus(mg/L)	0.07	0.08	0.23	0.3	0.47	5.37	0.14	0.19	0.49
Faecal Coliforms (CFU/100ml)	560	850	76000	13000	78000	9300000	8300	9000	36000
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	07/09/1999	23/09/1999	05/10/1999	20/10/1999	04/11/1999	23/11/1999	08/12/1999	20/12/1999	05/01/2000
Temperature (oC)	14.71	16.68	17.2	17.79	14.77	18.07	19.52	17.73	19.34
Electrical Conductivity (ms/cm)	0.80	1.10	0.20	0.50	0.70	1.30	0.70	0.70	0.70
Electrical Conductivity (µS/cm)	800	1100	200	500	700	1300	700	700	700
Turbidity (NTU)	35.1	97.2	345.8	56.9	16.8	14.4	77.0	87.4	58.8
Dissolved oxygen (mg/L)	10.2	10.1	10.2	9.0	6.9	3.1	0.7	4.9	4.5
Dissolved oxygen (%sat)	100.6	104.1	105.7	94.4	67.9	32.6	7.7	51.0	48.9
pH (x.xx)	7.30	7.35	7.36	7.20	7.38	7.36	7.73	7.21	7.27
Salinity (ppt)	0.4	0.5	0.1	0.3	0.3	0.7	0.3	0.3	0.4
Suspended Solids (mg/L)	17	40	153	28	7	6	39	49	19
Ammonium-Nitrogen (mg/L)	0.62	0.08	0.07	0.13	0.2	0.29	0.03	0.01	0.02
Oxidised Nitrogen (mg/L)	1.08	0.87	0.61	0.87	0.64	0.92	0.36	0.01	0.81
TKN (mg/L)									
Total Nitrogen (mg/L)	1.7	2.92	1.62	1.35	1.33	2.14	2.22	1.25	1.62
Total Phosphorus(mg/L)	0.05	0.48	0.24	0.07	0.06	0.28	0.85	0.44	0.28
Faecal Coliforms (CFU/100ml)	600	10	42000	13000	26000	3100	1100	190000	3300
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	19/01/2000	02/02/2000	21/02/2000	07/03/2000	21/03/2000	04/04/2000	18/04/2000	01/05/2000	19/05/2000
Temperature (oC)	18.39	19.68	21	20.7	20.12		18.25	17.38	14.7
Electrical Conductivity (ms/cm)	0.60	1.20	1.20	0.00	0.20		0.70	0.60	0.70
Electrical Conductivity (µS/cm)	600	1200	1200		200		700	600	700
Turbidity (NTU)	27.7	29.3	73.8	87.0	68.3		11.2	67.5	25.2
Dissolved oxygen (mg/L)	4.5	2.2	1.4	8.6	9.2		6.8	4.1	4.0
Dissolved oxygen (%sat)	47.8	24.2	15.0	96.1	101.8		71.6	42.4	38.8
pH (x.xx)	9.22	10.01	7.66	7.17	7.00		9.48	7.07	7.36
Salinity (ppt)	0.3	0.6	0.6	0.0	0.1		0.3	0.3	0.4
Suspended Solids (mg/L)	10	13	19	34	38	36	12	18	6
Ammonium-Nitrogen (mg/L)	0.01	0.01	0.08	0.06	0.04	0.44	0.34	0.45	0.01
Oxidised Nitrogen (mg/L)	0.01	0.36	0.01	0.18	0.81	1.06	0.4	0.97	0.62
TKN (mg/L)									
Total Nitrogen (mg/L)	0.81	1.64	3.79	0.59	1.16	2.05	1.82	1.68	1.21
Total Phosphorus(mg/L)	0.2	0.44	0.6	0.11	0.1	0.15	0.18	0.16	0.09
Faecal Coliforms (CFU/100ml)	17000	55000	200000	32000	17000	60000	2200	9000	1000000
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	07/06/2000	26/06/2000	05/07/2000	19/07/2000	04/08/2000	17/08/2000	05/09/2000	21/09/2000	06/10/2000
Temperature (oC)	12.94	11.55	12.34	12.47	11.23	10.62	13.76	17.74	16.05
Electrical Conductivity (ms/cm)	0.50	0.80	0.80	1.00	0.80	0.90	0.90	0.70	0.80
Electrical Conductivity (µS/cm)	500	800	800	1000	800	900	900	700	800
Turbidity (NTU)	89.3	121.3	16.0	74.7	21.8	41.3	118.8	21.1	34.5
Dissolved oxygen (mg/L)	6.9	6.5	5.3	5.9	0.7	5.8	4.4	3.3	1.8
Dissolved oxygen (%sat)	65.6	59.5	49.7	53.8	5.8	52.3	42.3	34.7	17.9
pH (x.xx)	7.39	7.39	7.21	7.66	7.27	7.29	7.98	7.19	7.05
Salinity (ppt)	0.3	0.4	0.4	0.5	0.4	0.4	0.5	0.4	0.4
Suspended Solids (mg/L)	13	46	9	34	9	56	32	13	12
Ammonium-Nitrogen (mg/L)	0.34	0.39	0.05	0.01	0.01	0.02	0.01	0.24	1.35
Oxidised Nitrogen (mg/L)	0.72	0.7	0.28	0.4	0.01	0.61	0.02	0.35	0.36
TKN (mg/L)									
Total Nitrogen (mg/L)	1.63	1.57	0.54	0.9	1.77	1.14	1.43	1.9	2.45
Total Phosphorus(mg/L)	0.18	0.11	0.04	0.5	1.38	0.12	4.18	0.29	0.34
Faecal Coliforms (CFU/100ml)	15000	430	2600	6800	700	420	400	21000	4000
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	20/10/2000	09/11/2000	22/11/2000	06/12/2000	20/12/2000	04/01/2001	18/01/2001	05/02/2001	21/02/2001
Temperature (oC)	16.91	15.9	17.6	23.26	22.4	23.27	22.37	26.66	21.95
Electrical Conductivity (ms/cm)	0.60	0.70	0.50	0.70	1.00	0.50	0.40	0.10	0.50
Electrical Conductivity (µS/cm)	600	700	500	700	1000	500	400	100	500
Turbidity (NTU)	68.9	19.9	53.7	16.7	28.4	20.0	301.8	209.5	367.6
Dissolved oxygen (mg/L)	5.2	0.5	7.1	4.8	2.6	3.2	8.0	8.1	7.7
Dissolved oxygen (%sat)	53.5	5.3	74.5	56.4	29.8	37.0	92.2	101.5	88.4
pH (x.xx)	7.28	7.11	7.36	7.40	7.19	6.97	8.59	7.25	8.13
Salinity (ppt)	0.3	0.4	0.3	0.3	0.5	0.2	0.2	0.1	0.2
Suspended Solids (mg/L)	33	9	23	6	7	8	146	498	177
Ammonium-Nitrogen (mg/L)	0.01	0.01	0.14	0.03	0.01	0.02	0.04	0.03	0.09
Oxidised Nitrogen (mg/L)	0.03	0.01	1.16	0.01	0.01	2.5	1.18	0.77	0.96
TKN (mg/L)									
Total Nitrogen (mg/L)	0.4	0.49	1.55	0.33	0.92	2.98	2.22	2.27	1.37
Total Phosphorus(mg/L)	0.07	0.2	0.07	0.05	0.13	0.05	0.21	0.75	0.14
Faecal Coliforms (CFU/100ml)	5000	600	3300	1600	9600	3200	34000	1400000	10000
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	06/03/2001	22/03/2001	05/04/2001	20/04/2001	09/05/2001	23/05/2001	06/06/2001	18/06/2001	03/07/2001
Temperature (oC)	21.43	19.65	20.49	19.58	17.42	16.24	15.47	13.14	13.05
Electrical Conductivity (ms/cm)	0.50	1.00	0.80	0.50	0.50	0.60	2.80	0.80	1.20
Electrical Conductivity (µS/cm)	500	1000	800	500	500	600	2800	800	1200
Turbidity (NTU)	126.3	106.6	8.3	13.6	63.0	139.5	23.5	31.6	7.2
Dissolved oxygen (mg/L)	7.6	0.0	4.8	7.0	9.1	7.0	6.4	4.7	1.1
Dissolved oxygen (%sat)	86.4	0.0	52.8	76.3	94.8	71.3	69.6	44.4	10.6
pH (x.xx)	7.46	6.78	7.50	7.36	7.05	7.44	7.46	7.35	6.83
Salinity (ppt)	0.3	0.5	0.4	0.3	0.2	0.3	1.5	0.4	0.6
Suspended Solids (mg/L)	64	31	4	6	18	83	15	22	21
Ammonium-Nitrogen (mg/L)	0.1	0.49	0.43	0.15	0.07	0.18	0.35	0.22	0.01
Oxidised Nitrogen (mg/L)	0.76	0.47	1.3	1.18	1.73	0.58	0.75	0.97	0.94
TKN (mg/L)									
Total Nitrogen (mg/L)	1.31	5.8	2.08	1.69	1.99	1.05	1.43	1.79	1.4
Total Phosphorus(mg/L)	0.19	2.03	0.19	0.14	0.06	0.4	0.05	0.16	0.3
Faecal Coliforms (CFU/100ml)	25000	59000	16000	24000	3400	8000	700	40000	56
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	19/07/2001	09/08/2001	21/08/2001	04/09/2001	20/09/2001	02/10/2001	19/10/2001	05/11/2001	22/11/2001
Temperature (oC)	12.73	11.79	12.56	15.12	17	19.11	16.49	16.56	16.7
Electrical Conductivity (ms/cm)	1.00	1.50	1.30	0.90	1.00	0.60	0.80	0.60	1.10
Electrical Conductivity (µS/cm)	1000	1500	1300	900	1000	600	800	600	1100
Turbidity (NTU)	68.9	22.6	23.5	64.9	134.0	54.7	62.7	23.1	26.1
Dissolved oxygen (mg/L)	5.9	3.2	2.9	6.9	4.7	4.8	2.5	0.0	5.7
Dissolved oxygen (%sat)	55.9	29.2	27.1	68.2	48.7	52.3	25.7	0.0	57.9
pH (x.xx)	7.31	6.57	7.09	8.62	9.21	7.24	7.27	7.07	6.97
Salinity (ppt)	0.5	0.8	0.6	0.5	0.5	0.3	0.4	0.3	0.5
Suspended Solids (mg/L)	24	57	26	15	19	28	21	9	16
Ammonium-Nitrogen (mg/L)	0.13	0.83	0.4	0.25	0.22	0.01	0.01	0.01	0.36
Oxidised Nitrogen (mg/L)	0.75	0.81	0.8	0.79	0.68	0.74	0.24	0.05	0.96
TKN (mg/L)									
Total Nitrogen (mg/L)	1.51	2.97	2.01	1.5	1.92	3.27	1.09	0.88	1.42
Total Phosphorus(mg/L)	0.15	0.34	0.16	0.07	0.23	1.32	0.11	0.24	0.05
Faecal Coliforms (CFU/100ml)	3300	10000	14000	300	16000	1700	110000	14000	180
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	04/12/2001	18/12/2001	09/01/2002	18/01/2002	07/02/2002	18/02/2002	06/03/2002	18/03/2002	08/04/2002
Temperature (oC)	24.14	20.53	21.75	19.64	20.82	21.4	21.68	21.29	19.67
Electrical Conductivity (ms/cm)	0.70	1.00	1.10	1.05	0.60	0.30	0.60	1.00	0.80
Electrical Conductivity (µS/cm)	700	1000	1100	1050	600	300	600	1000	800
Turbidity (NTU)	60.6	29.2	28.1	59.1	39.9	86.3	116.4	38.9	19.8
Dissolved oxygen (mg/L)	6.4	3.7	1.7	5.2	6.7	8.1	6.4	4.9	8.1
Dissolved oxygen (%sat)	75.9	41.4	19.7	56.6	74.5	92.5	73.1	55.2	89.0
pH (x.xx)	7.37	6.92	6.75	6.77	7.25	7.38	7.22	7.27	7.70
Salinity (ppt)	0.4	0.5	0.6	0.5	0.3	0.2	0.3	0.5	0.4
Suspended Solids (mg/L)	34	16	15	26	21	40	63	10	10
Ammonium-Nitrogen (mg/L)	0.08	0.01	0.05	0.02	0.13	0.03	0.04	0.05	0.31
Oxidised Nitrogen (mg/L)	0.65	0.26	0.21	0.26	1.3	0.37	0.41	0.45	0.63
TKN (mg/L)									
Total Nitrogen (mg/L)	2.34	0.66	0.8	0.7	1.98	0.93	0.95	0.79	1.27
Total Phosphorus(mg/L)	0.16	0.04	0.03	0.08	0.04	0.09	0.06	0.03	0.05
Faecal Coliforms (CFU/100ml)	20000	600	510	1000	12000	10000	6000	430	1600
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	19/04/2002	02/05/2002	20/05/2002	05/06/2002	18/06/2002	02/07/2002	18/07/2002	06/08/2002	20/08/2002
Temperature (oC)	19.99	17.74	13.85	15.11	13.24	12.46	11.65	12.92	14.38
Electrical Conductivity (ms/cm)	0.70	0.80	0.30	0.70	0.90	0.60	0.60	1.50	0.90
Electrical Conductivity (µS/cm)	700	800	300	700	900	600	600	1500	900
Turbidity (NTU)	26.4	26.6	36.2	16.6	23.0	26.9	22.0	32.8	82.1
Dissolved oxygen (mg/L)	7.3	5.9	8.3	6.2	7.1	8.1	8.8	6.6	7.6
Dissolved oxygen (%sat)	80.9	61.7	79.8	62.0	68.3	75.9	80.6	62.7	7.4
pH (x.xx)	7.54	7.42	7.30	7.33	7.33	7.40	7.30	6.79	7.75
Salinity (ppt)	0.4	0.4	0.1	0.4	0.5	0.3	0.3	0.8	0.4
Suspended Solids (mg/L)	15	14	20	8	14	17	14	47	32
Ammonium-Nitrogen (mg/L)	0.28	0.2	0.08	0.29	0.42	0.33	0.23	0.45	0.23
Oxidised Nitrogen (mg/L)	0.57	0.73	0.67	0.52	0.67	0.51	0.66	0.85	0.88
TKN (mg/L)									
Total Nitrogen (mg/L)	1.27	1.25	1.29	1.08	1.12	1.28	1.01	1.64	1.59
Total Phosphorus(mg/L)	0.08	0.05	0.12	0.14	0.03	0.19	0.06	0.94	0.16
Faecal Coliforms (CFU/100ml)	4100	1200	51000	2800	50	17000	230	590	7300
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	04/09/2002	17/09/2002	09/10/2002	21/10/2002	11/11/2002	21/11/2002	03/12/2002	18/12/2002	15/01/2003
Temperature (oC)	17.01	14.21	16.45	19.07	17.46	17.75	22.95	21.04	23.04
Electrical Conductivity (ms/cm)	1.15	0.10	0.90	1.00	1.00	0.80	0.90	0.70	0.90
Electrical Conductivity (µS/cm)	1150	100	900	1000	1000	800	900	700	900
Turbidity (NTU)	35.3	168.6	246.7	40.7	24.7	10.5	6.9	11.4	12.7
Dissolved oxygen (mg/L)	4.4	11.3	1.2	1.4	2.3	3.7	4.3	6.3	0.5
Dissolved oxygen (%sat)	45.8	109.9	12.5	14.9	24.2	37.9	49.6	70.9	5.5
pH (x.xx)	7.14	7.65	7.13	7.54	9.03	7.99	7.89	7.91	7.77
Salinity (ppt)	0.6	0.0	0.5	0.5	0.5	0.4	0.4	0.4	0.5
Suspended Solids (mg/L)	28	73	188	18	24	26	8	6	14
Ammonium-Nitrogen (mg/L)	0.06	0.27	0.01	0.06	0.01	0.01	0.01	0.09	0.01
Oxidised Nitrogen (mg/L)	0.62	0.55	0.01	0.39	0.57	0.71	0.95	1.93	0.01
TKN (mg/L)									
Total Nitrogen (mg/L)	1.66	1.35	0.79	1.42	2.06	1.53	1.44	2.49	1.07
Total Phosphorus(mg/L)	0.28	0.17	1.4	0.26	0.22	0.12	0.06	0.07	0.24
Faecal Coliforms (CFU/100ml)	2000	13000	2500	9000	8100	5600	3700	3400	26000
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)			890.00	30.00	5.00	5.00	20.00	160.00	5.00
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	22/01/2003	05/02/2003	18/02/2003	03/03/2003	19/03/2003	11/04/2003	16/04/2003	08/05/2003	19/05/2003
Temperature (oC)	21.16	20.45	21.16	19.3	19.43	17.27	17.56	17.96	17.99
Electrical Conductivity (ms/cm)	1.00	1.00	0.70	0.80	0.80	0.80	0.70	0.80	0.70
Electrical Conductivity (µS/cm)	1000	1000	700	800	800	800	700	800	700
Turbidity (NTU)	14.0	14.4	259.4	79.0	10.8	10.4	19.8	17.1	24.8
Dissolved oxygen (mg/L)	1.2	0.1	7.5	5.9	6.1	4.5	7.2	6.1	7.4
Dissolved oxygen (%sat)	13.1	1.1	84.0	63.7	66.2	47.6	75.3	64.5	78.6
pH (x.xx)	7.80	7.63	7.91	7.90	7.83	7.87	7.76	7.51	7.44
Salinity (ppt)	0.5	0.5	0.3	0.4	0.4	0.4	0.4	0.4	0.4
Suspended Solids (mg/L)	9	18	142	48	10	8	10	12	25
Ammonium-Nitrogen (mg/L)	0.28	0.02	0.21	0.19	0.05	0.16	0.13	0.21	0.61
Oxidised Nitrogen (mg/L)	0.3	0.01	0.9	2.4	1.61	1.2	0.88	0.49	1.1
TKN (mg/L)									
Total Nitrogen (mg/L)	1.46	2.8	1.46	3.1	2.01	1.85	1.25	1.07	2.99
Total Phosphorus(mg/L)	0.34	0.61	0.16	0.05	0.12	0.24	0.06	0.13	0.28
Faecal Coliforms (CFU/100ml)	47000	0	44000	5200	10000	33000	610	650	1800
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)	14000.00								
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	05/06/2003	18/06/2003	04/07/2003	17/07/2003	14/08/2003	18/08/2003	04/09/2003	18/09/2003	07/10/2003
Temperature (oC)	16.39	14.85	14.29	14.08	14.03	13.38	13.03	16.18	
Electrical Conductivity (ms/cm)	0.80	1.00	0.60	1.00	1.10	1.20	1.00	1.00	
Electrical Conductivity (µS/cm)	800	1000	600	1000	1100	1200	1000	1000	
Turbidity (NTU)	29.8	35.9	34.6	20.0	40.6	18.2	63.5	71.3	
Dissolved oxygen (mg/L)	7.8	7.8	7.9	6.4	3.2	2.5	4.0	3.5	
Dissolved oxygen (%sat)	79.1	77.1	77.5	62.5	30.7	23.6	38.0	35.3	
pH (x.xx)	7.41	7.77	7.27	7.61	6.97	6.96	7.16	7.28	
Salinity (ppt)	0.4	0.5	0.3	0.5	0.6	0.6	0.5	0.5	
Suspended Solids (mg/L)	11	11	32	9	17	18	16	120	44
Ammonium-Nitrogen (mg/L)	0.97	1.32	0.24	1.33	0.61	0.48	0.55	0.62	0.3
Oxidised Nitrogen (mg/L)	0.45	0.67	0.47	0.63	1.07	1.01	0.76	0.75	1.02
TKN (mg/L)									
Total Nitrogen (mg/L)	1.67	2.33	2.09	2.3	1.82	1.97	2.16	1.76	1.55
Total Phosphorus(mg/L)	0.1	0.06	0.31	0.06	0.11	0.22	1.19	0.25	0.18
Faecal Coliforms (CFU/100ml)	7100	1900	1500	160	8600	6300	2400	4500	8000
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	20/10/2003	13/11/2003	20/11/2003	11/12/2003	18/12/2003	13/01/2004	21/01/2004	04/02/2004	18/02/2004
Temperature (oC)	18.72	16.94					20.18	20.76	21.24
Electrical Conductivity (ms/cm)	0.70	0.90					1.60	0.80	1.10
Electrical Conductivity (µS/cm)	700	900					1600	800	1100
Turbidity (NTU)	96.4	19.7					14.7	11.8	13.4
Dissolved oxygen (mg/L)	8.0	3.8					0.1	4.2	0.4
Dissolved oxygen (%sat)	86.1	39.0					0.7	47.2	3.9
pH (x.xx)	7.65	7.71					6.61	7.59	6.98
Salinity (ppt)	0.3	0.5					0.9	0.4	0.6
Suspended Solids (mg/L)	64	53	10	15	9	7	18	5	8
Ammonium-Nitrogen (mg/L)	0.47	0.32	0.01	0.31	1.52	0.2	0.01	0.02	0.04
Oxidised Nitrogen (mg/L)	1.05	0.85	0.5	0.32	0.53	1.18	0.42	0.69	0.64
TKN (mg/L)									
Total Nitrogen (mg/L)	2.15	2.8	0.83	1.38	2.58	1.87	0.87	1.23	1.07
Total Phosphorus(mg/L)	0.17	0.43	0.06	0.17	0.07	0.05	0.05	0.07	0.06
Faecal Coliforms (CFU/100ml)	45000	5100	510	5	11000	1100	8100	38000	2200
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	08/03/2004	18/03/2004	29/03/2004	20/04/2004	05/05/2004	26/05/2004	31/05/2004	17/06/2004	08/07/2004
Temperature (oC)		20.37	19.805	17.98	15.045	15.17	9.535	11.945	11.29
Electrical Conductivity (ms/cm)		1.10	0.80	2.90	0.90	1.00	0.40	1.05	0.90
Electrical Conductivity (µS/cm)		1100	800	2900	900	1000	400	1050	900
Turbidity (NTU)		17.2	19.3	92.9	25.7	34.4	1.4	11.7	9.9
Dissolved oxygen (mg/L)		1.2	5.2	0.0	4.0	4.7	10.4	1.8	7.5
Dissolved oxygen (%sat)		12.4	56.1	0.1	38.9	46.5	90.6	16.1	68.5
pH (x.xx)		7.56	7.93	10.89	7.58	7.65	7.79	7.01	8.16
Salinity (ppt)		0.6	0.4	1.5	0.4	0.5	0.2	0.5	0.5
Suspended Solids (mg/L)	36	6	24	16	17	13	7	6	14
Ammonium-Nitrogen (mg/L)	0.49	0.36	0.96	0.29	0.28	0.08	0.35	0.03	0.005
Oxidised Nitrogen (mg/L)	1.16	1.42	0.41	1.14	1.11	1.1	1.39	3.2	8
TKN (mg/L)									
Total Nitrogen (mg/L)	2.71	2.35	1.69	2.36	1.81	1.77	1.99	3.88	8.85
Total Phosphorus(mg/L)	0.2	0.08	0.07	0.153	0.07	0.17	0.05	0.066	0.124
Faecal Coliforms (CFU/100ml)	160000	27000	10000	14000	130	800	790	2700	1400
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)			236						
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	20/07/2004	03/08/2004	18/08/2004	06/09/2004	15/09/2004	07/10/2004	19/10/2004	02/11/2004	18/11/2004
Temperature (oC)	13.21	12.73	12.04	15.135	14.445	17.53	16.36	18.245	20.42
Electrical Conductivity (ms/cm)	0.80	0.70	0.10	0.90	0.50	0.70	0.40	0.50	0.50
Electrical Conductivity (µS/cm)	800	700	100	900	500	700	400	500	500
Turbidity (NTU)	8.0	11.1	87.5	58.5	8.0	17.5	295.5	14.7	12.2
Dissolved oxygen (mg/L)	8.1	8.3	10.6	9.3	8.9	8.8	9.5	4.6	9.2
Dissolved oxygen (%sat)	77.3	78.8	98.6	92.8	86.9	92.6	96.8	49.6	101.8
pH (x.xx)	7.73	7.65	7.49	10.80	7.80	7.48	7.29	7.64	7.51
Salinity (ppt)	0.4	0.3	0.1	0.5	0.3	0.3	0.2	0.3	0.2
Suspended Solids (mg/L)	3	4	39	93	7	9	124	5	5
Ammonium-Nitrogen (mg/L)	0.02	0.11	0.05	0.21	0.005	0.07	0.06	0.03	0.07
Oxidised Nitrogen (mg/L)	5.4	6.2	0.9	3.4	3.4	4.1	1.99	0.9	1.92
TKN (mg/L)									
Total Nitrogen (mg/L)	6.6	6.6	1.42	6.9	3.9	4.5	2.54	1.09	2.46
Total Phosphorus(mg/L)	0.052	0.039	0.105	0.61	0.042	0.157	0.088	0.028	0.048
Faecal Coliforms (CFU/100ml)	380	460	3800	100	21000	370	600	1600	400
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	29/11/2004	16/12/2004	11/01/2005	18/01/2005	10/02/2005	16/02/2005	09/03/2005	15/03/2005	04/04/2005
Temperature (oC)	21.425	23.335	18.205	19.89	19.7	20.7	20.02	21.235	
Electrical Conductivity (ms/cm)	0.50	0.70	0.70	0.70	1.60	0.80	0.70	0.80	
Electrical Conductivity (µS/cm)	500	700	700	700	1600	800	700	800	
Turbidity (NTU)	11.8	24.6	4.0	11.4	14.5	6.3	8.4	8.4	
Dissolved oxygen (mg/L)	7.0	6.8	6.4	4.4	4.4	3.7	5.4	4.2	
Dissolved oxygen (%sat)	78.9	79.5	67.6	48.3	48.8	41.6	59.0	48.4	
pH (x.xx)	7.53	7.64	7.71	7.87	7.70	7.54	7.63	7.76	
Salinity (ppt)	0.2	0.4	0.4	0.4	0.8	0.4	0.3	0.4	
Suspended Solids (mg/L)	10	12	4	10	23	5	4	2	26
Ammonium-Nitrogen (mg/L)	0.1	0.005	0.56	2.7	1.13	0.04	0.04	0.08	0.17
Oxidised Nitrogen (mg/L)	1.86	0.86	1.61	0.75	1.61	1.01	0.95	0.65	0.52
TKN (mg/L)									
Total Nitrogen (mg/L)	2.38	1.54	2.63	4.28	3.81	1.53	1.29	1.13	1.59
Total Phosphorus(mg/L)	0.089	0.104	0.089	0.394	0.221	0.053	0.044	0.061	0.248
Faecal Coliforms (CFU/100ml)	400	81000	5100	270000	100000	11000	680	2500	37000
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	19/04/2005	10/05/2005	19/05/2005	07/06/2005	16/06/2005	08/07/2005	19/07/2005	08/08/2005	24/08/2005
Temperature (oC)	17.935	17.045	14.47	13.26	13.015	13.445	10.68	11.65	10.97
Electrical Conductivity (ms/cm)	0.90	0.70	1.20	0.70	1.00	0.90	0.80	0.70	0.95
Electrical Conductivity (µS/cm)	900	700	1200	700	1000	900	800	700	950
Turbidity (NTU)	11.5	14.4	21.0	15.6	15.4	29.1	26.5	17.0	13.5
Dissolved oxygen (mg/L)	6.2	7.2	7.8	6.3	4.4	7.5	8.1	7.6	9.3
Dissolved oxygen (%sat)	65.8	74.6	76.5	59.8	41.5	71.6	73.2	69.4	84.4
pH (x.xx)	7.65	7.61	7.24	7.57	9.61	7.81	7.60	7.61	10.11
Salinity (ppt)	0.5	0.4	0.6	0.4	0.5	0.5	0.4	0.4	0.5
Suspended Solids (mg/L)	1	3	28	16	49	5	14	14	31
Ammonium-Nitrogen (mg/L)	0.12	0.1	0.48	0.12	0.34	0.005	0.01	0.299	0.774
Oxidised Nitrogen (mg/L)	0.96	0.72	1.22	0.48	0.25	0.74	2.3	0.796	1.08
TKN (mg/L)								2.1	3.6
Total Nitrogen (mg/L)	1.31	1.03	2.09	0.99	3.39	1.8	3.46	2.9	4.6
Total Phosphorus(mg/L)	0.037	0.035	0.088	0.086	0.342	0.353	0.309	0.11	0.31
Faecal Coliforms (CFU/100ml)	14000	1700	1700	220	700	700	41000	1000	970
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	05/09/2005	20/09/2005	07/10/2005	19/10/2005	01/11/2005	23/11/2005	05/12/2005	20/12/2005	11/01/2006
Temperature (oC)	14.42	13.635	15.935	17.34		18.21	19.84	7.72	23.55
Electrical Conductivity (ms/cm)	0.70	0.50	2.60	0.50		0.60	0.60	0.80	0.50
Electrical Conductivity (µS/cm)	700	500	2600	500		600	600	800	500
Turbidity (NTU)	195.0	22.7	226.6	28.8		32.9	20.0	7.6	31.7
Dissolved oxygen (mg/L)	8.2	9.5	3.6	8.5		6.3	6.0	13.3	7.2
Dissolved oxygen (%sat)	80.5	91.4	35.8	88.1		66.7	68.5	111.5	85.5
pH (x.xx)	7.60	7.76	11.77	8.48		7.80	7.50	7.84	7.70
Salinity (ppt)	0.3	0.3	1.4	0.3		0.3	0.3	0.4	0.3
Suspended Solids (mg/L)	92	26	85	7	22	10	14	2	11
Ammonium-Nitrogen (mg/L)	0.225	0.353	0.838	0.226	0.175	0.25	0.387	0.089	0.224
Oxidised Nitrogen (mg/L)	0.54	0.739	0.837	0.64	1.04	1.07	1.15	0.915	1.3
TKN (mg/L)	2.6	0.9	7	3.1	1.8	3.5	2.4	0.6	1.41
Total Nitrogen (mg/L)	3.1	1.6	7.8	3.8	2.8	4.6	3.52	1.52	2.71
Total Phosphorus(mg/L)	1.29	0.005	1.31	0.11	0.15	0.3	0.074	0.053	0.225
Faecal Coliforms (CFU/100ml)	2300	130	5	13000	300	2800	800	210	230
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	17/01/2006	01/02/2006	20/02/2006	27/02/2006	21/03/2006	11/04/2006	20/04/2006	01/05/2006	17/05/2006
Temperature (oC)	23.09	26.17	22.33	22.23	20.36	15.2	17.94		14.39
Electrical Conductivity (ms/cm)	0.40	0.70	0.60	0.50	0.50	0.90	0.70		0.80
Electrical Conductivity (µS/cm)	400	700	600	500	500	900	700		800
Turbidity (NTU)	170.0	4.8	9.5	52.3	4.3	33.0	14.2		83.8
Dissolved oxygen (mg/L)	8.1	4.1	5.4	7.6	4.7	0.7	1.9		2.7
Dissolved oxygen (%sat)	94.5	50.9	62.1	87.3	52.0	6.8	20.0		25.9
pH (x.xx)	7.58	7.53	7.79	7.51	7.60	7.09	7.37		7.28
Salinity (ppt)	0.2	0.4	0.3	0.2	0.3	0.5	0.3		0.4
Suspended Solids (mg/L)	54	6	6	18	3	8	2	6	29
Ammonium-Nitrogen (mg/L)	0.045	0.339	0.087	0.051	0.533	0.182	0.256	0.146	0.431
Oxidised Nitrogen (mg/L)	1.02	1	0.967	1.2	1.32	0.233	1.18	0.525	0.908
TKN (mg/L)	0.46	1.3	0.7	1.05	1.38	0.77	0.47	0.48	1.35
Total Nitrogen (mg/L)	1.41	2.3	1.67	2.25	2.7	1.01	1.65	1	2.26
Total Phosphorus(mg/L)	0.083	0.46	0.111	0.068	0.066	0.0025	0.034	0.148	0.17
Faecal Coliforms (CFU/100ml)	6400	310	400	100	160	1980000	1160	150	1600
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	15/06/2006	23/06/2006	11/07/2006	20/07/2006	07/08/2006	22/08/2006	06/09/2006	19/09/2006	11/10/2006
Temperature (oC)	11.1	12.08	9.68	11.41	13.39	10.96	12.13	15.93	
Electrical Conductivity (ms/cm)	0.70	0.50	0.70	0.50	0.60	0.90	0.80	0.80	
Electrical Conductivity (µS/cm)	700	500	700	500	600	900	800	800	
Turbidity (NTU)	8.9	107.0	16.8	97.0	11.7	21.6	21.0	23.1	
Dissolved oxygen (mg/L)	7.7	8.9	5.4	8.9	9.5	5.1	4.2	8.3	
Dissolved oxygen (%sat)	69.6	83.0	47.4	81.7	90.5	46.6	39.3	84.3	
pH (x.xx)	7.22	7.75	7.10	7.57	7.49	7.38	7.00	7.49	
Salinity (ppt)	0.4	0.3	0.4	0.3	0.3	0.5	0.5	0.4	
Suspended Solids (mg/L)	4	37	9	48	14	26	8	4	16
Ammonium-Nitrogen (mg/L)	0.196	0.206	0.231	0.062	0.149	0.282	0.251	0.289	0.725
Oxidised Nitrogen (mg/L)	1.54	0.987	0.54	1.04	1.81	0.506	0.606	1.62	0.097
TKN (mg/L)	0.46	1.06	0.62	0.33	0.21	4.08	0.84	1.04	3.48
Total Nitrogen (mg/L)	2	2.05	1.16	1.37	2.02	4.58	1.45	2.6	3.58
Total Phosphorus(mg/L)	0.218	0.279	0.334	0.105	0.031	0.437	0.05	0.0025	0.094
Faecal Coliforms (CFU/100ml)	290	5400	1200	710	200	190000	64	100	500
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	18/10/2006	06/11/2006	22/11/2006	04/12/2006	20/12/2006	02/01/2007	18/01/2007	07/02/2007	21/02/2007
Temperature (oC)	17.75	17.91	18.75	16.65	19.1	20.44	21.58	22.17	22.26
Electrical Conductivity (ms/cm)	0.80	0.30	1.00	0.60	0.90	0.40	0.60	0.70	3.10
Electrical Conductivity (µS/cm)	800	300	1000	600	900	400	600	700	3100
Turbidity (NTU)	7.0	191.0	32.5	24.3	43.6	14.6	40.9	37.7	94.4
Dissolved oxygen (mg/L)	3.2	9.0	0.1	7.6	0.7	4.9	0.8	3.1	4.3
Dissolved oxygen (%sat)	33.6	95.0	1.0	77.8	7.7	55.7	8.5	35.8	49.3
pH (x.xx)	7.20	7.63	7.44	8.04	7.30	7.31	7.62	7.21	2.00
Salinity (ppt)	0.4	0.1	0.5	0.3	0.4	0.2	0.3	0.4	1.7
Suspended Solids (mg/L)	7	81	10	8	4	7	19	8	53
Ammonium-Nitrogen (mg/L)	0.778	0.065	0.825	0.115	0.228	0.175	0.628	1.12	4.85
Oxidised Nitrogen (mg/L)	0.454	0.596	0.254	0.872	0.563	0.789	0.149	0.825	0.934
TKN (mg/L)	1.84	0.78	1.21	0.83	0.47	0.65	1.34	2.18	30.7
Total Nitrogen (mg/L)	2.3	1.38	1.46	1.71	1.03	1.44	1.48	3.01	31.6
Total Phosphorus(mg/L)	0.124	0.115	0.0025	0.016	0.036	0.098	0.103	0.05	0.013
Faecal Coliforms (CFU/100ml)	690	130000	180	1000	1	1900	15000	510000	110
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	08/03/2007	20/03/2007	03/04/2007	18/04/2007	30/04/2007	22/05/2007	05/06/2007	19/06/2007	05/07/2007
Temperature (oC)	20.5	22.25	18.53	17.73		13.58		13.37	10.83
Electrical Conductivity (ms/cm)	0.80	0.70	0.90	1.00		0.90		0.30	1.00
Electrical Conductivity (µS/cm)	800	700	900	1000		900		300	1000
Turbidity (NTU)	6.9	72.0	11.5	11.0		9.5		144.0	9.8
Dissolved oxygen (mg/L)	7.4	4.7	5.5	3.0		4.9		10.4	4.8
Dissolved oxygen (%sat)	83.0	54.6	59.1	31.2		47.5		98.5	43.8
pH (x.xx)	7.50	7.74	7.24	6.79		7.41		7.40	7.22
Salinity (ppt)	0.4	0.4	0.4	0.8		0.4		0.2	0.5
Suspended Solids (mg/L)	2	7	4	6	6	6	8	40	16
Ammonium-Nitrogen (mg/L)	0.142	0.443	1.84	0.428	0.272	0.15	1.38	0.005	0.195
Oxidised Nitrogen (mg/L)	1.8	1.45	1.12	0.645	2.01	0.517	0.198	1.47	0.869
TKN (mg/L)	0.38	1.5	3.48	1.59	0.86	0.43	4.3	0.025	0.38
Total Nitrogen (mg/L)	2.18	3	4.6	2.23	2.87	0.9	4.5	1.49	1.25
Total Phosphorus(mg/L)	0.032	0.07	0.005	0.0025	0.013	0.05	0.075	0.059	0.071
Faecal Coliforms (CFU/100ml)	11400	32000	410	7500	250	4300	590	2200	740
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	19/07/2007	13/08/2007	23/08/2007	10/09/2007	20/09/2007	03/10/2007	17/10/2007	15/11/2007	28/11/2007
Temperature (oC)	7.29	11.73	13.14	14.41	15.21	18.44		18.4	21.24
Electrical Conductivity (ms/cm)	0.90	0.90	0.30	0.60	0.30	0.78		0.70	0.52
Electrical Conductivity (µS/cm)	900	900	300	600	300	780		700	520
Turbidity (NTU)	10.2	21.5	33.2	10.4	365.3	48.0		5.7	43.0
Dissolved oxygen (mg/L)	8.9	3.1	9.1	6.2	7.7	8.6		8.0	5.9
Dissolved oxygen (%sat)	73.2	28.4	86.9	60.9	77.1	88.8		84.9	65.9
pH (x.xx)	7.11	7.84	7.52	7.48	7.55	7.13		7.47	7.45
Salinity (ppt)	0.4	0.5	0.2	0.3	0.2	0.4		0.4	0.3
Suspended Solids (mg/L)	2	10	13	12	260	5	6	3	2
Ammonium-Nitrogen (mg/L)	0.093	1.29	0.055	0.112	1.29	0.354	0.237	0.127	0.249
Oxidised Nitrogen (mg/L)	0.807	0.204	1.13	0.536	1.97	0.225	0.215	1.08	0.831
TKN (mg/L)	0.36	3.59	0.36	0.79	6.82	0.72	0.64	0.19	0.39
Total Nitrogen (mg/L)	1.17	3.79	1.49	1.32	8.79	0.95	0.86	1.3	1.22
Total Phosphorus(mg/L)	0.0025	0.194	0.02	0.041	0.329	0.027	0.025	0.005	0.155
Faecal Coliforms (CFU/100ml)	460	11000	650	3200	28000	410	510	390	7100
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	14/12/2007	20/12/2007	10/01/2008	23/01/2008	23/01/2008	04/02/2008	20/02/2008	28/02/2008	26/03/2008
Temperature (oC)	19.16	18	22.46	20.92	20.92	21.6	21.3	19.24	18.8
Electrical Conductivity (ms/cm)	0.76	0.66	0.82	0.64	0.64	0.24	0.64	0.04	0.38
Electrical Conductivity (µS/cm)	760	660	820	640	640	240	640	40	380
Turbidity (NTU)	11.8	7.2	3.8	10.5	10.5	45.0	6.0	137.0	65.0
Dissolved oxygen (mg/L)	8.1	7.9	7.9	8.5	8.5	8.2	8.5	9.1	6.2
Dissolved oxygen (%sat)	87.1	85.1	91.1	94.5	94.5	93.5	95.8	98.0	67.0
pH (x.xx)	7.63	7.46	7.48	7.67	7.67	7.39	7.69	7.39	7.49
Salinity (ppt)	0.4	0.3	0.4	0.3	0.3	0.1	0.3	0.0	0.2
Suspended Solids (mg/L)	6	3	2	6	4	8	2	44	6
Ammonium-Nitrogen (mg/L)	0.184	0.092	0.117	0.062	0.064	0.035	0.064	0.036	0.038
Oxidised Nitrogen (mg/L)	1.15	0.778	0.348	0.761	0.765	1.12	1	0.505	0.951
TKN (mg/L)	0.47	0.22	0.39	0.35	0.35	0.27	0.39	0.33	0.16
Total Nitrogen (mg/L)	1.6	1	0.7	1.11	1.12	1.39	1.39	0.84	1.11
Total Phosphorus(mg/L)	0.06	0.035	0.04	0.045	0.049	0.079	0.019	0.098	0.058
Faecal Coliforms (CFU/100ml)	1800	700	15	1200	1700	7000	1600	65000	15000
Enterococci (CFU/100ml)					0.5				
Bicarbonate Alkalinity (mg/CaCO3/L)				142	136				
Chloride (mg/L)				95.4	92				
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)				0.2	0.3				
Sodium (mg/L)				60	63				
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)				40	39				
Aluminium (ug/L)				0.08	0.09				
Arsenic (ug/L)				0.5	0.5				
Cadmium (ug/L)				0.05	0.05				
Chromium (ug/L)				0.5	0.5				
Copper (ug/L)				3	3				
Lead (ug/L)				0.5	0.5				
Manganese (ug/L)				69	68				
Molybdenum (ug/L)				2	3				
Nickel (ug/L)				2	2				
Selenium (ug/L)				5	5				
Silver (ug/L)				0.5	0.5				
Uranium (ug/L)				0.5	0.5				
Zinc (ug/L)				47	46				
Boron (ug/L)				100	100				
Iron (ug/L)				860	850				
Mercury (ug/L)				0.05	0.05				
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	10/04/2008	07/05/2008	20/05/2008	29/05/2008	17/06/2008	08/07/2008	23/07/2008	08/08/2008	08/08/2008
Temperature (oC)	16.15	12.0	10.8	12.0	15.3	12.2	9.1	9.6	
Electrical Conductivity (ms/cm)	0.54	0.82	0.91	0.97	0.50	0.46	0.87	0.64	
Electrical Conductivity (µS/cm)	540	820	910	970	500	462.4196662	873.3575272	639.5058755	
Turbidity (NTU)	15.0	4.3	8	3.6	43.6	7.3	12.3	8	
Dissolved oxygen (mg/L)	6.1	7.9	7.5	7.0	8.95	8.73	9.14	8.08	
Dissolved oxygen (%sat)	61.0	72.7	68.0	65.0	89.4	81.2	78.8	70.8	
pH (x.xx)	7.40	7.43	7.51	7.43	7.46	7.17	7.48	7.19	
Salinity (ppt)	0.3	0.41	0.46	0.49	0.25	0.23	0.44	0.32	
Suspended Solids (mg/L)	5	3	3	2	16	5	2	4	
Ammonium-Nitrogen (mg/L)	0.138	1.16	0.654	2.07	0.099	0.219	3.01	0.69	0.62
Oxidised Nitrogen (mg/L)	1.21	1.09	0.314	1.12	0.804	0.446	0.41	0.36	0.35
TKN (mg/L)	0.37	1.42	1.5	2.44	1.44	0.59	3.63	0.95	
Total Nitrogen (mg/L)	1.58	2.51	1.82	3.56	2.2	1.04	4.04	1.31	1.37
Total Phosphorus(mg/L)	0.023	0.019	0.023	0.025	0.04	0.025	0.006	0.039	0.086
Faecal Coliforms (CFU/100ml)	3500	200	360	250	1200	470	180	260	340
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)								115	
Chloride (mg/L)								107	
Sulphate as SO_4^{2-}(mg/L)								33	
Fluoride (mg/L)									
Sodium (mg/L)								69	
Potassium (mg/L)								12	
Magnesium (mg/L)								12	
Calcium (mg/L)								38	
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)								0.5	
Carbonate Alkalinity as CaCO3(ug/L)								0.5	
Total Alkalinity as CaCO3(mg/L)								115	
Ionic Balance(%)								1.14	
Total Anions(meq/L)								6	
Total Cations(meq/L)								6.14	
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	20/08/2008	16/09/2008	02/10/2008	02/10/2008	07/10/2008	13/10/2008	29/10/2008	10/11/2008	25/11/2008
Temperature (oC)	8.5	14.6	14.3		12.68	18.76	17.7	17.31	16.59
Electrical Conductivity (ms/cm)	0.89	0.70	0.99		0.61	1.24	0.11	0.84	0.67
Electrical Conductivity (µS/cm)	892.7410778	700	990		610	1240	110	840	670
Turbidity (NTU)	6.8	8.3	16		8	58	74.4	4.6	6.2
Dissolved oxygen (mg/L)	8.38	9.8	1.2		5.5	2.03	9.26	6.42	7.55
Dissolved oxygen (%sat)	72.0	96.8	12		52	21.4	97.2	73	78
pH (x.xx)	7.30	7.75	7.3		7.06	6.88	7.32	7.51	7.37
Salinity (ppt)	0.45	0.35	0.5		0.27	0.63	0.05	0.42	0.33
Suspended Solids (mg/L)	5	2	20		4	37	33	4	3
Ammonium-Nitrogen (mg/L)	1.77	0.13	3.91	4.00	0.1	0.54	0.19	1.32	0.63
Oxidised Nitrogen (mg/L)	0.48	0.77	0.005	0.005	1.41	0.88	0.3	0.56	1.32
TKN (mg/L)	2.01	0.2	4.68		0.56	9.54	0.99	1.62	0.96
Total Nitrogen (mg/L)	2.49	0.96	4.7	5.70	1.96	10.4	1.28	2.18	2.28
Total Phosphorus(mg/L)	0.0025	0.03	0.17	0.325	0.145	0.936	0.125	0.031	0.019
Faecal Coliforms (CFU/100ml)	75	130	1100		400	64000	20000	70	440
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)					98				
Chloride (mg/L)					91				
Sulphate as SO_4^{2-}(mg/L)					27				
Fluoride (mg/L)									
Sodium (mg/L)					52				
Potassium (mg/L)					10				
Magnesium (mg/L)					10				
Calcium (mg/L)					33				
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)					0.5				
Carbonate Alkalinity as CaCO3(ug/L)					0.5				
Total Alkalinity as CaCO3(mg/L)					98				
Ionic Balance(%)					1.38				
Total Anions(meq/L)					5.09				
Total Cations(meq/L)					4.95				
BOD5/CBOD5(mg/L)			107		4				
Total Organic Carbon(mg/L)			63		8				

Site ID	010								
DATE	10/12/2008	23/12/2008	08/01/2009	21/01/2009	13/02/2009	25/02/2009	13/03/2009	24/03/2009	07/04/2009
Temperature (oC)	19.31	18.79	21.17	21.79	18.68	21.29	19.37	20.45	17.14
Electrical Conductivity (ms/cm)	0.73	0.75	0.48	0.7	0.1	0.71	0.69	0.73	0.73
Electrical Conductivity (µS/cm)	730	750	480	700	100	710	690	730	730
Turbidity (NTU)	5.8	5	2	1.2	55.2	3.9	13.4	2.8	4.4
Dissolved oxygen (mg/L)	2.3	5.6	6.54	7.27	9.1	6.89	5.76	7.35	6.99
Dissolved oxygen (%sat)	25.3	58.2	73.9	83	97.4	77.8	62.7	81.7	72.7
pH (x.xx)	7.2	7.38	7.43	7.51	7.41	7.59	7.3	7.68	7.46
Salinity (ppt)	0.37	0.38	0.24	0.35	0.05	0.36	0.32	0.36	0.36
Suspended Solids (mg/L)	3	2	1	2	53	3	8	1	1
Ammonium-Nitrogen (mg/L)	1.49	0.77	0.22	0.3	0.1	0.1	0.27	0.1	0.08
Oxidised Nitrogen (mg/L)	0.49	0.236	0.16	0.4	0.14	0.5	0.87	0.95	0.93
TKN (mg/L)	2.43	1.45	0.61	0.8	0.4	0.36	0.37	0.25	0.24
Total Nitrogen (mg/L)	2.92	1.69	0.8	1.2	0.5	0.86	1.24	1.2	1.17
Total Phosphorus(mg/L)	0.088	0.11	0.08	0.055	0.08	0.054	0.077	0.116	0.047
Faecal Coliforms (CFU/100ml)	790	200	4700	180	18000	5400	8400	210	730
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)	1		1	4	4	5	2	2	1
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	22/04/2009	07/05/2009	20/05/2009	09/06/2009	11/06/2009	24/06/2009	07/07/2009	22/07/2009	06/08/2009
Temperature (oC)	17.77	13.86	16.45	11.82	9.54	13.14	10.51	11.84	11.81
Electrical Conductivity (ms/cm)	0.41	0.66	0.3	0.69	0.43	0.6	0.64	0.92	0.7
Electrical Conductivity (µS/cm)	410	660	300	690	430	600	640	920	700
Turbidity (NTU)	67.5	4.4	115	6.7	4.8	8.1	34.5	5	53
Dissolved oxygen (mg/L)	6.12	7.9	6.96	9.31	8.42	8.78	8.02	7.97	8.8
Dissolved oxygen (%sat)	64.3	76.5	71.3	82	74	83.5	77	78	80.8
pH (x.xx)	7.32	7.43	7.24	7.45		7.44	7.41	7.49	7.38
Salinity (ppt)	0.2	0.33	0.15	0.34	0.22	0.3	0.32	0.46	0.4
Suspended Solids (mg/L)	21	1	39	2	6	2	14	1	3
Ammonium-Nitrogen (mg/L)	0.19	0.13	0.09	0.05	0.84	0.11	0.44	0.03	0.17
Oxidised Nitrogen (mg/L)	0.95	0.43	0.94	0.67	0.53	1.02	1.52	0.15	0.57
TKN (mg/L)	0.71	0.44	0.66	0.19	1.38				
Total Nitrogen (mg/L)	1.66	0.87	1.6	0.86	1.91	1.32	2.99	0.51	0.93
Total Phosphorus(mg/L)	0.11	0.034	0.093	0.029	0.137	0.043	0.118	0.042	0.035
Faecal Coliforms (CFU/100ml)	12000	290	11000	80	36000	2600	22000	73	94
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)	1	2		2	2				1
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	19/08/2009	17/09/2009	30/09/2009	14/10/2009	28/10/2009	17/11/2009	01/12/2009	17/12/2009	19/01/2010
Temperature (oC)	12.8	15.91	14.66	14.18	17.7	19.85	17.1	21.63	17.63
Electrical Conductivity (ms/cm)	0.68	0.63	0.79	0.59	0.6	0.75	0.3	0.43	0.41
Electrical Conductivity (µS/cm)	680	630	790	590	600	750	300	430	410
Turbidity (NTU)	21.4	5.2	4.8	4.1	8	11.9	10	1.8	1.6
Dissolved oxygen (mg/L)	9.06	7.8	5.08	8.81	8.77	5.9	7.6	6.85	7.1
Dissolved oxygen (%sat)	85.3	79	49.6	85.7	92.4	64.6	78	77.6	74.5
pH (x.xx)	9.64	7.4	7.53	7.71	7.62	7.6	7.47	7.49	7.5
Salinity (ppt)	0.34	0.32	0.4	0.29	0.3	0.38	0.15	0.21	0.2
Suspended Solids (mg/L)	17	5	2	2	5	3	5	5	1
Ammonium-Nitrogen (mg/L)	0.48	0.55	0.005	0.29	0.22	0.46	0.07	0.13	0.05
Oxidised Nitrogen (mg/L)	0.21	0.34	0.005	0.39	0.82	0.05	0.51	0.14	0.16
TKN (mg/L)									
Total Nitrogen (mg/L)	2.97	1.19	0.8	0.93	1.27	1.2	1.72	0.57	0.43
Total Phosphorus(mg/L)	0.47	0.064	0.083	0.057	0.053	0.193	0.083	0.1	0.051
Faecal Coliforms (CFU/100ml)	17000	1900	2900	210	900	480000	5400	170	710
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)								0.74	
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)	40		22						3
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	28/01/2010	09/02/2010	24/02/2010	17/03/2010	31/03/2010	15/04/2010	27/04/2010	11/05/2010	25/05/2010
Temperature (oC)	22.44	22.59	20.43	17.53	20.3	15.46	15.3	13.53	14.62
Electrical Conductivity (ms/cm)	0.64	0.59	0.85	0.85	0.3	1.17	0.77	0.94	0.2
Electrical Conductivity (µS/cm)	640	590	850	850	300	1170	770	940	200
Turbidity (NTU)	1.5	23.4	9.6	3.5	84.4	8.9	4.7	3	17.1
Dissolved oxygen (mg/L)	6.87	7.89	4.91	7.93	7.9	6.26	7.73	7.88	8.6
Dissolved oxygen (%sat)	79.4	91.5	54.5	83	87.4	62.7	77	75.7	84.4
pH (x.xx)	7.7	8.06	7.55	7.55	7.5	7.72	7.56	7.5	7.69
Salinity (ppt)	0.32	0.29	0.43	0.43	0.16	0.59	0.42	0.48	0.1
Suspended Solids (mg/L)	1	10	1	1	30	4	1	1	9
Ammonium-Nitrogen (mg/L)	0.2	0.2	0.66	0.12	0.08	0.01	0.21	0.33	0.04
Oxidised Nitrogen (mg/L)	0.19	1.79	0.01	0.38	1.88	0.01	0.13	0.26	0.28
TKN (mg/L)									
Total Nitrogen (mg/L)	0.74	2.41	1.22	0.83	2.81	0.62	0.63	0.86	0.98
Total Phosphorus(mg/L)	0.102	0.101	0.262	0.055	0.119	0.151	0.081	0.071	0.115
Faecal Coliforms (CFU/100ml)	640	35000	600	87	18000	3800	2900	650	16000
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)						0.53		0.38	
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)							2		
Lead (ug/L)							0.5		
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)							18		
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)						6			
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	16/06/2010	30/06/2010	13/07/2010	27/07/2010	09/08/2010	24/08/2010	06/09/2010	22/09/2010	06/10/2010
Temperature (oC)	9.65	7.17	12.09	12.4	11.88	11.47	12.35	14.72	16.55
Electrical Conductivity (ms/cm)	0.9	1.48	2.18	1.58	0.78	0.86		0.46	0.56
Electrical Conductivity (µS/cm)	900	1480	2180	1580	780	860		460	560
Turbidity (NTU)	10	39.7	23.4	55	56	11	12.3	6.5	40.6
Dissolved oxygen (mg/L)	8.1	6.1	5.76	8	9.13	7.96	8.49	8.52	8.79
Dissolved oxygen (%sat)	71	50.7	53.8	75.1	84.7	72.4	79.4	84	90.1
pH (x.xx)	7.49	8.98	9.2	10.1	7.37	7.61	7.65	7.45	7.4
Salinity (ppt)	0.45	0.75	1.13	0.81	0.39	0.44		0.23	0.28
Suspended Solids (mg/L)	4	21	29	51	3	5	9	2	2
Ammonium-Nitrogen (mg/L)	0.45	0.21	0.69	1.48	0.19	0.27	0.3	0.16	0.25
Oxidised Nitrogen (mg/L)	0.21	0.05	0.06	0.38	0.25	0.06	1.72	0.58	0.71
TKN (mg/L)									
Total Nitrogen (mg/L)	1.13	2.38	4.53	6	0.74	0.89	3.01	1.27	1.19
Total Phosphorus(mg/L)	0.054	0.393	0.54	0.81	0.046	0.101	0.044	0.077	0.048
Faecal Coliforms (CFU/100ml)	800	820	1600	2400	260	860	1000	3400	2500
Enterococci (CFU/100ml)									
E Coli (CFU/100mL)									
Bicarbonate Alkalinity (mg/CaCO3/L)		256			124				95.6
Chloride (mg/L)		207			139				43
Sulphate as SO_4^{2-}(mg/L)		29			47				22
Fluoride (mg/L)	0.22	1.03			0.29				0.26
Sodium (mg/L)		267	378		96.1				57.8
Potassium (mg/L)		9.64			6.23				4.95
Magnesium (mg/L)		14.3			15.2				10.7
Calcium (mg/L)		38.9	35.9		40.1				30
Aluminium (ug/L)		335	254						
Arsenic (ug/L)		2	1						
Cadmium (ug/L)		0.5	0.5						
Chromium (ug/L)		3	0.5						
Copper (ug/L)		37	24						
Lead (ug/L)		1	2						
Manganese (ug/L)		348	256						
Molybdenum (ug/L)		11	10						
Nickel (ug/L)		5	4						
Selenium (ug/L)		1.5	1.5						
Silver (ug/L)		0.5	0.5						
Uranium (ug/L)		0.5	0.5						
Zinc (ug/L)		188	92						
Boron (ug/L)		44	37						
Iron (ug/L)		4430	3380						
Mercury (ug/L)		0.05							
Cobalt (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)					124				
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									

Site ID	010								
DATE	16/06/2010	30/06/2010	13/07/2010	27/07/2010	09/08/2010	24/08/2010	06/09/2010	22/09/2010	06/10/2010
BOD5/CBOD5(mg/L)		136	152	185					
Total Organic Carbon(mg/L)				106.2					
Dissolved Organic Carbon(mg/L)				102					

Site ID	010								
DATE	19/10/2010	01/11/2010	16/11/2010	09/12/2010	22/12/2010	10/01/2011	24/01/2011	14/02/2011	02/03/2011
Temperature (oC)	15.64	17.93	20.91	20.43	17.2	21.9	21.08	20.57	20
Electrical Conductivity (ms/cm)	0.38	0.61	0.43	0.45	0.36	0.21	9.8	0.46	0.64
Electrical Conductivity (µS/cm)	380	610	430	450	360	210	9800	460	640
Turbidity (NTU)	73.0	31.7	40.1	7.9	2.5	34	14.8	7.5	1.4
Dissolved oxygen (mg/L)	8.89	8.38	9.31	7.56	8.56	9.04	5.79	7.35	7.02
Dissolved oxygen (%sat)	89.5	88.6	105	83.8	88.8	102.9	64.2	81.7	77.5
pH (x.xx)	7.87	7.5	7.7	7.35	7.47	7.62	7.4	7.27	7.5
Salinity (ppt)	0.19	0.3	0.22	0.22	0.18	0.07	0.4	0.23	0.32
Suspended Solids (mg/L)	59	13	9	2	2	20	5	3	1
Ammonium-Nitrogen (mg/L)	0.4	0.005	0.09	0.05	0.08	0.04	1.01	0.1	0.11
Oxidised Nitrogen (mg/L)	0.83	0.61	0.83	0.38	0.46	0.37	0.13	0.41	0.34
TKN (mg/L)									
Total Nitrogen (mg/L)	2.92	1.1	1.16	0.65	0.69	0.83	1.45	0.94	0.77
Total Phosphorus(mg/L)	0.355	0.11	0.06	0.034	0.035	0.084	0.105	0.075	0.068
Faecal Coliforms (CFU/100ml)	100000	5000	6000	500	870	9800	3400	15000	250
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)				75.4					
Chloride (mg/L)				71					
Sulphate as SO_4^{2-}(mg/L)				22					
Fluoride (mg/L)		0.31		0.77					
Sodium (mg/L)				39.4				42.5	
Potassium (mg/L)				3.89				4.93	
Magnesium (mg/L)				8.07				6.84	
Calcium (mg/L)				21.7				27.6	
Aluminium (ug/L)	2670			76				184	
Arsenic (ug/L)	0.5			0.5				0.5	
Cadmium (ug/L)	0.5			0.5				0.5	
Chromium (ug/L)	4			0.5				0.5	
Copper (ug/L)	27			4				6	
Lead (ug/L)	5			0.5				2	
Manganese (ug/L)	86			45				48	
Molybdenum (ug/L)	4			0.5				2	
Nickel (ug/L)	6			0.5				1	
Selenium (ug/L)	1.5			1.5				1.5	
Silver (ug/L)	0.5			0.5				0.5	
Uranium (ug/L)	0.5			0.5				0.5	
Zinc (ug/L)	255			28				208	
Boron (ug/L)	32			29				65	
Iron (ug/L)	3950			850				787	
Mercury (ug/L)	0.1			0.05				0.05	
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)	13						1	1	1
Total Organic Carbon(mg/L)					5.2	8.5			7.4

Site ID	010								
DATE	25/03/2011	05/04/2011	21/04/2011	04/05/2011	20/05/2011	07/06/2011	15/06/2011	01/07/2011	26/07/2011
Temperature (oC)	18.11	18.37	16.06	16.51	11.93	10.66	14.13	13.3	12.08
Electrical Conductivity (ms/cm)	0.73	0.28	0.76	0.69	0.93	0.73	0.32	0.52	0.62
Electrical Conductivity (µS/cm)	730	280	760	690	930	730	320	520	620
Turbidity (NTU)	5.3	26.7	11.3	6.9	12.5	8.4	219.9	39	85.3
Dissolved oxygen (mg/L)	8.48	8.57	8.28	9.11	8.42	10.11	10.92	7.7	9.01
Dissolved oxygen (%sat)	90.1	91.4	84.3	93.5	78.8	90	105.9	73.5	84
pH (x.xx)	7.46	7.4	7.41	7.41	7.4	7.44	6.86	8.5	7.41
Salinity (ppt)	0.36	0.14	0.38	0.34	0.47	0.37	0.16	0.27	0.31
Suspended Solids (mg/L)	1	15	3	3	4	2	66	26	52
Ammonium-Nitrogen (mg/L)	0.09	0.09	0.76	0.16	0.47	0.12	0.03	0.23	0.11
Oxidised Nitrogen (mg/L)	1.41	0.73	1.43	1.07	0.2	0.9	1.58	0.73	1.56
TKN (mg/L)									
Total Nitrogen (mg/L)	1.79	1.41	2.37	1.49	1.68	1.31	1.9	1.66	1.84
Total Phosphorus(mg/L)	0.033	0.081	0.069	0.036	0.168	0.031	0.101	0.183	0.058
Faecal Coliforms (CFU/100ml)	620	15000	12000	730	4100	390	6100	6800	4000
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									1
Total Organic Carbon(mg/L)	6.1								

Site ID	010								
DATE	01/08/2011	16/08/2011	13/09/2011	07/10/2011	13/10/2011	26/10/2011	10/11/2011	22/11/2011	13/01/2012
Temperature (oC)	11.83	11.22	10.6	14.61	14.92	16	20.38	18.93	15.91
Electrical Conductivity (ms/cm)	0.85	0.86	0.95	1.33	0.78	0.3	0.21	0.16	0.68
Electrical Conductivity (µS/cm)	850	860	950	1330	780	300	210	160	680
Turbidity (NTU)	16.1	13.1	20.8	53.5	27	13	68.1	59.6	8.8
Dissolved oxygen (mg/L)	9.71	7.58	7.78	6.89	7.76	7.04	8.26	7.13	5.99
Dissolved oxygen (%sat)	89.7	73	75.5	68	75.6	72	92.2	78.2	60.6
pH (x.xx)	7.2	7.43	7.45	10.09	7.53	6.89	7.59	7	7.1
Salinity (ppt)	0.43	0.43	0.48	0.68	0.39	0.15	0.11	0.08	0.34
Suspended Solids (mg/L)	3	5	9	52	7	6	40	31	3
Ammonium-Nitrogen (mg/L)	0.13	0.33	0.34	1.28	0.36	0.1	0.32	0.06	0.1
Oxidised Nitrogen (mg/L)	1.16	0.65	0.4	0.41	0.64	0.3	0.73	0.38	0.47
TKN (mg/L)									
Total Nitrogen (mg/L)	1.5	1.33	0.97	10.6	1.16	0.99	2.23	0.79	0.72
Total Phosphorus(mg/L)	0.029	0.055	0.083	2.22	0.043	0.086	0.209	0.102	0.049
Faecal Coliforms (CFU/100ml)	180	2600	330	210000	500	12000	29000	65000	750
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)			120	369					
Chloride (mg/L)				150					
Sulphate as SO_4^{2-}(mg/L)				31					
Fluoride (mg/L)				0.56					
Sodium (mg/L)			116	229					
Potassium (mg/L)			7.36	35.2					
Magnesium (mg/L)			18.4	9.56					
Calcium (mg/L)			48	27.2					
Aluminium (ug/L)			351	462					
Arsenic (ug/L)			0.5	2					
Cadmium (ug/L)			0.5	0.5					
Chromium (ug/L)			0.5	43					
Copper (ug/L)			2	33					
Lead (ug/L)			0.5	1					
Manganese (ug/L)			194	196					
Molybdenum (ug/L)			2	5					
Nickel (ug/L)			2	213					
Selenium (ug/L)			1.5	1.5					
Silver (ug/L)			0.5	0.5					
Uranium (ug/L)			0.5	0.5					
Zinc (ug/L)			49	217					
Boron (ug/L)			69	32					
Iron (ug/L)			2410	2490					
Mercury (ug/L)			0.005	0.005					
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)						7.6			

Site ID	010								
DATE	24/01/2012	09/02/2012	13/03/2012	13/04/2012	09/05/2012	04/06/2012	03/07/2012	22/08/2012	20/09/2012
Temperature (oC)	19.49	19.93	20.82	14.54	12.02	14.54	8.49	10.11	12.54
Electrical Conductivity (ms/cm)	0.51	0.56	0.67	0.64	0.74	0.57	0.89	0.93	0.66
Electrical Conductivity (µS/cm)	510	560	670	640	740	570	890	930	660
Turbidity (NTU)	19.5	8.8	8.7	12	8.2	214.9	16.1	15.4	10.1
Dissolved oxygen (mg/L)	7.72	6.54	8.36	7.59	7.38	8.49	10.11	8.78	8.12
Dissolved oxygen (%sat)	84.1	72	93.6	74.6	68.6	83.2	86.2	78	76.1
pH (x.xx)	7.33	7.35	7.49	7.13	7.57	7.6	7.66	7.69	7.61
Salinity (ppt)	0.25	0.28	0.33	0.32	0.37	0.28	0.45	0.47	0.33
Suspended Solids (mg/L)	12	5	5	4	4	104	1	2	5
Ammonium-Nitrogen (mg/L)	0.08	0.04	0.09	0.05	0.04	0.08	0.33	0.2	0.09
Oxidised Nitrogen (mg/L)	0.89	0.84	1.29	0.24	0.66	0.85	0.9	0.55	0.48
TKN (mg/L)									
Total Nitrogen (mg/L)	1.2	1.16	1.61	0.51	0.97	1.21	1.44	1.07	0.95
Total Phosphorus(mg/L)	0.058	0.039	0.031	0.032	0.038	0.076	0.018	0.031	0.041
Faecal Coliforms (CFU/100ml)	4600	5800	780	1600	4000	4800	410	230	990
Enterococci (CFU/100ml)									
E Coli (CFU/100mL)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Cobalt (ug/L)			1						
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									

Site ID	010								
DATE	24/01/2012	09/02/2012	13/03/2012	13/04/2012	09/05/2012	04/06/2012	03/07/2012	22/08/2012	20/09/2012
BOD5/CBOD5(mg/L)				7					
Total Organic Carbon(mg/L)									
Dissolved Organic Carbon(mg/L)									

Site ID	010								
DATE	16/10/2012	13/11/2012	10/12/2012	09/01/2013	22/01/2013	15/02/2013	26/02/2013	15/03/2013	26/03/2013
Temperature (oC)	18.86	15.98	18.06	21.66	21.00	19.59	23.53	20.27	22.15
Electrical Conductivity (ms/cm)	0.68	0.61	0.34	0.53	0.59	0.67	0.61	0.38	1.08
Electrical Conductivity (µS/cm)	680	610	340	530	590	670	610	380	1080
Turbidity (NTU)	20.3	8.3	17.4	2.6	2.2	8.5	15.8	35.8	5.5
Dissolved oxygen (mg/L)	8.5	7.3	7.29	7.59	7.40	8.54	8.22	6.71	8.11
Dissolved oxygen (%sat)	91.4	74	77.1	86.3	83.2	93.30	96.80	74.40	93.40
pH (x.xx)	7.75	7.63	7.41	7.85	7.55	7.87	7.68	7.42	7.53
Salinity (ppt)	0.34	0.31	0.17	0.26	0.29	0.34	0.32	0.19	0.55
Suspended Solids (mg/L)	5	5	5	4	8	3	5	15	2
Ammonium-Nitrogen (mg/L)	0.09	0.25	0.03	0.05	0.06	0.06	0.16	0.01	0.04
Oxidised Nitrogen (mg/L)	0.47	0.61	1.06	0.17	0.5	0.93	1.69	1.01	1.01
TKN (mg/L)									
Total Nitrogen (mg/L)	0.82	1.43	1.52	0.62	0.85	1.15	2.36	2.41	1.24
Total Phosphorus(mg/L)	0.033	0.205	0.09	0.083	0.072	0.025	0.037	0.145	0.029
Faecal Coliforms (CFU/100ml)	1100	5600	6900	480	580	610	4600	50000	1100
Enterococci (CFU/100ml)									
E Coli (CFU/100mL)					580				1100
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Cobalt (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									

Site ID	010								
DATE	16/10/2012	13/11/2012	10/12/2012	09/01/2013	22/01/2013	15/02/2013	26/02/2013	15/03/2013	26/03/2013
BOD5/CBOD5(mg/L)	1			1		1	1	20	1
Total Organic Carbon(mg/L)									
Dissolved Organic Carbon(mg/L)									

Site ID	010								
DATE	09/04/2013	23/04/2013	23/05/2013	29/05/2013	11/06/2013	24/06/2013	11/07/2013	23/07/2013	06/08/2013
Temperature (oC)	16.58	17.23	13.60	14.03	13.44	13.35	10.14	8.87	10.46
Electrical Conductivity (ms/cm)	0.63	0.64	0.38	0.57	0.72	0.38	0.85	0.88	0.92
Electrical Conductivity (µS/cm)	630	640	380	570	720	380	850	880	920
Turbidity (NTU)	5.5	10.4	62.2	30.0	9.6	43.9	11.7	10.4	7.0
Dissolved oxygen (mg/L)	7.56	9.43	9.34	9.62	9.64	10.16	10.53	9.96	9.21
Dissolved oxygen (%sat)	77.6	98.00	89.80	93.50	92.50	97.2	93.60	86.00	82.60
pH (x.xx)	7.66	7.82	8.45	7.77	7.69	7.47	7.81	7.64	7.44
Salinity (ppt)	0.31	0.32	0.19	0.28	0.36	0.19	0.43	0.44	0.46
Suspended Solids (mg/L)	2	3	29	17	25	13	1	1	1
Ammonium-Nitrogen (mg/L)	0.11	0.06	0.72	0.06	0.07	0.1	0.11	0.08	0.34
Oxidised Nitrogen (mg/L)	0.91	1.52	2.9	1.36	1.3	1.85	1.78	1.3	0.97
TKN (mg/L)									
Total Nitrogen (mg/L)	1.21	1.79	10.4	1.64	1.43	2.61	2.01	1.53	1.48
Total Phosphorus(mg/L)	0.048	0.023	0.13	0.049	0.025	0.097	0.02	0.018	0.018
Faecal Coliforms (CFU/100ml)	310	370	3800	500	1100	2000	230	260	370
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)	1		11	1	1	1	1	1	1
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	23/08/2013	03/09/2013	17/09/2013	01/10/2013	25/10/2013	05/11/2013	21/11/2013	03/12/2013	16/12/2013
Temperature (oC)	10.70	13.19	15.78	16.70	14.34	16.22	18.84	17.78	19.80
Electrical Conductivity (ms/cm)	0.98	0.92	0.42	0.84	0.37	0.64	0.56	0.67	0.81
Electrical Conductivity (µS/cm)	980	920	420	840	370	640	560	670	810
Turbidity (NTU)	6.2	7.6	27.9	8.7	3.8	1.0	8.3	6.9	2.1
Dissolved oxygen (mg/L)	9.01	8.87	8.80	7.52	7.26	6.05	8.49	7.94	6.18
Dissolved oxygen (%sat)	81.30	84.40	88.80	77.20	71.00	61.50	90.50	83.70	67.30
pH (x.xx)	7.56	7.46	10.09	7.83	7.41	7.44	7.63	7.55	7.40
Salinity (ppt)	0.50	0.46	0.21	0.42	0.18	0.32	0.28	0.34	0.41
Suspended Solids (mg/L)	1	4	17	1	2	2	2	2	6
Ammonium-Nitrogen (mg/L)	0.06	0.05	0.48	0.04	0.03	0.05	0.09	0.05	1.19
Oxidised Nitrogen (mg/L)	0.6	0.58	4	0.33	0.15	0.06	1.91	0.91	2.2
TKN (mg/L)									
Total Nitrogen (mg/L)	0.84	0.95	9	0.67	0.42	0.36	2.12	1.16	4.14
Total Phosphorus(mg/L)	0.016	0.024	0.103	0.034	0.035	0.043	0.028	0.024	0.038
Faecal Coliforms (CFU/100ml)	25	29	3000	330	270	120	660	38	810
Enterococci (CFU/100ml)									
E Coli (CFU/100mL)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)							0.2	0.33	0.36
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
Cobalt (ug/L)				1					
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									

Site ID	010								
DATE	23/08/2013	03/09/2013	17/09/2013	01/10/2013	25/10/2013	05/11/2013	21/11/2013	03/12/2013	16/12/2013
BOD5/CBOD5(mg/L)	1	1	7		1	1	1	1	1
Total Organic Carbon(mg/L)									
Dissolved Organic Carbon(mg/L)									

Site ID	010								
DATE	03/01/2014	14/01/2014	04/02/2014	11/02/2014	11/03/2014	26/03/2014	09/04/2014	15/04/2014	01/05/2014
Temperature (oC)	21.22	20.20	21.73	20.73	22.70	20.29	17.98	16.49	16.50
Electrical Conductivity (ms/cm)	0.59	0.83	0.25	0.37	0.62	0.60	0.67	0.53	0.60
Electrical Conductivity (µS/cm)	590	830	250	370	620	600	670	530	600
Turbidity (NTU)	4.7	1.1	50.4	7.1	3.0	10.0	8.2	5.6	4.5
Dissolved oxygen (mg/L)	6.97	6.37	7.52	6.18	8.03	7.35	9.61	7.59	8.85
Dissolved oxygen (%sat)	78.70	70.50	85.70	69.00	93.10	81.40	101.30	79.60	90.60
pH (x.xx)	7.57	7.73	7.52	7.35	7.68	7.69		7.59	7.59
Salinity (ppt)	0.27	0.42	0.12	0.18	0.31	0.30	0.35	0.27	0.30
Suspended Solids (mg/L)	3	1	24	3	2	4	5	4	1
Ammonium-Nitrogen (mg/L)	0.03	0.21	0.09	0.005	0.21	0.05	0.19	0.04	0.02
Oxidised Nitrogen (mg/L)	0.98	1.17	0.69	0.26	1.04	0.7	1.38	0.85	0.86
TKN (mg/L)									
Total Nitrogen (mg/L)	1.29	1.59	1.87	0.62	1.41	0.89	1.73	0.99	1.03
Total Phosphorus(mg/L)	0.046	0.037	0.271	0.061	0.032	0.035	0.062	0.03	0.023
Faecal Coliforms (CFU/100ml)	1200	31	2300	3700	590	490	620	170	300
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)					147	119			
Chloride (mg/L)					115	108			
Sulphate as SO_4^{2-}(mg/L)					75	33			
Fluoride (mg/L)	0.28	0.44	0.31	0.28	0.32	0.29			
Sodium (mg/L)					76.2	74.1			
Potassium (mg/L)					6.94	5.28			
Magnesium (mg/L)					15.3	11.1			
Calcium (mg/L)					46.4	38.1			
Aluminium (ug/L)					26	339			
Arsenic (ug/L)					0.5	0.5			
Cadmium (ug/L)					0.5	0.5			
Chromium (ug/L)					0.5	0.5			
Copper (ug/L)					2	5			
Lead (ug/L)					0.5	0.5			
Manganese (ug/L)					90	51			
Molybdenum (ug/L)					3	2			
Nickel (ug/L)					2	2			
Selenium (ug/L)					1.5	1.5			
Silver (ug/L)					0.5	0.5			
Uranium (ug/L)					0.5	0.5			
Zinc (ug/L)					17	31			
Boron (ug/L)					70	74			
Iron (ug/L)					510	1150			
Mercury (ug/L)					0.005	0.005			
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)	1	1	17	5	1	1	1	1	3
Total Organic Carbon(mg/L)									

Site ID	010								
DATE	12/05/2014	04/06/2014	20/06/2014	02/07/2014	16/07/2014	01/08/2014	21/08/2014	29/08/2014	11/09/2014
Temperature (oC)	14.35	13.05	12.00	8.60	12.83	12.81	12.68	13.78	12.54
Electrical Conductivity (ms/cm)	0.57	0.73	0.90	1.44	0.19	1.93	0.26	0.45	0.51
Electrical Conductivity (µS/cm)	570	730	900	1440	190	1930	260	450	510
Turbidity (NTU)	7.0	9.7	11.1	7.5	168.0	5.8	19.8	24.9	22.6
Dissolved oxygen (mg/L)	8.33	4.65	5.48	7.17	9.72	3.87	9.92	9.93	10.42
Dissolved oxygen (%sat)	81.50	44.20	50.90	61.60	91.80	36.70	93.40	95.90	89.00
pH (x.xx)	7.51	7.42	7.54	7.70	8.41	7.22	7.57	7.14	7.72
Salinity (ppt)	0.28	0.36	0.45	0.78	0.09	1.00	0.13	0.22	0.24
Suspended Solids (mg/L)	2	4	6	2	84	1	4	8	4
Ammonium-Nitrogen (mg/L)	0.04	0.63	0.27	0.19	0.005	1.04	0.05	0.09	0.09
Oxidised Nitrogen (mg/L)	0.48	0.54	0.6	0.78	0.4	0.77	1.15	1.69	1.13
TKN (mg/L)									
Total Nitrogen (mg/L)	0.71	3.04	1.32	1.49	1.41	3.21	1.62	2.31	1.32
Total Phosphorus(mg/L)	0.03	0.056	0.046	0.057	0.326	0.042	0.045	0.054	0.027
Faecal Coliforms (CFU/100ml)	270	1100	600	260	5000	240	2700	750	660
Enterococci (CFU/100ml)									
E Coli (CFU/100mL)									
Bicarbonate Alkalinity (mg/CaCO3/L)			125						90.7
Chloride (mg/L)			180						82
Sulphate as SO_4^{2-}(mg/L)			31						38
Fluoride (mg/L)	0.34	0.44	0.43	0.92	0.14	0.59			0.23
Sodium (mg/L)			108						55.1
Potassium (mg/L)			5.83						3.82
Magnesium (mg/L)			14.5						11.2
Calcium (mg/L)			49.1						31.7
Aluminium (ug/L)			34						1280
Arsenic (ug/L)			0.5						0.5
Cadmium (ug/L)			0.5						0.5
Chromium (ug/L)			0.5						1
Copper (ug/L)			3						8
Lead (ug/L)			0.5						2
Manganese (ug/L)			145						76
Molybdenum (ug/L)			3						2
Nickel (ug/L)			2						2
Selenium (ug/L)			1.5						1.5
Silver (ug/L)			0.5						0.5
Uranium (ug/L)			0.5						0.5
Zinc (ug/L)			44						50
Boron (ug/L)			74						56
Iron (ug/L)			1650						1970
Mercury (ug/L)			0.005						0.005
Cobalt (ug/L)			3						
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									

Site ID	010								
DATE	12/05/2014	04/06/2014	20/06/2014	02/07/2014	16/07/2014	01/08/2014	21/08/2014	29/08/2014	11/09/2014
BOD5/CBOD5(mg/L)	1	6		1	18	1	3	1	1
Total Organic Carbon(mg/L)									
Dissolved Organic Carbon(mg/L)									

Site ID	010								
DATE	25/09/2014	09/10/2014	24/10/2014	03/11/2014	25/11/2014	08/12/2014	23/12/2014	07/01/2015	19/01/2015
Temperature (oC)	15.45	15.23	17.70	14.17	21.50	21.04	20.87	22.09	20.92
Electrical Conductivity (ms/cm)	0.68	0.69	0.77	0.91	0.42	0.31	0.71	0.55	0.49
Electrical Conductivity (µS/cm)	680	690	770	910	420	310	710	550	490
Turbidity (NTU)	7.5	3.0	5.5	4.0	7.5	38.1	14.0	4.5	2.9
Dissolved oxygen (mg/L)	7.90	7.20	7.98	5.61	5.08	8.19	5.70	5.91	6.00
Dissolved oxygen (%sat)	79.10	71.90	83.80	54.70	57.70	92.00	63.70	67.50	67.00
pH (x.xx)	7.80	7.61	7.74	7.65	7.52	7.62	7.50	7.53	7.52
Salinity (ppt)	0.34	0.34	0.39	0.46	0.21	0.16	0.36	0.28	0.24
Suspended Solids (mg/L)	1	2	2	1	6	5	4	1	1
Ammonium-Nitrogen (mg/L)	0.1	0.05	0.03	0.55	0.03	0.08	0.3	0.04	0.03
Oxidised Nitrogen (mg/L)	1.06	0.84	0.94	0.93	0.56	1.08	1.54	0.75	0.71
TKN (mg/L)									
Total Nitrogen (mg/L)	1.33	0.98	1.19	2.62	1.07	2.01	2.66	1.02	0.98
Total Phosphorus(mg/L)	0.022	0.017	0.02	0.08	0.075	0.068	0.055	0.037	0.048
Faecal Coliforms (CFU/100ml)	1100	59	540	450	12000	24000	7900	1900	2100
Enterococci (CFU/100ml)								450	
Bicarbonate Alkalinity (mg/CaCO3/L)						52.8			
Chloride (mg/L)						34			
Sulphate as SO_4^{2-}(mg/L)						19			
Fluoride (mg/L)	0.49	0.57	0.49	0.56	0.37	0.12	0.61	0.65	0.58
Sodium (mg/L)						24.5			
Potassium (mg/L)						3.18			
Magnesium (mg/L)						4.43			
Calcium (mg/L)						21.5			
Aluminium (ug/L)						1580			
Arsenic (ug/L)						1			
Cadmium (ug/L)						0.5			
Chromium (ug/L)						2			
Copper (ug/L)						10			
Lead (ug/L)						4			
Manganese (ug/L)						37			
Molybdenum (ug/L)						2			
Nickel (ug/L)						2			
Selenium (ug/L)						1.5			
Silver (ug/L)						0.5			
Uranium (ug/L)						0.5			
Zinc (ug/L)						78			
Boron (ug/L)						30			
Iron (ug/L)						1180			
Mercury (ug/L)						0.005			
Hydroxide Alkalinity as CaCO3(mg/L)									
Carbonate Alkalinity as CaCO3(ug/L)									
Total Alkalinity as CaCO3(mg/L)									
Ionic Balance(%)									
Total Anions(meq/L)									
Total Cations(meq/L)									
BOD5/CBOD5(mg/L)	1	1	1	1	2		5	1	1
Total Organic Carbon(mg/L)									

Site ID	010				
DATE	03/02/2015	18/02/2015	03/03/2015	17/03/2015	10/04/2015
Temperature (oC)	20.10	20.58	18.61	16.86	18.27
Electrical Conductivity (ms/cm)	0.61	0.48	0.37	0.41	0.63
Electrical Conductivity (µS/cm)	610	480	370	410	630
Turbidity (NTU)	4.6	7.0	1.2	0.5	25.8
Dissolved oxygen (mg/L)	6.55	6.94	7.67	7.64	6.85
Dissolved oxygen (%sat)	72.20	77.30	82.00	78.90	72.40
pH (x.xx)	7.72	7.60	7.62	8.91	7.46
Salinity (ppt)	0.27	0.24	0.19	0.20	0.29
Suspended Solids (mg/L)	3	4	1	1	13
Ammonium-Nitrogen (mg/L)	0.51	0.06	0.06	0.12	0.15
Oxidised Nitrogen (mg/L)	2.06	1.21	1.09	1.26	1.28
TKN (mg/L)					
Total Nitrogen (mg/L)	4.97	1.53	1.49	1.63	1.94
Total Phosphorus(mg/L)	0.024	0.026	0.03	0.025	0.12
Faecal Coliforms (CFU/100ml)	950	16000	800	470	3200
Enterococci (CFU/100ml)		510	570	1100	760
Bicarbonate Alkalinity (mg/CaCO3/L)				59.3	
Chloride (mg/L)				52	
Sulphate as SO_4^{2-}(mg/L)				19	
Fluoride (mg/L)	0.6	0.7	0.69	0.75	0.53
Sodium (mg/L)				36.3	
Potassium (mg/L)				6.54	
Magnesium (mg/L)				8.12	
Calcium (mg/L)				36.6	
Aluminium (ug/L)				60	
Arsenic (ug/L)				0.5	
Cadmium (ug/L)				0.5	
Chromium (ug/L)				4	
Copper (ug/L)				6	
Lead (ug/L)				0.5	
Manganese (ug/L)				16	
Molybdenum (ug/L)				1	
Nickel (ug/L)				0.5	
Selenium (ug/L)				1.5	
Silver (ug/L)				0.5	
Uranium (ug/L)				0.5	
Zinc (ug/L)				23	
Boron (ug/L)				51	
Iron (ug/L)				474	
Mercury (ug/L)				0.005	
Hydroxide Alkalinity as CaCO3(mg/L)					
Carbonate Alkalinity as CaCO3(ug/L)					
Total Alkalinity as CaCO3(mg/L)					
Ionic Balance(%)					
Total Anions(meq/L)					
Total Cations(meq/L)					
BOD5/CBOD5(mg/L)	1	1	1	1	4
Total Organic Carbon(mg/L)					

Site ID	023								
DATE	06/10/1994	17/10/1994	20/10/1994	03/11/1994	15/11/1994	07/12/1994	16/12/1994	06/01/1995	17/01/1995
Temperature (oC)	15.7	16.1	15.5	14.4	19.3	20.3	19.6	20.7	22.8
Electrical Conductivity (ms/cm)	0.54	0.58	0.29	0.20	0.27	0.20	0.13	0.37	0.38
Electrical Conductivity (µS/cm)	540	580	290	200	270	200	130	370	380
Turbidity (NTU)	10.0	20.0	115.0	25.0	5.0	21.0	18.0	10.0	3.0
Dissolved oxygen (mg/L)	6.9	4.7	8.9	4.2	3.0	1.5	2.2	4.3	6.1
Dissolved oxygen (%sat)									
pH (x.xx)	7.54	7.02	6.97	7.60	7.35	6.86	6.95	7.05	7.65
Salinity (ppt)	0.2	0.2	0.1	0.0	0.1	0.0	0.1	0.1	0.1
Suspended Solids (mg/L)	4	9	30	10	5	6	4	2	2
Ammonium-Nitrogen (mg/L)	0.01	0.01	0.01	0.05	0.01	0.12	0.06	0.04	0.01
Oxidised Nitrogen (mg/L)	0.05	0.04	0.41	0.15	0.05	0.02	0.07	0.23	0.08
TKN (mg/L)									
Total Nitrogen (mg/L)	0.46	0.58	1.08	0.56	0.52	0.82	0.66	0.9	0.53
Total Phosphorus(mg/L)	0.03	0.05	0.09	0.05	0.15	0.16	0.08	0.04	0.04
Faecal Coliforms (CFU/100ml)	130	91	4500	2600	300	13	130	240	200
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	02/02/1995	15/02/1995	02/03/1995	07/03/1995	07/03/1995	15/03/1995	06/04/1995	20/04/1995	04/05/1995
Temperature (oC)	19.5	20.2	19.7	20.2	20.2	18.2	15.3	14.7	15.3
Electrical Conductivity (ms/cm)	0.30	0.34	0.70	0.26	0.26	0.52	0.59	0.36	0.12
Electrical Conductivity (µS/cm)	300	340	700	260	260	520	590	360	120
Turbidity (NTU)	9.0	11.0	35.0	42.0	42.0	6.0	7.0	14.0	77.0
Dissolved oxygen (mg/L)	3.3	3.7	9.0	7.4	7.4	6.1	5.1	6.5	8.4
Dissolved oxygen (%sat)									
pH (x.xx)	6.85	7.13	7.70	7.46	7.46	7.05	7.09	7.28	7.48
Salinity (ppt)	0.1	0.1	0.0	0.1	0.1	0.2	0.2	0.1	0.0
Suspended Solids (mg/L)	3	4	14	13	13	3	2	2	66
Ammonium-Nitrogen (mg/L)	0.02	0.06	0.01	0.04	0.03	0.05	0.04	0.03	0.01
Oxidised Nitrogen (mg/L)	0.05	0.13	0.55	0.42	0.41	0.25	0.09	0.24	0.37
TKN (mg/L)									
Total Nitrogen (mg/L)	0.48	0.44	0.93	0.83	0.78	0.7	0.41	0.67	0.93
Total Phosphorus(mg/L)	0.05	0.03	0.05	0.07	0.06	0.04	0.03	0.04	0.14
Faecal Coliforms (CFU/100ml)	440	3200	2300	1900	2200	3300	360	900	77000
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	17/05/1995	07/06/1995	07/06/1995	19/06/1995	05/07/1995	14/07/1995	03/08/1995	16/08/1995	05/09/1995
Temperature (oC)	15.3	11.7	11.7	10.2	7.7	9.2	7.2	9.2	12.1
Electrical Conductivity (ms/cm)	0.14	0.50	0.50	0.45	1.86	0.70	0.30	0.50	0.10
Electrical Conductivity (µS/cm)	140	500	500	450	1860	700	300	500	100
Turbidity (NTU)	21.0	3.0	3.0	11.1	8.6	8.1	0.0	0.8	11.9
Dissolved oxygen (mg/L)	10.5	8.0	8.0	13.1	8.6	9.5	9.5	9.9	6.9
Dissolved oxygen (%sat)									
pH (x.xx)	7.34	7.10	7.10	7.40	7.30	7.32	7.50	7.81	7.12
Salinity (ppt)	0.0	0.2	0.2	0.2	0.7	0.4	0.2	0.2	0.1
Suspended Solids (mg/L)	20	2	3	2	2	2	2	2	6
Ammonium-Nitrogen (mg/L)	0.02	0.02	0.03	0.03	0.03	0.06	0.06	0.02	0.02
Oxidised Nitrogen (mg/L)	0.3	0.25	0.19	0.44	0.31	0.45	0.08	0.16	0.34
TKN (mg/L)									
Total Nitrogen (mg/L)	0.7	0.4	0.34	0.84	0.53	0.61	0.94	0.36	0.74
Total Phosphorus(mg/L)	0.08	0.001	0.02	0.02	0.02	0.02	0.03	0.01	0.05
Faecal Coliforms (CFU/100ml)	3000	350	560	3800	220	120	420	40	500
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	19/09/1995	04/10/1995	16/10/1995	07/11/1995	17/11/1995	21/11/1995	05/12/1995	14/12/1995	04/01/1996
Temperature (oC)	15	14.7	15.5	16.9	18.2	16.2	19.8	18.4	18.7
Electrical Conductivity (ms/cm)	0.40	0.50	0.50	0.20	0.40	0.30	0.30	0.50	0.20
Electrical Conductivity (µS/cm)	400	500	500	200	400	300	300	500	200
Turbidity (NTU)	16.6	1.2	2.0	60.5	2.5	27.6	9.2	17.8	24.7
Dissolved oxygen (mg/L)	9.3	9.1	4.8	4.1	3.3	9.5	5.7	5.7	8.4
Dissolved oxygen (%sat)									
pH (x.xx)	7.33	7.33	6.78	7.04	6.87	7.55	7.64	7.47	7.06
Salinity (ppt)	0.2	0.3	0.3	0.1	0.2	0.2	0.2	0.2	0.1
Suspended Solids (mg/L)	4	2	3	22	3	10	5	9	9
Ammonium-Nitrogen (mg/L)	0.03	0.02	0.01	0.03	0.1	0.01	0.02	0.04	0.01
Oxidised Nitrogen (mg/L)	0.41	0.34	0.1	0.32	0.04	0.66	0.11	0.19	0.14
TKN (mg/L)									
Total Nitrogen (mg/L)	0.68	0.6	0.4	0.66	0.6	0.98	0.46	0.67	0.59
Total Phosphorus(mg/L)	0.03	0.02	0.02	0.06	0.05	0.04	0.04	0.04	0.04
Faecal Coliforms (CFU/100ml)	290	1800	98	2300	180	2400	3300	4000	4200
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	18/01/1996	06/02/1996	16/02/1996	05/03/1996	18/03/1996	02/04/1996	15/04/1996	02/05/1996	02/05/1996
Temperature (oC)	20.7	22	17.9	19.7	18.8	18.9	14.9	16.9	16.9
Electrical Conductivity (ms/cm)	0.50	0.40	0.50	0.10	0.30	0.40	0.00	0.00	0.00
Electrical Conductivity (µS/cm)	500	400	500	100	300	400			
Turbidity (NTU)	2.9	2.4	12.7	43.8	2.6	1.6	4.8	77.9	77.9
Dissolved oxygen (mg/L)	5.9	6.0	6.5	7.7	3.8	7.8	5.8	9.8	9.8
Dissolved oxygen (%sat)									
pH (x.xx)	7.17	7.20	7.21	7.90	7.34	7.39	7.53	7.39	7.39
Salinity (ppt)	0.3	0.2	0.2	0.0	0.1	0.2	0.0	0.0	0.0
Suspended Solids (mg/L)	2	3	3	12	3	2	2	66	27
Ammonium-Nitrogen (mg/L)	0.04	0.05	0.04	0.04	0.04	0.01	0.01	0.01	0.01
Oxidised Nitrogen (mg/L)	0.15	0.04	0.17	0.18	0.12	0.07	0.13	0.27	0.2
TKN (mg/L)									
Total Nitrogen (mg/L)	0.48	0.48	0.63	0.45	0.39	0.45	0.34	0.68	0.68
Total Phosphorus(mg/L)	0.03	0.06	0.05	0.06	0.05	0.03	0.03	0.1	0.1
Faecal Coliforms (CFU/100ml)	800	140	2000	4000	700	220	2200	17000	16000
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	20/05/1996	05/06/1996	18/06/1996	03/07/1996	19/07/1996	05/08/1996	19/08/1996	04/09/1996	16/09/1996
Temperature (oC)	13.9	12.6	13.2	8.4	8.3	10.8	9.6	12.1	13.7
Electrical Conductivity (ms/cm)	0.20	0.50	0.20	0.50	0.60	0.50	0.70	0.30	0.40
Electrical Conductivity (µS/cm)	200	500	200	500	600	500	700	300	400
Turbidity (NTU)	8.9	11.8	52.3	6.4	30.4	7.6	0.9	16.2	7.2
Dissolved oxygen (mg/L)	10.6	14.4	9.9	10.2	10.5	9.5	10.8	10.5	8.6
Dissolved oxygen (%sat)		135.9	93.9	86.5	89.1	84.9	93.8	96.9	81.7
pH (x.xx)	6.47	7.26	7.49	7.37	7.31	7.70	7.76	6.98	7.02
Salinity (ppt)	0.1	0.2	0.1	0.3	0.3	0.3	0.4	0.1	0.2
Suspended Solids (mg/L)	3	2	9	3	2	2	2	2	2
Ammonium-Nitrogen (mg/L)	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.03	0.02
Oxidised Nitrogen (mg/L)	0.26	0.15	0.51	0.09	0.12	0.35	0.07	0.74	0.14
TKN (mg/L)									
Total Nitrogen (mg/L)	0.49	0.32	0.86	0.34	0.22	0.62	0.52	1.17	0.34
Total Phosphorus(mg/L)	0.02	0.02	0.05	0.01	0.02	0.02	0.03	0.02	0.02
Faecal Coliforms (CFU/100ml)	0	340	1600	280	88	220	1500	180	700
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	16/09/1996	01/10/1996	16/10/1996	05/11/1996	20/11/1996	06/12/1996	17/12/1996	07/01/1997	20/01/1997
Temperature (oC)	13.7	14	18	14.7	18.5	21.6	18.2	19.2	19.5
Electrical Conductivity (ms/cm)	0.40	0.20	0.40	0.00	0.10	0.40	0.30	0.30	0.30
Electrical Conductivity (µS/cm)	400	200	400		100	400	300	300	300
Turbidity (NTU)	7.2	33.0	1.0	107.0	0.0	5.0	28.0	17.4	1.2
Dissolved oxygen (mg/L)	8.6	9.6	5.9	10.9	4.5	3.9	9.9	4.2	1.8
Dissolved oxygen (%sat)	81.7	93.0	62.8	106.9	48.4	43.9	105.7	44.6	21.3
pH (x.xx)	7.02	7.49	7.14	7.68	7.13	7.14	7.55	6.99	7.00
Salinity (ppt)	0.2	0.1	0.2	0.0	0.1	0.2	0.1	0.2	0.1
Suspended Solids (mg/L)	2	6	2	42	3	4	14	17	4
Ammonium-Nitrogen (mg/L)	0.02	0.01	0.03	0.03	0.03	0.01	0.02	0.01	0.03
Oxidised Nitrogen (mg/L)	0.28	0.67	0.03	0.31	0.04	0.01	0.18	0.06	0.01
TKN (mg/L)									
Total Nitrogen (mg/L)	0.61	0.99	0.35	0.58	0.41	0.26	0.61	0.6	0.58
Total Phosphorus(mg/L)	0.02	0.04	0.02	0.02	0.04	0.04	0.06	0.08	0.06
Faecal Coliforms (CFU/100ml)	1500	2000	300	5000	320	170	11000	10000	500
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	06/02/1997	18/02/1997	05/03/1997	18/03/1997	07/04/1997	17/04/1997	06/05/1997	19/05/1997	04/06/1997
Temperature (oC)	21.05	21.35	21.7	20	17	16.8	17.4	13.1	11
Electrical Conductivity (ms/cm)	0.40	0.30	0.40	0.30	0.50	0.50	0.70	0.20	0.30
Electrical Conductivity (µS/cm)	400	300	400	300	500	500	700	200	300
Turbidity (NTU)	11.3	0.5	8.5	3.2	1.7	1.4	62.0	13.5	4.2
Dissolved oxygen (mg/L)	4.8	16.2	1.4	5.5	6.2	6.5	4.4	6.8	6.8
Dissolved oxygen (%sat)	52.9	183.1	16.1	60.8	64.0	66.1	46.3	67.8	60.8
pH (x.xx)	6.99	6.94	7.06	7.16	7.30	7.13	6.92	6.65	6.88
Salinity (ppt)	0.2	0.1	0.2	0.2	0.2	0.2	0.4	0.1	0.2
Suspended Solids (mg/L)	2	2	3	4	2	2	10	7	10
Ammonium-Nitrogen (mg/L)	0.06	0.02	0.02	0.06	0.04	0.02	0.06	0.06	0.02
Oxidised Nitrogen (mg/L)	0.08	0.12	0.02	0.03	0.02	0.02	0.09	0.1	0.02
TKN (mg/L)									
Total Nitrogen (mg/L)	0.45	0.46	0.37	0.47	0.33	0.48	0.64	0.47	1.58
Total Phosphorus(mg/L)	0.04	0.03	0.04	0.04	0.02	0.02	0.05	0.03	0.23
Faecal Coliforms (CFU/100ml)	2100	2000	1200	1100	390	240	4200	1700	860
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	18/06/1997	02/07/1997	02/07/1997	18/07/1997	05/08/1997	18/08/1997	04/09/1997	18/09/1997	01/10/1997
Temperature (oC)	10.8	10.7	10.7	8.2	9.8	9.5	13.5	12.8	13.45
Electrical Conductivity (ms/cm)	0.20	0.20	0.20	0.40	0.40	0.50	0.10	0.30	0.30
Electrical Conductivity (µS/cm)	200	200	200	400	400	500	100	300	300
Turbidity (NTU)	7.7	33.1	33.0	5.0	2.2	2.1	36.2	9.3	3.6
Dissolved oxygen (mg/L)	9.4	10.1	10.1	11.9	11.2	9.4	7.3	6.8	12.4
Dissolved oxygen (%sat)	84.6	90.8	90.8	100.5	98.7	82.1	69.6	65.1	118.8
pH (x.xx)	7.27	7.02	7.02	7.24	7.07	7.72	7.39	7.20	7.38
Salinity (ppt)	0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1
Suspended Solids (mg/L)	2	9	10	2	9	2	5	5	2
Ammonium-Nitrogen (mg/L)	0.01	0.02	0.02	0.02	0.02	0.05	0.04	0.02	0.02
Oxidised Nitrogen (mg/L)	0.23	0.71	0.71	0.51	0.07	0.04	0.09	0.26	0.15
TKN (mg/L)									
Total Nitrogen (mg/L)	0.5	1.15	1.14	0.7	0.26	0.31	0.38	0.53	0.43
Total Phosphorus(mg/L)	0.03	0.06	0.06	0.01	0.01	0.02	0.03	0.03	0.02
Faecal Coliforms (CFU/100ml)	1700	1500	1500	320	360	240	1800	2100	740
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	20/10/1997	05/11/1997	17/11/1997	18/11/1997	03/12/1997	18/12/1997	07/01/1998	19/01/1998	04/02/1998
Temperature (oC)	14.25	16.8	21.2	21.2	22	22.65	21.1	21.8	24.45
Electrical Conductivity (ms/cm)	0.40	0.30	0.30	0.30	0.30	0.30	0.10	0.30	0.40
Electrical Conductivity (µS/cm)	400	300	300	300	300	300	100	300	400
Turbidity (NTU)	2.6	39.9	4.2	4.2	3.3	4.7	10.4	1.9	2.3
Dissolved oxygen (mg/L)	6.0	9.3	4.8	4.8	0.5	0.3	3.6	0.0	1.6
Dissolved oxygen (%sat)	58.2	98.6	55.0	55.0	5.4	3.2	40.5	0.0	18.8
pH (x.xx)	6.98	7.35	6.44	6.44	7.11	7.04	7.17	6.77	6.83
Salinity (ppt)	0.2	0.1	0.2	0.2	0.2	0.1	0.1	0.2	0.2
Suspended Solids (mg/L)	2	40	2	3	14	2	5	3	4
Ammonium-Nitrogen (mg/L)	0.02	0.01	0.04	0.03	0.04	0.06	0.04	0.01	0.06
Oxidised Nitrogen (mg/L)	0.01	0.36	0.03	0.03	0.01	0.01	0.16	0.03	0.01
TKN (mg/L)									
Total Nitrogen (mg/L)	0.29	1.28	0.47	0.46	0.48	0.59	0.61	0.44	0.62
Total Phosphorus(mg/L)	0.03	0.1	0.05	0.06	0.05	0.07	0.06	0.05	0.05
Faecal Coliforms (CFU/100ml)	58	40000	230	190	800	10000	2300	2600	1100
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	18/02/1998	05/03/1998	19/03/1998	02/04/1998	17/04/1998	04/05/1998	20/05/1998	02/06/1998	02/06/1998
Temperature (oC)	20.3	24.8	20.8	19.6	16.8	16.2	16.2	12.9	12.9
Electrical Conductivity (ms/cm)	0.20	0.20	0.30	0.40	0.10	0.30	0.30	0.50	0.50
Electrical Conductivity (µS/cm)	200	200	300	400	100	300	300	500	500
Turbidity (NTU)	13.0	1.8	1.2	5.7	12.6	11.0	16.8	7.1	7.1
Dissolved oxygen (mg/L)	6.0	4.0	0.5	2.1	9.5	9.4	9.3	11.8	11.8
Dissolved oxygen (%sat)	64.9	47.1	5.3	22.2	97.4	94.8	94.1	111.2	111.2
pH (x.xx)	6.94	6.73	7.01	7.11	7.31		7.30	7.38	7.38
Salinity (ppt)	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.2
Suspended Solids (mg/L)	7	4	2	3	2	3	3	5	5
Ammonium-Nitrogen (mg/L)	0.07	0.03	0.09	0.08	0.02	0.02	0.02	0.01	0.01
Oxidised Nitrogen (mg/L)	0.26	0.01	0.07	0.01	0.15	0.66	0.41	0.2	0.21
TKN (mg/L)									
Total Nitrogen (mg/L)	0.7	0.36	0.58	0.44	0.39	1	1.01	0.42	0.46
Total Phosphorus(mg/L)	0.05	0.04	0.04	0.04	0.03	0.02	0.04	0.02	0.02
Faecal Coliforms (CFU/100ml)	1800	720	900	1200	4700	2200	1900	3500	2300
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	18/06/1998	02/07/1998	17/07/1998	05/08/1998	20/08/1998	08/09/1998	17/09/1998	06/10/1998	20/10/1998
Temperature (oC)	10.5	9.9	8.3	11.2	12.9	12.8	12.1	18.1	17.05
Electrical Conductivity (ms/cm)	0.70	0.30	0.50	0.50	0.30	0.30	0.50	0.50	0.20
Electrical Conductivity (µS/cm)	700	300	500	500	300	300	500	500	200
Turbidity (NTU)	23.8	18.5	4.1	4.7	18.6	5.6	6.0	0.5	38.6
Dissolved oxygen (mg/L)	11.5	8.5	11.9	12.6	11.0	9.9	13.0	7.2	8.0
Dissolved oxygen (%sat)	103.6	75.1	101.6	115.0	104.2	93.5	120.4	76.6	82.6
pH (x.xx)	7.26	7.20	7.14	7.57	7.18	6.84	7.08	7.12	7.04
Salinity (ppt)	0.3	0.1	0.2	0.2	0.2	0.2	0.2	0.3	0.1
Suspended Solids (mg/L)	10	6	2	2	2	3	2	2	14
Ammonium-Nitrogen (mg/L)	0.01	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.01
Oxidised Nitrogen (mg/L)	0.42	0.35	0.12	0.17	0.51	0.11	0.11	0.04	0.12
TKN (mg/L)									
Total Nitrogen (mg/L)	0.76	0.65	0.32	0.38	0.79	0.29	0.33	0.32	0.49
Total Phosphorus(mg/L)	0.04	0.03	0.01	0.01	0.03	0.02	0.02	0.02	0.05
Faecal Coliforms (CFU/100ml)	5800	2200	360	1000	260	1400	760	390	3100
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	03/11/1998	18/11/1998	09/12/1998	17/12/1998	06/01/1999	06/01/1999	20/01/1999	01/02/1999	19/02/1999
Temperature (oC)	14.5	16.4	19.3	21.4			21.4	20.3	21.1
Electrical Conductivity (ms/cm)	0.40	0.20	0.20	0.20			0.20	0.30	0.50
Electrical Conductivity (µS/cm)	400	200	200	200			200	300	500
Turbidity (NTU)	5.4	34.9	43.2	11.3			6.7	5.0	3.6
Dissolved oxygen (mg/L)	5.2	9.5		0.0			6.2		0.0
Dissolved oxygen (%sat)	50.0	97.4		0.0			70.4		0.0
pH (x.xx)	6.87	7.51	7.09	6.94			7.48	6.95	6.89
Salinity (ppt)	0.2	0.1	0.1	0.1			0.1	0.1	0.2
Suspended Solids (mg/L)	4	18	20	6	4	4	5	1	3
Ammonium-Nitrogen (mg/L)	0.05	0.01	0.02	0.08	0.09	0.1	0.03	0.02	0.05
Oxidised Nitrogen (mg/L)	0.08	0.34	0.21	0.05	0.01	0.01	0.31	0.19	0.06
TKN (mg/L)									
Total Nitrogen (mg/L)	0.63	0.65	0.54	0.48	0.6	0.59	0.63	0.38	0.44
Total Phosphorus(mg/L)	0.05	0.05	0.05	0.04	0.1	0.09	0.11	0.03	0.04
Faecal Coliforms (CFU/100ml)	400	13000	16000	1000	2000	2800	7000	1100	700
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	01/03/1999	17/03/1999	07/04/1999	20/04/1999	05/05/1999	24/05/1999	03/06/1999	16/06/1999	06/07/1999
Temperature (oC)	19.8	21	17.7	15	13.1	15.4	11.7	8.8	9.2
Electrical Conductivity (ms/cm)	0.30	0.80	0.40	0.50	0.40	0.30	0.50	0.50	0.50
Electrical Conductivity (µS/cm)	300	800	400	500	400	300	500	500	500
Turbidity (NTU)	46.2	4.1	10.6	11.7	7.7	187.3	7.3	7.6	8.8
Dissolved oxygen (mg/L)	9.1	4.0	9.3	8.3	9.2	11.3	6.2	7.2	5.8
Dissolved oxygen (%sat)	99.5	45.4	98.1	82.1	87.1	112.1	59.9	61.9	50.1
pH (x.xx)	7.52	7.30	7.26	7.03	7.08	7.50	7.31	7.21	7.35
Salinity (ppt)	0.1	0.4	0.2	0.2	0.2	0.1	0.3	0.3	0.2
Suspended Solids (mg/L)	47	2	1	2	2	124	2	3	1
Ammonium-Nitrogen (mg/L)	0.01	0.05	0.01	0.03	0.03	0.17	0.03	0.02	0.02
Oxidised Nitrogen (mg/L)	0.16	0.09	0.49	0.27	0.2	0.2	0.18	0.16	0.42
TKN (mg/L)									
Total Nitrogen (mg/L)	0.53	0.41	0.86	0.58	0.45	1.23	0.47	0.41	0.66
Total Phosphorus(mg/L)	0.07	0.04	0.03	0.03	0.03	0.25	0.03	0.02	0.02
Faecal Coliforms (CFU/100ml)	21000	2600	600	1200	920	76000	1800	1100	560
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	19/07/1999	04/08/1999	04/08/1999	19/08/1999	07/09/1999	07/09/1999	23/09/1999	05/10/1999	20/10/1999
Temperature (oC)	12	8.7	8.7	9.63	13.35	13.35	14.75	15.71	15.77
Electrical Conductivity (ms/cm)	0.40	0.40	0.40	0.50	0.40	0.40	0.50	0.20	0.30
Electrical Conductivity (µS/cm)	400	400	400	500	400	400	500	200	300
Turbidity (NTU)	10.3	6.7	6.7	5.4	18.0	18.0	6.0	69.0	24.0
Dissolved oxygen (mg/L)	10.4	10.6	10.6	10.8	9.0	9.0	10.5	10.4	9.7
Dissolved oxygen (%sat)	96.6	90.7	90.7	94.1	85.9	85.9	103.6	104.4	97.9
pH (x.xx)	7.11	6.95	6.95	7.24	7.04	7.04	7.18	7.60	7.30
Salinity (ppt)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2
Suspended Solids (mg/L)	1	1	2	1	6	5	1	48	7
Ammonium-Nitrogen (mg/L)	0.01	0.05	0.01	0.01	0.01	0.01	0.03	0.01	0.01
Oxidised Nitrogen (mg/L)	0.57	0.24	0.26	0.34	0.3	0.3	0.08	0.21	0.81
TKN (mg/L)									
Total Nitrogen (mg/L)	0.79	0.43	0.42	0.53	0.61	0.62	0.33	0.55	1.18
Total Phosphorus(mg/L)	0.02	0.02	0.02	0.01	0.03	0.03	0.02	0.07	0.05
Faecal Coliforms (CFU/100ml)	260	620	360	140	2900	1400	560	13000	15000
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	03/11/1999	23/11/1999	08/12/1999	20/12/1999	05/01/2000	05/01/2000	19/01/2000	19/01/2000	02/02/2000
Temperature (oC)	15.1	17.25	21.31	16.93	19.97	19.97	19.95	19.95	20.99
Electrical Conductivity (ms/cm)	0.30	0.50	0.50	0.40	0.30	0.30	0.30	0.30	0.30
Electrical Conductivity (µS/cm)	300	500	500	400	300	300	300	300	300
Turbidity (NTU)	11.6	6.2	5.3	13.3	4.8	4.8	4.2	4.2	4.6
Dissolved oxygen (mg/L)	10.6	5.8	3.0	8.5	2.1	2.1	2.1	2.1	0.4
Dissolved oxygen (%sat)	105.5	60.1	33.8	87.5	22.5	22.5	21.9	21.9	4.9
pH (x.xx)	7.44	7.06	6.80	7.06	6.67	6.67	6.88	6.88	6.66
Salinity (ppt)	0.1	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.2
Suspended Solids (mg/L)	6	5	2	6	4	5	5	5	9
Ammonium-Nitrogen (mg/L)	0.01	0.05	0.08	0.01	0.12	0.12	0.11	0.11	0.16
Oxidised Nitrogen (mg/L)	0.32	0.07	0.04	0.19	0.05	0.06	0.03	0.03	0.01
TKN (mg/L)									
Total Nitrogen (mg/L)	0.54	0.32	0.32	0.59	0.41	0.39	0.37	0.37	0.52
Total Phosphorus(mg/L)	0.04	0.04	0.04	0.07	0.06	0.05	0.06	0.07	0.11
Faecal Coliforms (CFU/100ml)	3600	560	170	6700	1600	1700	760	600	1300
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	21/02/2000	07/03/2000	04/04/2000	04/04/2000	18/04/2000	01/05/2000	19/05/2000	19/05/2000	07/06/2000
Temperature (oC)	20.58	18.92	18.92	18.92	17.09	15.62	12.11	12.11	7.58
Electrical Conductivity (ms/cm)	0.40	0.00	0.50	0.50	0.20	0.30	0.50	0.50	0.50
Electrical Conductivity (µS/cm)	400		500	500	200	300	500	500	500
Turbidity (NTU)	6.6	26.0	6.9	6.9	15.2	4.4	5.7	5.7	7.7
Dissolved oxygen (mg/L)	0.7	9.1	5.2	5.2	6.5	5.3	6.2	6.2	8.7
Dissolved oxygen (%sat)	7.1	97.5	56.0	56.0	67.4	53.2	57.5	57.5	72.0
pH (x.xx)	6.85	7.11	6.98	6.98	6.87	6.61	6.95	6.95	7.21
Salinity (ppt)	0.2	0.0	0.3	0.3	0.1	0.2	0.2	0.2	0.3
Suspended Solids (mg/L)	22	15	4	4	7	1	5	4	1
Ammonium-Nitrogen (mg/L)	0.3	0.02	0.09	0.08	0.06	0.07	0.05	0.05	0.05
Oxidised Nitrogen (mg/L)	0.01	0.54	0.14	0.16	0.15	0.09	0.18	0.17	0.16
TKN (mg/L)									
Total Nitrogen (mg/L)	0.54	0.85	0.44	0.45	0.42	0.38	0.44	0.44	0.42
Total Phosphorus(mg/L)	0.1	0.05	0.04	0.04	0.05	0.04	0.03	0.03	0.02
Faecal Coliforms (CFU/100ml)	3300	7000	5900	6600	11000	7800	3600	3400	5000
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	26/06/2000	05/07/2000	19/07/2000	04/08/2000	17/08/2000	05/09/2000	21/09/2000	06/10/2000	20/10/2000
Temperature (oC)	9.04	11.37	9.67	9.33	9.42	11.35	14.25	16.28	15.9
Electrical Conductivity (ms/cm)	0.40	0.40	0.30	0.40	0.30	0.20	0.50	0.30	0.10
Electrical Conductivity (µS/cm)	400	400	300	400	300	200	500	300	100
Turbidity (NTU)	8.3	8.4	6.4	7.3	7.6	8.3	4.5	11.4	17.2
Dissolved oxygen (mg/L)	7.9	9.3	9.8	8.5	8.7	7.3	5.8	2.8	7.5
Dissolved oxygen (%sat)	68.5	84.5	86.9	74.0	76.4	67.2	55.9	28.7	76.0
pH (x.xx)	7.26	7.15	7.33	7.02	6.95	7.18	6.94	6.69	7.13
Salinity (ppt)	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.1
Suspended Solids (mg/L)	5	2	1	6	7	3	4	1	7
Ammonium-Nitrogen (mg/L)	0.07	0.04	0.01	0.05	0.02	0.03	0.02	0.07	0.03
Oxidised Nitrogen (mg/L)	0.11	0.2	34	0.16	0.16	0.14	0.01	0.03	0.13
TKN (mg/L)									
Total Nitrogen (mg/L)	0.43	0.41	36.1	0.36	0.42	0.38	0.23	0.29	0.43
Total Phosphorus(mg/L)	0.03	0.02	0.16	0.03	0.04	0.03	0.03	0.05	0.04
Faecal Coliforms (CFU/100ml)	3200	65	8	4500	310	280	150	330	1000
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	09/11/2000	22/11/2000	06/12/2000	20/12/2000	04/01/2001	18/01/2001	18/01/2001	05/02/2001	21/02/2001
Temperature (oC)	16.22	18.22	20.37	21.66	22.1	21.08	21.08	23.49	21.2
Electrical Conductivity (ms/cm)	0.30	0.20	0.40	0.40	0.50	0.20	0.20	0.40	0.10
Electrical Conductivity (µS/cm)	300	200	400	400	500	200	200	400	100
Turbidity (NTU)	3.9	7.1	11.9	5.0	7.6	73.7	73.7	4.3	190.3
Dissolved oxygen (mg/L)	2.5	6.0	3.6	2.4	3.5	8.3	8.3	6.7	8.4
Dissolved oxygen (%sat)	24.7	63.5	40.1	26.4	39.5	93.2	93.2	79.5	42.6
pH (x.xx)	6.77	7.04	7.00	6.97	6.82	7.32	7.32	7.21	7.24
Salinity (ppt)	0.2	0.1	0.2	0.2	0.2	0.1	0.1	0.2	0.1
Suspended Solids (mg/L)	3	2	5	4	3	39	36	1	63
Ammonium-Nitrogen (mg/L)	0.09	0.04	0.06	0.07	0.05	0.01	0.01	0.02	0.02
Oxidised Nitrogen (mg/L)	0.02	0.18	0.1	0.04	0.01	0.45	0.44	0.27	0.36
TKN (mg/L)									
Total Nitrogen (mg/L)	0.32	0.5	0.42	0.42	0.36	0.95	0.92	0.54	0.74
Total Phosphorus(mg/L)	0.06	0.04	0.04	0.08	0.06	0.11	0.1	0.04	0.12
Faecal Coliforms (CFU/100ml)	260	400	1600	1200	1500	27000	14000	2100	24000
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	06/03/2001	22/03/2001	05/04/2001	20/04/2001	09/05/2001	23/05/2001	06/06/2001	18/06/2001	03/07/2001
Temperature (oC)	19.87	18.34	16.94	16.99	16.13	12.3	11.17	10.08	9.24
Electrical Conductivity (ms/cm)	0.30	0.40	0.40	0.50	0.30	0.40	0.50	0.50	0.50
Electrical Conductivity (µS/cm)	300	400	400	500	300	400	500	500	500
Turbidity (NTU)	23.5	4.8	5.4	5.6	24.8	45.0	10.6	9.1	13.2
Dissolved oxygen (mg/L)	8.5	7.1	4.4	7.1	10.0	9.3	9.9	8.1	9.0
Dissolved oxygen (%sat)	92.8	75.2	45.0	73.6	101.6	86.6	89.8	71.6	78.0
pH (x.xx)	7.35	7.12	6.97	7.12	7.36	7.37	7.14	7.21	7.12
Salinity (ppt)	0.1	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3
Suspended Solids (mg/L)	6	4	3	4	4	18	1	3	1
Ammonium-Nitrogen (mg/L)	0.01	0.03	0.06	0.12	0.02	0.02	0.02	0.02	0.04
Oxidised Nitrogen (mg/L)	0.16	0.3	0.1	0.38	1.2	0.33	0.34	0.26	0.33
TKN (mg/L)									
Total Nitrogen (mg/L)	0.42	0.56	0.38	0.71	1.49	0.59	0.53	0.51	0.58
Total Phosphorus(mg/L)	0.04	0.02	0.02	0.05	0.04	0.04	0.02	0.03	0.02
Faecal Coliforms (CFU/100ml)	4600	2200	110	4800	800	1800	360	700	260
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	19/07/2001	09/08/2001	21/08/2001	04/09/2001	20/09/2001	02/10/2001	19/10/2001	05/11/2001	22/11/2001
Temperature (oC)	8.72	9.64	10.21	11.81	16.07	16.9	16.68	16.98	15.24
Electrical Conductivity (ms/cm)	0.50	0.60	0.60	0.50	0.30	0.30	0.20	0.40	0.20
Electrical Conductivity (µS/cm)	500	600	600	500	300	300	200	400	200
Turbidity (NTU)	15.8	17.5	4.8	12.7	16.4	2.0	4.9	31.9	14.7
Dissolved oxygen (mg/L)	8.5	8.6	6.9	8.2	5.9	9.8	2.6	1.6	6.5
Dissolved oxygen (%sat)	72.7	76.2	60.8	76.0	59.2	101.0	27.2	16.3	64.3
pH (x.xx)	7.31	7.08	7.10	7.21	7.03	4.66	6.77	6.77	6.96
Salinity (ppt)	0.3	0.3	0.3	0.2	0.2	0.2	0.1	0.2	0.1
Suspended Solids (mg/L)	3	1	2	14	1	11	5	4	6
Ammonium-Nitrogen (mg/L)	0.04	0.03	0.02	0.04	0.05	0.01	0.1	0.14	0.07
Oxidised Nitrogen (mg/L)	0.33	0.28	0.18	0.23	0.06	0.4	0.05	0.02	0.18
TKN (mg/L)									
Total Nitrogen (mg/L)	0.6	0.48	0.45	0.48	0.31	0.93	0.39	0.48	0.49
Total Phosphorus(mg/L)	0.04	0.03	0.02	0.02	0.03	0.06	0.06	0.06	0.04
Faecal Coliforms (CFU/100ml)	4500	1700	260	330	280	5600	340	190	1900
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	04/12/2001	18/12/2001	09/01/2002	18/01/2002	07/02/2002	18/02/2002	06/03/2002	18/03/2002	08/04/2002
Temperature (oC)	22.74	20.92	21.44	19.4	19.37	20.91	20.05	19.95	16.73
Electrical Conductivity (ms/cm)	0.20	0.30	0.20	0.30	0.40	0.40	0.30	0.50	0.40
Electrical Conductivity (µS/cm)	200	300	200	300	400	400	300	500	400
Turbidity (NTU)	34.0	7.7	14.9	8.4	10.6	19.9	50.0	14.3	6.8
Dissolved oxygen (mg/L)	2.8	1.7	0.8	1.3	8.8	8.8	8.0	4.6	7.5
Dissolved oxygen (%sat)	32.5	18.6	8.7	13.7	95.9	98.0	88.5	49.7	76.8
pH (x.xx)	6.73	6.85	6.84	6.81	7.50	7.65	7.30	7.04	7.18
Salinity (ppt)	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2
Suspended Solids (mg/L)	20	4	4	7	4	10	16	2	10
Ammonium-Nitrogen (mg/L)	0.01	0.2	0.11	0.1	0.4	0.02	0.03	0.07	0.03
Oxidised Nitrogen (mg/L)	0.4	0.03	0.03	0.05	4.5	0.28	0.44	0.09	0.13
TKN (mg/L)									
Total Nitrogen (mg/L)	0.95	0.55	0.51	0.56	5.9	0.61	0.78	0.39	0.5
Total Phosphorus(mg/L)	0.1	0.09	0.08	0.09	0.1	0.04	0.05	0.04	0.04
Faecal Coliforms (CFU/100ml)	25000	1600	1200	1100	700	2500	1900	2200	4200
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	19/04/2002	02/05/2002	20/05/2002	05/06/2002	18/06/2002	02/07/2002	18/07/2002	06/08/2002	20/08/2002
Temperature (oC)	18.23	15.26	11.14	11.86	10.71	7.09	7.37	9.94	11.19
Electrical Conductivity (ms/cm)	0.30	0.50	0.30	0.40	0.40	0.60	0.50	0.40	0.20
Electrical Conductivity (µS/cm)	300	500	300	400	400	600	500	400	200
Turbidity (NTU)	14.9	3.8	4.8	13.2	7.3	5.7	4.4	4.8	13.8
Dissolved oxygen (mg/L)	6.9	5.1	7.3	8.1	6.8	9.2	9.4	6.9	8.0
Dissolved oxygen (%sat)	72.2	50.1	65.9	74.8	61.0	75.8	7.8	61.3	72.5
pH (x.xx)	7.15	7.03	6.95	7.16	7.12	7.18	7.25	7.10	7.06
Salinity (ppt)	0.1	0.2	0.1	0.2	0.2	0.3	0.2	0.2	0.1
Suspended Solids (mg/L)	7	2	3	5	1	2	3	4	10
Ammonium-Nitrogen (mg/L)	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.04	0.03
Oxidised Nitrogen (mg/L)	0.27	0.07	0.12	0.14	0.14	0.24	0.14	0.14	0.37
TKN (mg/L)									
Total Nitrogen (mg/L)	0.69	0.32	0.33	0.6	0.34	0.41	0.32	0.42	0.84
Total Phosphorus(mg/L)	0.05	0.03	0.03	0.03	0.02	0.02	0.01	0.03	0.05
Faecal Coliforms (CFU/100ml)	5100	1400	760	1300	1400	1400	140	160	4400
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	04/09/2002	17/09/2002	09/10/2002	21/10/2002	07/11/2002	21/11/2002	03/12/2002	18/12/2002	15/01/2003
Temperature (oC)	13.33	12.9	16.94	17.11	17.6	19.14	21.3	21.87	20.68
Electrical Conductivity (ms/cm)	0.40	0.40	0.50	0.40	0.50	0.50	0.30	0.40	0.50
Electrical Conductivity (µS/cm)	400	400	500	400	500	500	300	400	500
Turbidity (NTU)	5.6	63.3	3.7	3.7	4.8	4.4	0.0	4.4	9.4
Dissolved oxygen (mg/L)	6.9	11.2	3.5	1.8	1.8	1.8	1.9	1.0	4.1
Dissolved oxygen (%sat)	66.1	106.4	36.2	18.5	19.1	19.7	21.8	11.9	45.6
pH (x.xx)	7.03	7.82	7.09	7.03	6.98	7.01	7.06	7.06	7.10
Salinity (ppt)	0.2	0.2	0.2	0.2	0.2	0.3	20.3	0.2	0.2
Suspended Solids (mg/L)	3	42	5	3	4	42	4	6	12
Ammonium-Nitrogen (mg/L)	0.04	0.01	0.1	0.1	0.12	0.17	0.1	0.22	0.09
Oxidised Nitrogen (mg/L)	0.08	0.33	0.04	0.02	0.01	0.02	0.09	0.01	0.01
TKN (mg/L)									
Total Nitrogen (mg/L)	0.31	0.93	0.43	0.42	0.46	0.51	0.62	0.63	0.89
Total Phosphorus(mg/L)	0.03	0.12	0.04	0.06	0.07	0.05	0.09	0.1	0.16
Faecal Coliforms (CFU/100ml)	1000	7000	660	260	320	1600	270	2100	3500
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)			130.00	20.00	380.00	60.00	210.00	80.00	30.00
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	22/01/2003	05/02/2003	18/02/2003	03/03/2003	19/03/2003	10/04/2003	16/04/2003	08/05/2003	19/05/2003
Temperature (oC)	22.46	20.96	20.81	18.62	18.39	15.79	17.02	14.55	15.71
Electrical Conductivity (ms/cm)	0.40	0.50	0.50	0.50	0.60	0.30	0.20	0.45	0.30
Electrical Conductivity (µS/cm)	400	500	500	500	600	300	200	450	300
Turbidity (NTU)	18.7	44.5	4.9	1.1	5.1	3.8	8.7	11.6	8.0
Dissolved oxygen (mg/L)	0.4	3.4	2.7	0.1	3.6	2.4	3.5	8.2	9.6
Dissolved oxygen (%sat)	3.9	38.8	30.2	0.7	38.0	23.7	36.3	80.3	96.3
pH (x.xx)	7.06	7.06	7.12	6.97	7.13	7.04	6.90	7.35	7.43
Salinity (ppt)	0.2	0.3	0.2	0.2	0.3	0.1	0.1	0.2	0.2
Suspended Solids (mg/L)	1	66	7	10	4	3	5	5	2
Ammonium-Nitrogen (mg/L)	0.02	0.01	0.09	0.06	0.07	0.09	0.05	0.02	0.03
Oxidised Nitrogen (mg/L)	0.01	0.01	0.06	0.01	0.18	0.03	0.04	0.27	0.62
TKN (mg/L)									
Total Nitrogen (mg/L)	1.31	1.7	0.62	0.61	0.55	0.34	0.35	0.58	0.9
Total Phosphorus(mg/L)	0.25	0.48	0.1	0.12	0.05	0.05	0.05	0.03	0.03
Faecal Coliforms (CFU/100ml)	2400	4000	960	6800	340	2100	2800	740	390
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	05/06/2003	18/06/2003	04/07/2003	17/07/2003	12/08/2003	18/08/2003	03/09/2003	18/09/2003	07/10/2003
Temperature (oC)	14.45	9.93	10.71	9.4		10.72	10.93	13.82	14.8
Electrical Conductivity (ms/cm)	0.40	0.70	0.40	0.50		0.60	0.50	0.60	0.20
Electrical Conductivity (µS/cm)	400	700	400	500		600	500	600	200
Turbidity (NTU)	12.7	6.2	29.5	8.9		4.1	9.6	3.0	26.6
Dissolved oxygen (mg/L)	9.1	8.6	10.9	8.9		6.6	6.8	4.1	8.0
Dissolved oxygen (%sat)	89.0	75.8	97.9	77.2		58.9	61.2	39.9	78.6
pH (x.xx)	7.09	7.09	7.46	7.24		7.20	7.13	7.09	7.18
Salinity (ppt)	0.2	0.3	0.2	0.3		0.3	0.3	0.3	0.1
Suspended Solids (mg/L)	3	2	8	4	1	1	2	2	16
Ammonium-Nitrogen (mg/L)	0.03	0.05	0.02	0.04	0.05	0.06	0.04	0.04	0.03
Oxidised Nitrogen (mg/L)	0.32	0.4	0.6	0.19	0.18	0.26	0.11	0.06	0.23
TKN (mg/L)									
Total Nitrogen (mg/L)	0.57	0.62	0.78	0.44	0.43	0.54	0.37	0.38	0.51
Total Phosphorus(mg/L)	0.03	0.04	0.03	0.02	0.02	0.03	0.03	0.04	0.05
Faecal Coliforms (CFU/100ml)	950	540	2600	340	160	120	460	170	1700
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	20/10/2003	14/11/2003	20/11/2003	08/12/2003	18/12/2003	14/01/2004	21/01/2004	03/02/2004	18/02/2004
Temperature (oC)	17	17.02	18.93				21.46		22.39
Electrical Conductivity (ms/cm)	0.20	0.60	0.30				0.20		0.20
Electrical Conductivity (µS/cm)	200	600	300				200		200
Turbidity (NTU)	34.5	4.5	4.1				6.3		5.0
Dissolved oxygen (mg/L)	8.2	0.1	2.3				0.2		0.1
Dissolved oxygen (%sat)	84.3	1.0	23.8				2.6		0.2
pH (x.xx)	7.34	6.99	6.99				6.99		6.89
Salinity (ppt)	0.1	0.3	0.2				0.1		0.1
Suspended Solids (mg/L)	10	13	4	3	5	8	7	5	11
Ammonium-Nitrogen (mg/L)	0.01	0.1	0.1	0.04	0.09	0.03	0.06	0.02	0.03
Oxidised Nitrogen (mg/L)	0.19	0.02	0.01	0.27	0.03	0.01	0.01	0.03	0.05
TKN (mg/L)									
Total Nitrogen (mg/L)	0.46	0.57	0.42	0.62	0.44	0.54	0.48	0.34	0.62
Total Phosphorus(mg/L)	0.04	0.1	0.06	0.04	0.06	0.1	0.12	0.05	0.21
Faecal Coliforms (CFU/100ml)	5600	510	330	1400	390	1200	570	740	3400
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	11/03/2004	18/03/2004	29/03/2004	20/04/2004	04/05/2004	26/05/2004	03/06/2004	17/06/2004	07/07/2004
Temperature (oC)		20.32	18.57	16.54	12.235	13	11.03	14.395	9.365
Electrical Conductivity (ms/cm)		0.50	0.50	0.60	1.10	0.60	0.50	0.65	0.40
Electrical Conductivity (µS/cm)		500	500	600	1100	600	500	650	400
Turbidity (NTU)		3.6	9.6	3.2	2.6	6.7	13.3	1.4	6.0
Dissolved oxygen (mg/L)		1.0	0.4	0.2	0.5	7.4	4.8	5.8	5.2
Dissolved oxygen (%sat)		10.9	4.7	1.3	4.3	70.1	43.5	58.8	44.9
pH (x.xx)		7.03	7.00	6.98	6.92	7.50	7.06	7.03	7.03
Salinity (ppt)		0.3	0.2	0.3	0.5	0.3	0.3	0.3	0.2
Suspended Solids (mg/L)	5	3	5	3	14	5	3	1	1
Ammonium-Nitrogen (mg/L)	0.02	0.03	0.08	0.1	0.14	0.02	0.09	0.1	0.09
Oxidised Nitrogen (mg/L)	0.03	0.04	0.03	0.02	0.04	0.28	0.05	0.06	0.08
TKN (mg/L)									
Total Nitrogen (mg/L)	0.4	0.36	0.42	0.38	0.49	0.56	0.43	0.39	0.38
Total Phosphorus(mg/L)	0.08	0.05	0.06	0.045	0.06	0.04	0.048	0.034	0.027
Faecal Coliforms (CFU/100ml)	1200	1400	1200	730	370	740	2600	720	230
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	20/07/2004	06/08/2004	19/08/2004	02/09/2004	15/09/2004	08/10/2004	19/10/2004	02/11/2004	18/11/2004
Temperature (oC)	10.34	9.275	11.105	11.84	11.045	15.74	14.91	18.565	18.965
Electrical Conductivity (ms/cm)	0.30	0.40	0.10	0.50	0.20	0.50	0.30	0.50	0.50
Electrical Conductivity (µS/cm)	300	400	100	500	200	500	300	500	500
Turbidity (NTU)	3.6	4.0	29.2	4.1	20.5	1.5	94.5	17.5	8.9
Dissolved oxygen (mg/L)	8.8	4.4	8.8	7.4	3.1	3.1	10.1	8.4	2.6
Dissolved oxygen (%sat)	78.1	37.8	79.4	68.0	28.0	30.9	99.4	89.5	27.8
pH (x.xx)	7.28	6.93	7.04	7.20	7.04	6.83	7.50	7.35	6.45
Salinity (ppt)	0.2	0.2	0.1	0.3	0.1	0.3	0.1	0.3	0.2
Suspended Solids (mg/L)	2	4	11	1	27	2	29	5	4
Ammonium-Nitrogen (mg/L)	0.02	0.08	0.02	0.02	0.11	0.04	0.04	0.005	0.05
Oxidised Nitrogen (mg/L)	0.17	0.09	0.31	0.16	0.04	0.28	0.83	0.32	0.13
TKN (mg/L)									
Total Nitrogen (mg/L)	0.36	0.36	0.54	0.37	0.47	0.58	1.19	0.64	0.79
Total Phosphorus(mg/L)	0.025	0.04	0.098	0.025	0.111	0.038	0.078	0.038	0.056
Faecal Coliforms (CFU/100ml)	340	260	1700	380	590	1300	690	1300	240
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	29/11/2004	16/12/2004	11/01/2005	08/02/2005	08/03/2005	04/04/2005	12/05/2005	08/06/2005	06/07/2005
Temperature (oC)	21.865	20.35	19.355	19.64	18.435	17.725	15.615	11.9	11.44
Electrical Conductivity (ms/cm)	0.40	0.30	0.30	0.40	0.50	0.30	0.50	0.50	0.50
Electrical Conductivity (µS/cm)	400	300	300	400	500	300	500	500	500
Turbidity (NTU)	10.2	15.0	6.0	3.2	4.7	17.0	4.9	12.3	2.9
Dissolved oxygen (mg/L)	1.7	0.3	0.3	1.0	0.4	8.4	1.4	3.4	7.1
Dissolved oxygen (%sat)	19.5	3.8	2.4	10.3	4.2	87.8	14.0	31.2	65.1
pH (x.xx)	6.98	6.82	6.91	7.03	6.82	7.68	6.98	7.07	7.20
Salinity (ppt)	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.3	0.2
Suspended Solids (mg/L)	6	3	7	9	10	8	9	9	1
Ammonium-Nitrogen (mg/L)	0.1	0.07	0.04	0.11	0.13	0.01	0.39	0.34	0.05
Oxidised Nitrogen (mg/L)	0.01	0.01	0.005	0.04	0.005	0.33	0.005	0.04	0.34
TKN (mg/L)									
Total Nitrogen (mg/L)	0.42	0.4	0.7	0.61	0.93	0.69	0.87	0.84	0.62
Total Phosphorus(mg/L)	0.08	0.09	0.149	0.074	0.202	0.053	0.14	0.11	0.033
Faecal Coliforms (CFU/100ml)	220	620	4000	920	7600	5800	3300	42	2400
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	10/08/2005	06/09/2005	06/09/2005	04/10/2005	02/11/2005	05/12/2005	11/01/2006	03/02/2006	02/03/2006
Temperature (oC)	10.825	11.975	11.975	16.295	20.34	19.09	25.48	24.11	20.94
Electrical Conductivity (ms/cm)	0.70	0.20	0.20	0.30	0.20	0.20	0.20	0.50	0.40
Electrical Conductivity (µS/cm)	700	200	200	300	200	200	200	500	400
Turbidity (NTU)	3.3	15.5	15.5	0.0	17.0	9.7	12.0	2.4	7.1
Dissolved oxygen (mg/L)	3.9	4.1	4.1	1.3	1.8	2.9	1.1	0.1	4.6
Dissolved oxygen (%sat)	35.6	37.8	37.8	13.1	20.0	30.7	13.5	1.4	52.4
pH (x.xx)	7.01	6.87	6.87	6.94	6.83	6.94	6.66	6.85	6.52
Salinity (ppt)	0.4	0.1	0.1	0.2	0.1	0.2	0.1	0.2	0.2
Suspended Solids (mg/L)	2	9	0.5	3	6	8	5	7	2
Ammonium-Nitrogen (mg/L)	0.188	0.084	0.132	0.308	0.099	0.103	0.098	0.042	0.021
Oxidised Nitrogen (mg/L)	0.095	0.174	0.099	0.005	0.075	0.068	0.032	0.04	0.663
TKN (mg/L)	0.6	0.7	0.3	0.6	0.8	0.4	0.42	0.38	0.4
Total Nitrogen (mg/L)	0.7	0.9	0.4	0.6	0.9	0.45	0.45	0.42	1.06
Total Phosphorus(mg/L)	0.005	0.02	0.005	0.13	0.02	0.075	0.071	0.114	0.048
Faecal Coliforms (CFU/100ml)	141	500	200	220	60	1200	300	1600	1600
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	02/05/2006	16/06/2006	13/07/2006	10/08/2006	06/09/2006	09/10/2006	09/11/2006	07/12/2006	02/01/2007
Temperature (oC)		8.65	8.51		13.73	18.11	15.9	18.83	20.84
Electrical Conductivity (ms/cm)		0.30	0.30		0.30	0.60	0.30	0.20	0.30
Electrical Conductivity (µS/cm)		300	300		300	600	300	200	300
Turbidity (NTU)		12.6	5.2		5.0	9.4	5.0	10.8	5.5
Dissolved oxygen (mg/L)		4.4	3.9		1.7	2.0	2.9	0.9	1.9
Dissolved oxygen (%sat)		38.1	33.8		16.8	21.7	29.2	9.5	21.4
pH (x.xx)		6.84	6.98		6.81	7.06	6.64	6.81	6.97
Salinity (ppt)		0.1	0.1		0.1	0.3	0.2	0.1	0.1
Suspended Solids (mg/L)	6	3	5	2	2	6	5	22	7
Ammonium-Nitrogen (mg/L)	0.48	0.037	0.092	0.005	0.238	0.234	0.102	0.146	0.09
Oxidised Nitrogen (mg/L)	0.06	0.132	0.09	0.521	0.05	0.024	0.094	0.022	0.032
TKN (mg/L)	0.94	0.36	0.52	0.34	0.74	0.78	0.47	0.61	0.43
Total Nitrogen (mg/L)	1	0.49	0.61	0.86	0.79	0.81	0.56	0.63	0.46
Total Phosphorus(mg/L)	0.1	0.052	0.048	0.025	0.022	0.031	0.043	0.091	0.146
Faecal Coliforms (CFU/100ml)	300	1300	230	1200	180	510	2400	350	2000
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	09/02/2007	08/03/2007	05/04/2007	30/04/2007	06/06/2007	04/07/2007	13/08/2007	11/09/2007	04/10/2007
Temperature (oC)	22.61	21.02	19.81	16.06	11.27	11.08	11.21	13.56	17.54
Electrical Conductivity (ms/cm)	0.40	0.30	0.40	0.20	0.30	0.50	0.60	0.18	0.28
Electrical Conductivity (µS/cm)	400	300	400	200	300	500	600	180	280
Turbidity (NTU)	11.8	17.3	13.8	23.3	8.9	17.6	10.1	20.4	26.9
Dissolved oxygen (mg/L)	1.0	3.8	0.4	6.4	1.1	9.7	6.2	9.4	2.1
Dissolved oxygen (%sat)	11.5	42.8	4.7	65.2	9.9	88.0	56.5	93.5	22.3
pH (x.xx)	6.55	6.84	6.77	7.28	6.83	7.07	7.50	7.42	6.84
Salinity (ppt)	0.2	0.2	0.2	0.1	0.2	0.2	0.3	0.1	0.1
Suspended Solids (mg/L)	16	5	5	5	6	2	3	3	4
Ammonium-Nitrogen (mg/L)	0.341	0.054	0.375	0.025	0.534	0.044	0.054	0.019	0.131
Oxidised Nitrogen (mg/L)	0.025	0.174	0.005	0.221	0.03	0.467	0.174	0.232	0.005
TKN (mg/L)	1.36	0.51	0.79	0.3	0.96	0.11	0.77	0.37	0.82
Total Nitrogen (mg/L)	1.38	0.68	0.79	0.52	0.98	0.58	0.94	0.6	0.82
Total Phosphorus(mg/L)	0.093	0.053	0.077	0.017	0.081	0.023	0.019	0.013	0.0025
Faecal Coliforms (CFU/100ml)	8900	5000	1500	2300	320	1400	120	3000	780
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	15/11/2007	14/12/2007	10/01/2008	04/02/2008	28/02/2008	10/04/2008	07/05/2008	29/05/2008	08/07/2008
Temperature (oC)	17.66	19.18	22.75	20.89	18.84	15.72	11.1	11.8	10.1
Electrical Conductivity (ms/cm)	0.46	0.20	0.50	0.10	0.04	0.10	0.40	0.54	0.48
Electrical Conductivity (µS/cm)	460	200	500	100	40	100	400	540	482.176726
Turbidity (NTU)	7.1	33.1	4.0	27.9	67.0	12.0	4.7	5.4	5.4
Dissolved oxygen (mg/L)	5.1	6.9	0.8	8.7	6.5	7.1	5.6	8.1	7.43
Dissolved oxygen (%sat)	53.9	74.4	10.0	97.6	69.4	71.6	51.3	75.1	66.0
pH (x.xx)	7.04	6.90	6.86	7.74	6.88	7.20	7.24	7.41	6.91
Salinity (ppt)	0.2	0.1	0.3	0.1	0.0	0.1	0.2	0.27	0.24
Suspended Solids (mg/L)	3	13	6	6	22	5	4	4	2
Ammonium-Nitrogen (mg/L)	0.037	0.037	0.098	0.018	0.014	0.043	0.087	0.094	0.022
Oxidised Nitrogen (mg/L)	0.189	0.155	0.031	0.483	0.308	0.217	0.147	0.085	0.232
TKN (mg/L)	0.33	0.31	0.52	0.28	0.21	0.21	0.37	0.42	0.28
Total Nitrogen (mg/L)	0.5	0.5	0.6	0.76	0.52	0.42	0.52	0.51	0.51
Total Phosphorus(mg/L)	0.02	0.04	0.04	0.082	0.064	0.023	0.017	0.035	0.0025
Faecal Coliforms (CFU/100ml)	2900	4300	12000	3600	9600	2800	1400	2800	200
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	04/08/2008	16/09/2008	16/10/2008	10/11/2008	10/12/2008	08/01/2009	13/02/2009	13/03/2009	07/04/2009
Temperature (oC)	8.1	15.1	15.23	17.5	20.1	21.17	17.66	18.65	17.13
Electrical Conductivity (ms/cm)	0.44	0.24	0.18	0.41	0.2	0.37	0.17	0.28	0.42
Electrical Conductivity (µS/cm)	442.6409292	240	180	410	200	370	170	280	420
Turbidity (NTU)	6.8	10.1	120.1	7.7	20	7.7	87	5.8	3.5
Dissolved oxygen (mg/L)	6.93	6.11	3.27	0.81	2.2	0.77	9.32	5.5	5.74
Dissolved oxygen (%sat)	58.7	60.7	32.9	10	24.2	8.6	97.7	59.3	59.6
pH (x.xx)	7.10	6.99	6.86	6.99	6.9	6.95	7.59	7	6.84
Salinity (ppt)	0.22	0.12	0.09	0.2	0.1	0.18	0.08	0.14	0.21
Suspended Solids (mg/L)	2	4	26	5	6	0.5	56	3	2
Ammonium-Nitrogen (mg/L)	0.099	0.005	0.06	0.31	0.16	0.08	0.02	0.03	0.037
Oxidised Nitrogen (mg/L)	0.301	0.12	0.16	0.005	0.101	0.087	0.212	0.157	0.202
TKN (mg/L)	0.28	0.27	0.52	0.85	0.55	0.67	0.36	0.28	0.33
Total Nitrogen (mg/L)	0.59	0.39	0.68	0.85	0.65	0.76	0.57	0.44	0.53
Total Phosphorus(mg/L)	0.0025	0.026	0.098	0.08	0.062	0.134	0.084	0.045	0.044
Faecal Coliforms (CFU/100ml)	1950	1400	3400	900	890	8000	16000	2800	5800
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	07/05/2009	09/06/2009	22/07/2009	21/08/2009	17/09/2009	13/10/2009	17/11/2009	17/12/2009	19/01/2010
Temperature (oC)	12.86	10.64	8.68	9.42	13.95		20.61	21.34	21.24
Electrical Conductivity (ms/cm)	0.47	0.42	0.3	0.44	0.46		0.39	0.38	0.21
Electrical Conductivity (µS/cm)	470	420	300	440	460		390	380	210
Turbidity (NTU)	4	4.3	2.8	2.5	3.2		3.4	3.4	6
Dissolved oxygen (mg/L)	3.65	8.44	7.56	6.26	2.9		0.3	0.23	0.87
Dissolved oxygen (%sat)	34.7	71	69	54.7	29		3.7	2.6	9.6
pH (x.xx)	7.05	7.2	7.23	7.23	7		7	7.08	6.7
Salinity (ppt)	0.23	0.21	0.15	0.22	0.21		0.19	0.19	0.1
Suspended Solids (mg/L)	4	2	1	1	3	1	3	3	9
Ammonium-Nitrogen (mg/L)	0.115	0.042	0.06	0.05	0.11	0.02	0.27	0.65	0.09
Oxidised Nitrogen (mg/L)	0.063	0.283	0.19	0.13	0.05	0.05	0.01	0.03	0.01
TKN (mg/L)	0.38	0.24							
Total Nitrogen (mg/L)	0.44	0.52	0.48	0.43	0.44	0.43	0.74	1.1	0.66
Total Phosphorus(mg/L)	0.029	0.011	0.036	0.037	0.065	0.052	0.19	0.142	0.166
Faecal Coliforms (CFU/100ml)	2100	2700	350	730	2200	1900	2500	270	9300
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									3
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	09/02/2010	18/03/2010	13/04/2010	11/05/2010	16/06/2010	13/07/2010	10/08/2010	06/09/2010	07/10/2010
Temperature (oC)	21.53	19.85	16.53	13.62	9.2	11.17	9.7	14.28	15.74
Electrical Conductivity (ms/cm)	0.37	0.45	0.24	0.6	0.52	0.28	0.29		0.38
Electrical Conductivity (µS/cm)	370	450	240	600	520	280	290	0	380
Turbidity (NTU)	10.1	1.9	2	1.6	2.7	7.4	30.2	5.5	
Dissolved oxygen (mg/L)	7.63	2.88	2.83	3.26	8.27	8.1	11.51	6.59	6.9
Dissolved oxygen (%sat)	86.6	31.4	29	31.4	71.9	73.5	101.2	64.2	69.7
pH (x.xx)	7.32	6.84	7.05	6.85	7.01	6.98	7.45	7.05	6.8
Salinity (ppt)	0.19	0.22	0.12	0.3	0.26	0.14	0.14		0.16
Suspended Solids (mg/L)	2	1	2	1	1	3	16	2	2
Ammonium-Nitrogen (mg/L)	0.03	0.13	0.11	0.11	0.47	0.02	0.04	0.03	0.03
Oxidised Nitrogen (mg/L)	0.69	0.08	0.05	0.04	1.24	0.3	0.45	0.25	0.41
TKN (mg/L)									
Total Nitrogen (mg/L)	1.07	0.51	0.37	0.53	2.14	0.56	0.9	0.5	0.68
Total Phosphorus(mg/L)	0.039	0.058	0.063	0.053	0.063	0.046	0.09	0.046	0.044
Faecal Coliforms (CFU/100ml)	3300	2600	1600	740	2000	2500	3400	1000	940
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									59.9
Chloride (mg/L)									58
Sulphate as SO_4^{2-}(mg/L)									23
Fluoride (mg/L)					0.12				0.1
Sodium (mg/L)						27.7			33.3
Potassium (mg/L)									2.97
Magnesium (mg/L)									6.08
Calcium (mg/L)						16.6			20
Aluminium (ug/L)						188			
Arsenic (ug/L)						0.5			
Cadmium (ug/L)						0.5			
Chromium (ug/L)						0.5			
Copper (ug/L)						4			
Lead (ug/L)						1			
Manganese (ug/L)						39			
Molybdenum (ug/L)						0.5			
Nickel (ug/L)						0.5			
Selenium (ug/L)						1.5			
Silver (ug/L)						0.5			
Uranium (ug/L)						0.5			
Zinc (ug/L)						11			
Boron (ug/L)						21			
Iron (ug/L)						882			
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	03/11/2010	08/12/2010	07/01/2011	16/02/2011	29/03/2011	29/03/2011	20/04/2011	14/06/2011	30/06/2011
Temperature (oC)	15.7	22.65	19.81	22.98	17.7	17.8	15.14	13.76	11.16
Electrical Conductivity (ms/cm)	0.31	0.32	0.34	0.26	0.54	0.52	0.44	0.14	0.28
Electrical Conductivity (µS/cm)	310	320	340	260	540	520	440	140	280
Turbidity (NTU)	17	4.1	17.8	2.7	12	13	6.3	172	10.8
Dissolved oxygen (mg/L)	8.41	3.59	8.24	1.35	2.3	1.5	7.6	9.96	9.93
Dissolved oxygen (%sat)	84.7	41.8	90.7	15.6	24	16	75.1	96	90.4
pH (x.xx)	7.21	6.92	7.4	6.9	6.8	6.8	7.36	6.9	
Salinity (ppt)	0.15	0.16	0.17	0.13	0.27	0.26	0.22	0.06	0.14
Suspended Solids (mg/L)	3	1	11	6	9		3	110	3
Ammonium-Nitrogen (mg/L)	0.005	0.04	0.005	0.11	1.15		0.1	0.005	0.01
Oxidised Nitrogen (mg/L)	0.58	0.09	0.15	0.01	0.08		0.47	0.24	0.29
TKN (mg/L)									
Total Nitrogen (mg/L)	0.96	0.47	0.53	0.6	2.23		0.9	0.84	0.52
Total Phosphorus(mg/L)	0.05	0.075	0.102	0.102	0.415		0.036	0.155	0.039
Faecal Coliforms (CFU/100ml)	690	3100	5400	3500	46000		110	5700	1500
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)		59.5							
Chloride (mg/L)		47							
Sulphate as SO_4^{2-}(mg/L)		14							
Fluoride (mg/L)		0.29							
Sodium (mg/L)		32.2							
Potassium (mg/L)		3.24							
Magnesium (mg/L)		6.37							
Calcium (mg/L)		20.8							
Aluminium (ug/L)		78							
Arsenic (ug/L)		0.5							
Cadmium (ug/L)		0.5							
Chromium (ug/L)		0.5							
Copper (ug/L)		6							
Lead (ug/L)		0.5							
Manganese (ug/L)		66							
Molybdenum (ug/L)		0.5							
Nickel (ug/L)		1							
Selenium (ug/L)		1.5							
Silver (ug/L)		0.5							
Uranium (ug/L)		0.5							
Zinc (ug/L)		17							
Boron (ug/L)		37							
Iron (ug/L)		1230							
Mercury (ug/L)		0.05							
BOD5/CBOD5(mg/L)				1					
Total Organic Carbon(mg/L)			8.6	8.7	10.7				

Site ID	023								
DATE	01/08/2011	05/10/2011	26/10/2011	23/11/2011	12/12/2011	13/01/2012	09/02/2012	13/03/2012	13/04/2012
Temperature (oC)	10	12.82	15.69	17.04	17.6	17.77	19.4	17.87	15.87
Electrical Conductivity (ms/cm)	0.43	0.4	0.44	0.05	0.11	0.35	0.33	0.35	0.36
Electrical Conductivity (µS/cm)	430	400	440	50	110	350	330	350	360
Turbidity (NTU)	11	7.3	8.1	50	77	9	7.2	8.8	16.9
Dissolved oxygen (mg/L)	9.17		8.49	8.64		5.55	7.85	7.36	6.58
Dissolved oxygen (%sat)	80		86.1	89.5		67	85.3	77.5	66.2
pH (x.xx)	7	7.3	7.04	7.69	7.4	6.85	6.96	7.04	7
Salinity (ppt)	0.22	0.2	0.22	0.02	0.05	0.17	0.16	0.17	0.18
Suspended Solids (mg/L)	3	9	2	28	82	1	1	2	8
Ammonium-Nitrogen (mg/L)	0.06	0.01	0.02	0.01	0.46	0.02	0.01	0.03	0.02
Oxidised Nitrogen (mg/L)	0.45	0.29	0.34	0.62	0.82	0.17	0.29	0.31	0.18
TKN (mg/L)									
Total Nitrogen (mg/L)	0.71	0.53	0.81	0.98	2.49	0.49	0.57	0.67	0.49
Total Phosphorus(mg/L)	0.029	0.038	0.053	0.086	0.284	0.034	0.035	0.035	0.037
Faecal Coliforms (CFU/100ml)	710	390	3900	2300	95000	890	1500	980	680
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)		58.3			27				
Chloride (mg/L)		73			27				
Sulphate as SO_4^{2-}(mg/L)		26			10				
Fluoride (mg/L)		0.15			0.07				
Sodium (mg/L)		48.2			18.6				
Potassium (mg/L)		2.94			2.84				
Magnesium (mg/L)		8.21			2.94				
Calcium (mg/L)		23.8			11.6				
Aluminium (ug/L)		339			3370				
Arsenic (ug/L)		0.5			3				
Cadmium (ug/L)		0.5			0.5				
Chromium (ug/L)		0.5			6				
Copper (ug/L)		14			16				
Lead (ug/L)		1			10				
Manganese (ug/L)		24			42				
Molybdenum (ug/L)		0.5			0.5				
Nickel (ug/L)		1			2				
Selenium (ug/L)		1.5			1.5				
Silver (ug/L)		0.5			0.5				
Uranium (ug/L)		0.5			2				
Zinc (ug/L)		17			59				
Boron (ug/L)		31			34				
Iron (ug/L)		1000			3390				
Mercury (ug/L)		0.005			0.02				
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)			9.1						

Site ID	023								
DATE	09/05/2012	04/06/2012	03/07/2012	22/08/2012	20/09/2012	16/10/2012	13/11/2012	10/12/2012	15/02/2013
Temperature (oC)	12.76	14.37	8.8	9.73	14.08	14.47	17.3	17.99	19.98
Electrical Conductivity (ms/cm)	0.46	0.24	0.43	0.5	0.31	0.24	0.29	0.4	0.38
Electrical Conductivity (µS/cm)	460	240	430	500	310	240	290	400	380
Turbidity (NTU)	7.6	23.5	8.5	4.1	12.2	7.4	4	4.1	3.4
Dissolved oxygen (mg/L)	8.2	9.43	9.5	8.82	5.48	4.69	0.63	1.76	5.06
Dissolved oxygen (%sat)	77.4	92.1	81.9	77.3	53.8	45.6	6.4	18.6	55.20
pH (x.xx)	6.95	7.36	7.08	7.23	7.07	7.22	6.94	6.91	7.06
Salinity (ppt)	0.23	0.09	0.21	0.25	0.15	0.12	0.11	0.2	0.19
Suspended Solids (mg/L)	2	8	1	1	7	5	3	2	2
Ammonium-Nitrogen (mg/L)	0.02	0.01	0.02	0.01	0.02	0.04	0.09	0.03	0.02
Oxidised Nitrogen (mg/L)	0.24	0.41	0.29	0.27	0.35	0.05	0.01	0.02	0.13
TKN (mg/L)									
Total Nitrogen (mg/L)	0.46	0.61	0.47	0.46	0.9	0.34	0.66	0.34	0.43
Total Phosphorus(mg/L)	0.022	0.051	0.019	0.014	0.084	0.046	0.125	0.07	0.045
Faecal Coliforms (CFU/100ml)	960	1900	870	210	910	630	250	540	560
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)									
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	15/03/2013	09/04/2013	29/05/2013	24/06/2013	23/07/2013	23/08/2013	17/09/2013	31/10/2013	21/11/2013
Temperature (oC)	19.72	16.6	13.26	12.54	8.77	9.46	16.19	15.45	18.51
Electrical Conductivity (ms/cm)	0.50	0.22	0.32	0.25	0.51	0.50	0.11	0.28	0.33
Electrical Conductivity (µS/cm)	500	220	320	250	510	500	110	280	330
Turbidity (NTU)	2.2	4.6	11.7	27.7	3.7	2.9	32.7	1.7	8.7
Dissolved oxygen (mg/L)	5.21	4.93	9.73	10.83	9.05	8.36	8.77	3.37	8.64
Dissolved oxygen (%sat)	56.80	55.6	92.80	101.6	77.40	73.10	89.10	37.11	92.60
pH (x.xx)	7.00	7.16	7.40	7.78	7.15	7.26	7.33	6.91	7.30
Salinity (ppt)	0.25	0.11	0.16	0.13	0.25	0.25	0.05	0.14	0.16
Suspended Solids (mg/L)	1	17	6	5	1	1	5	3	2
Ammonium-Nitrogen (mg/L)	0.03	0.04	0.005	0.01	0.01	0.01	0.005	0.05	0.01
Oxidised Nitrogen (mg/L)	0.13	0.19	0.26	0.91	0.28	0.17	0.23	0.03	0.41
TKN (mg/L)									
Total Nitrogen (mg/L)	0.4	0.84	0.56	1.26	0.5	0.34	0.56	0.37	0.74
Total Phosphorus(mg/L)	0.03	0.124	0.03	0.046	0.017	0.016	0.06	0.061	0.033
Faecal Coliforms (CFU/100ml)	500	4000	350	1700	300	180	2400	35	280
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)									
Chloride (mg/L)									
Sulphate as SO_4^{2-}(mg/L)									
Fluoride (mg/L)									
Sodium (mg/L)									
Potassium (mg/L)									
Magnesium (mg/L)									
Calcium (mg/L)									
Aluminium (ug/L)									
Arsenic (ug/L)									
Cadmium (ug/L)									
Chromium (ug/L)									
Copper (ug/L)									
Lead (ug/L)									
Manganese (ug/L)									
Molybdenum (ug/L)									
Nickel (ug/L)									
Selenium (ug/L)									
Silver (ug/L)									
Uranium (ug/L)									
Zinc (ug/L)									
Boron (ug/L)									
Iron (ug/L)									
Mercury (ug/L)									
BOD5/CBOD5(mg/L)					1	1			1
Total Organic Carbon(mg/L)									

Site ID	023								
DATE	16/12/2013	14/01/2014	11/02/2014	27/03/2014	15/04/2014	12/05/2014	20/06/2014	16/07/2014	21/08/2014
Temperature (oC)	19.87	20.66	21.14	19.91	16.52	13.27	11.57	9.48	11.36
Electrical Conductivity (ms/cm)	0.42	0.48	0.26	0.05	0.29	0.25	0.20	0.43	0.27
Electrical Conductivity (µS/cm)	420	480	260	50	290	250	200	430	270
Turbidity (NTU)	7.7	4.6	28.5	24.3	2.9	9.8	1.1	2.7	12.2
Dissolved oxygen (mg/L)	0.38	0.21	1.26	8.63	5.49	4.14	4.89	9.43	10.63
Dissolved oxygen (%sat)	7.60	2.30	14.20	94.70	56.20	39.80	44.90	82.40	97.10
pH (x.xx)	6.93	6.96	6.89	7.43	7.19	7.05	7.04	7.14	7.67
Salinity (ppt)	0.21	0.24	0.13	0.02	0.14	0.12	0.10	0.21	0.17
Suspended Solids (mg/L)	4	4	10	10	1	1	2	1	2
Ammonium-Nitrogen (mg/L)	0.005	0.02	0.02	0.01	0.02	0.01	0.03	1.25	0.02
Oxidised Nitrogen (mg/L)	0.01	0.005	0.01	0.17	0.18	0.04	0.12	0.24	1.18
TKN (mg/L)									
Total Nitrogen (mg/L)	0.39	0.4	0.4	0.45	0.44	0.27	0.37	1.8	1.51
Total Phosphorus(mg/L)	0.063	0.064	0.081	0.059	0.039	0.034	0.032	0.042	0.043
Faecal Coliforms (CFU/100ml)	320	540	340	3700	610	550	840	10000	440
Enterococci (CFU/100ml)									
Bicarbonate Alkalinity (mg/CaCO3/L)				26.1			51.4		
Chloride (mg/L)				8.9			37		
Sulphate as SO_4^{2-}(mg/L)				5.3			10		
Fluoride (mg/L)				0.08			0.17		
Sodium (mg/L)				7.39			25.1		
Potassium (mg/L)				1.78			2.13		
Magnesium (mg/L)				1.79			5.16		
Calcium (mg/L)				8.27			17		
Aluminium (ug/L)				1130			40		
Arsenic (ug/L)				0.5			0.5		
Cadmium (ug/L)				0.5			0.5		
Chromium (ug/L)				1			0.5		
Copper (ug/L)				12			1		
Lead (ug/L)				2			0.5		
Manganese (ug/L)				15			47		
Molybdenum (ug/L)				0.5			1		
Nickel (ug/L)				0.5			0.5		
Selenium (ug/L)				1.5			1.5		
Silver (ug/L)				0.5			0.5		
Uranium (ug/L)				0.5			0.5		
Zinc (ug/L)				24			14		
Boron (ug/L)				20			30		
Iron (ug/L)				894			983		
Mercury (ug/L)				0.005			0.005		
BOD5/CBOD5(mg/L)		2	1						
Total Organic Carbon(mg/L)									

Site ID	023							
DATE	11/09/2014	09/10/2014	03/11/2014	08/12/2014	08/12/2014	19/01/2015	18/02/2015	17/03/2015
Temperature (oC)	13.68	15.77	16.17	21.00	21.00	21.28	21.73	17.94
Electrical Conductivity (ms/cm)	0.18	0.49	0.48	0.26	0.26	0.43	0.25	0.28
Electrical Conductivity (µS/cm)	180	490	480	260	260	430	250	280
Turbidity (NTU)	1.9	3.1	3.9	17.8	17.8	2.7	3.4	3.4
Dissolved oxygen (mg/L)	11.53	1.80	0.71	8.60	8.60	0.37	1.09	3.48
Dissolved oxygen (%sat)	100.55	18.10	7.20	96.10	96.10	4.00	12.40	36.70
pH (x.xx)	7.26	6.99	6.95	7.51	7.51	7.08	6.91	6.98
Salinity (ppt)	0.09	0.24	0.24	0.13	0.13	0.21	0.12	0.14
Suspended Solids (mg/L)	2	4	12	3	2	5	3	3
Ammonium-Nitrogen (mg/L)	0.01	0.03	0.01	0.01	0.005	0.005	0.01	0.05
Oxidised Nitrogen (mg/L)	0.12	0.04	0.01	0.9	0.89	0.005	0.07	0.07
TKN (mg/L)								
Total Nitrogen (mg/L)	0.36	0.36	0.41	1.3	1.27	0.42	0.4	0.4
Total Phosphorus(mg/L)	0.028	0.074	0.077	0.052	0.052	0.099	0.063	0.058
Faecal Coliforms (CFU/100ml)	710	34	43	17000	7900	770	110	400
Enterococci (CFU/100ml)							54	200
Bicarbonate Alkalinity (mg/CaCO3/L)	33.2			39.1	38.2			37
Chloride (mg/L)	25			33	33			42
Sulphate as SO_4^{2-}(mg/L)	9.4			16	16			8.9
Fluoride (mg/L)	0.1			0.09	0.09			0.16
Sodium (mg/L)	16.1			22.8	22.6			29.4
Potassium (mg/L)	1.53			2.79	2.88			4.07
Magnesium (mg/L)	3.65			4.04	4.06			5.5
Calcium (mg/L)	10.9			17.2	17.2			17.8
Aluminium (ug/L)	203			1140	1150			116
Arsenic (ug/L)	0.5			1	1			0.5
Cadmium (ug/L)	0.5			0.5	0.5			0.5
Chromium (ug/L)	0.5			0.5	0.5			0.5
Copper (ug/L)	2			6	3			5
Lead (ug/L)	0.5			3	3			1
Manganese (ug/L)	16			16	16			71
Molybdenum (ug/L)	0.5			0.5	0.5			0.5
Nickel (ug/L)	0.5			0.5	0.5			0.5
Selenium (ug/L)	1.5			1.5	1.5			1.5
Silver (ug/L)	0.5			0.5	0.5			0.5
Uranium (ug/L)	0.5			0.5	0.5			0.5
Zinc (ug/L)	12			22	19			16
Boron (ug/L)	26			28	31			57
Iron (ug/L)	607			1020	1050			1540
Mercury (ug/L)	0.005			0.005	0.005			0.005
BOD5/CBOD5(mg/L)			1			1		1
Total Organic Carbon(mg/L)								

Ku-ring-gai Shire Council

Parameter	unit	ANZECC	Apr-98	Apr-02	Sep-02	Apr-03	Sep-03	Apr-04	Sep-04	Apr-05
			006 Coups Creek							
pH	pH units	6.5-7.5	7.1	7.8	7.9	7.7	7.8	7.2	7.82	7.6
EC	uS/cm	125-2220*	613	530	360	400	510	471	509	107
DO	mg/L		8.2	10.9	10.3	8.9	10.1	8.7	8.9	10.9
Turbidity	NTU	2-25	2.09	2	3	35	1	55	0.7	1.8
Alkalinity	mg/L			48	46	44			32	40

Parameter	unit	ANZECC	Apr-98	Sep-98	Apr-99	Apr-05	Sep-05	Oct-05
			012 Cockles Creek			**025 Glade Oval**		
pH	pH units	6.5-7.5	7.2	6.4				
EC	uS/cm	125-2220*	246	184	242			
DO	mg/L		8.2	8.8	8.1			
Turbidity	NTU	2-25	2.1	2.4	1.7			
Tot. phosphorous	mg/L	0.02					0.027	0.081
Tot. nitrogen	mg/L	0.015					0.57	0.76
Faecal coliforms	CFU/100ml					272.3		
Ammonia	mg/L	0.013				0.2		

Hills Shire Coucil

Parameter	**Unit**	**ANZECC**	**DARLING MILLS CREEK 1 - G3**								
			24/01/2006	14/03/2006	12/04/2006	10/05/2006	® 4/7/2006	® 30/8/2006	®27/02/2007	19/04/2007	(m)29/5/2007
DO	**% or mg/L**	90-110%	91.60%	79.00%	54.20%	50.70%	96.10%	91.60%	93.50%	79.00%	
Temp	**oC**		24.4	22.8	19.2	12.8	11.7	13.2	21.6	17.8	
pH	**pH**	6.5-7.5	7.25	7.1	7.25	6.94	5.75	6.51	6.73	6.48	
EC	**us/cm**	125-2220*	338	180.1	420	485	84	459	348	308	
Faecal	**CFU/ 100ml**		400	~16	~14	~3	1500	670	2600	38	~83
E. Coli	**CFU/ 100ml**		400	~16	~14	~3	1500	670	2600	38	~83
Tot. Nitrogen	**mg/L**	0.015	0.32	0.28	0.51	0.92	0.52	0.56	1.94	0.23	0.32
Tot. Phosphorous	**mg/L**	0.02	0.021	0.02	0.006	0.013	0.078	0.026	0.08	0.017	0.016
BOD	**mg/L**		<2	<2	<2	<2	<2	<2	<2	<2	<2
TSS	**mg/L**		<2	<2	4	5	15	3	7	2	<2

Parameter	**Unit**	**ANZECC**	**DARLING MILLS CREEK 1 - G3**								
			24/07/2007	10/10/2007	21/11/2007	11/03/2008	31/03/2008	29/04/2008	3/09/2008	1/10/2008	2/08/2009
DO	**% or mg/L**	90-110%	85.50%	69.30%	86.50%	96.40%	89.10%	96.50%	93.00%	98.20%	88.30%
Temp	**oC**		9.8	16	23.6	19.9	16.3	13	12.3	17.3	8.6
pH	**pH**	6.5-7.5	5.98	6.31	6.37	7.15	7.5	7.44	7.61	7.42	5.88
EC	**us/cm**	125-2220*	348	327	286	262	174.4	251	143.1	233	340
Faecal	**CFU/ 100ml**		530	62	60	700	390	410	290	510	2500
E. Coli	**CFU/ 100ml**		530	62	60	700	390	410	290	510	2500
Tot. Nitrogen	**mg/L**	0.015	0.82	0.29	0.32	0.83	0.32	0.8	0.53	0.32	1.59
Tot. Phosphorous	**mg/L**	0.02	0.012	0.008	0.018	0.023	0.018	0.02	0.017	0.021	0.063
BOD	**mg/L**		<2	<2	<2	<2	<2	<2	<2	<2	<2
TSS	**mg/L**		<2	<2	3	<2	<2	<2	2	5	<2

Parameter	**Unit**	**ANZECC**	**DARLING MILLS CREEK 1 - G3**								
			1/09/2009	®(m) 7/10/2009	(m) 11/11/09	®(m) 9/12/2009	28/01/2010	18/02/2010	17/03/2010	14/04/2010	12/05/2010
DO	**% or mg/L**	90-110%	85.20%			7.04	4.31	8.78	8.22	8.85	9.28
Temp	**oC**		11.6	17.3	22.7	22.4	23.1	20.7	19.7	16	12.7
pH	**pH**	6.5-7.5	7.45	7.65	8.15	n/a	n/a	n/a	n/a	n/a	n/a
EC	**us/cm**	125-2220*	254	150.6	309	237	211	277	216	139	188.6
Faecal	**CFU/ 100ml**		38	2000	45	~93	~1100	590	~870	210	41

E. Coli	CFU/ 100ml		38	1500	45	~93	~1100	590	~870	210	41
Tot. Nitrogen	mg/L	0.015	0.29	1.28	0.25	0.35	0.25	1.15	0.32	0.39	0.36
Tot. Phosphorous	mg/L	0.02	0.011	0.049	0.011	0.016	0.015	0.024	0.016	0.019	0.017
BOD	mg/L		<2	<2	<2	<2	<2	<2	<2	<2	<2
TSS	mg/L		5	14	4	<2	<2	<2	3	<2	<2

Parameter	Unit	ANZECC	DARLING MILLS CREEK 1 - G3								
			® 23/06/2010	22/07/2010	11/08/2010	31/08/2010	13/10/2010	11/11/2010	9/12/2010	18/01/2011	10/02/2011
DO	% or mg/L	90-110%	10.46	10.82	10.09	10.5	9.36	9.79	7.81	7.96	7.53
Temp	oC		12	11.3	11.2	13.5	18.5	16.6	24.7	24.4	20.7
pH	pH	6.5-7.5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
EC	us/cm	125-2220*	277	263	136.5	210	164.5	201	204	160.1	157.2
Faecal	CFU/ 100ml		400	240	510	~100	~140	280	330	520	640
E. Coli	CFU/ 100ml		400	240	510	~100	~140	230	330	520	640
Tot. Nitrogen	mg/L	0.015	0.63	0.47	0.5	0.36	0.42	0.52	0.39	0.28	0.28
Tot. Phosphorous	mg/L	0.02	0.028	0.03	0.02	0.01	0.022	0.025	0.021	0.055	0.015
BOD	mg/L		<2	<2	<2	<2	<2	<2	<2	<2	<2
TSS	mg/L		<2	4	2	<2	<2	<2	<2	<2	2

Parameter	Unit	ANZECC	DARLING MILLS CREEK 1 - G3								
			15/03/2011	6/05/2011	6/06/2011	30/06/2011	27/07/2011	17/08/2011	15/09/2011	19/10/2011	30/11/2011
DO	% or mg/L	90-110%	7.65	8.72	10.13	10.85	10.16	10.4	9.88	11.27	9.41
Temp	oC		21.1	15.7	11.4	13.5	9.8	6.7	15.5	16	20.8
pH	pH	6.5-7.5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
EC	us/cm	125-2220*	175.3	425	447	438	407	415	351	482	506
Faecal	CFU/ 100ml		300	870	330	~820	240	57	74	~110	180
E. Coli	CFU/ 100ml		300	870	330	~820	240	57	74	~110	180
Tot. Nitrogen	mg/L	0.015	0.25	0.71	0.96	0.73	1.36	0.38	0.29	0.64	0.86
Tot. Phosphorous	mg/L	0.02	0.011	0.016	0.014	0.021	0.02	0.019	0.012	0.024	0.025
BOD	mg/L		<2	<2	<2	<2	<2	<2	3	<2	<3
TSS	mg/L		10	<2	<2	<2	3	21	<2	<2	2

Parameter	Unit	ANZECC	DARLING MILLS CREEK 1 - G3								
			7/12/2011	20/01/2012	21/02/2012	21/03/2012	24/04/2012	21/05/2012	18/06/2012	16/07/2012	13/08/2012
DO	% or mg/L	90-110%	9.86	8.16	8.74	9.35	9.1	10.3	10.59	8.86	10.23
Temp	oC		17.4	21.9	20.9	19.5	18	11.5	11.2	10.4	10.3
pH	pH	6.5-7.5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	7.89
EC	us/cm	125-2220*	360	480	431	319	379	448	313	360	627
Faecal	CFU/ 100ml		260	550	580	260	670	38	3800	~160	~170
E. Coli	CFU/ 100ml		260	550	700	260	670	38	3800	~160	~170
Tot. Nitrogen	mg/L	0.015	0.4	0.57	0.83	0.8	0.94	0.42	0.96	0.58	0.31
Tot. Phosphorous	mg/L	0.02	0.025	0.026	0.027	0.28	0.023	0.013	0.042	0.017	0.005
BOD	mg/L		<2	<2	<2	<2	<2	<2	<2	<2	<2
TSS	mg/L		3	<2	2	2	3	<2	8	3	2

Parameter	Unit	ANZECC	DARLING MILLS CREEK 1 - G3								
			12/09/2012	8/10/2012	6/11/2012	4/12/2012	7/01/2013	2/11/2013	5/03/2013	5/04/2013	® 27/05/2013
DO	% or mg/L	90-110%	10.9	8.82	7.45	7.99	8.23	8.42	97.10%	91.60%	n/a
Temp	oC		16.4	16.5	21.3	19.9	20.6	21.5	20.5	18.6	11.7
pH	pH	6.5-7.5	7.79	7.6	7.43	7.36	7.49	7.88	7.8	7.36	7.9
EC	us/cm	125-2220*	483	383	462	319	281	254	440	202.5	306
Faecal	CFU/ 100ml		41	21	~100	310	30	2600	210	2200	580
E. Coli	CFU/ 100ml		41	41	~100	310	30	2600	210	2200	480
Tot. Nitrogen	mg/L	0.015	0.3	0.34	0.28	0.34	0.3	0.67	0.92	0.46	0.41
Tot. Phosphorous	mg/L	0.02	0.024	0.027	0.012	0.028	0.019	0.038	0.028	0.03	0.018
BOD	mg/L		3	<2	<2	<2	<2	<2	<2	<2	<2

TSS	mg/L		4	2	2	<2	<2	3	4	5	<2

Parameter	Unit	ANZECC	DARLING MILLS CREEK 1 - G3								
			19/06/2013	22/07/2013	12/08/2013	9/09/2013	15/10/2013	5/11/2013	10/12/2013	6/1/2014	7/2/2014
DO	% or mg/L	90-110%	94.30%	89.80%	87.70%	78.10%	72.90%	11.00%	85.30%	63.50%	160.10%
Temp	oC		11.2	10.7	11.2	17.8	17.4	17.2	23.7	21.9	19.1
pH	pH	6.5-7.5	8.03	7.58	7.5	7.49	8.02	8.5	7.9	7.93	7.73
EC	us/cm	125-2220*	453	426	395	581	569	433	495	315	404
Faecal	CFU/ 100ml		220	400	68	39	~1800	~9	28	50	43
E. Coli	CFU/ 100ml		220	400	68	39	~1800	~9	28	42	43
Tot. Nitrogen	mg/L	0.015	0.33	0.52	0.45	0.31	0.64	0.28	0.32	0.3	0.26
Tot. Phosphorous	mg/L	0.02	0.012	0.017	0.016	0.015	0.04	0.01	0.014	0.014	0.009
BOD	mg/L		<2	<2	<2	<2	<2	<2	<2	<2	<2
TSS	mg/L		<2	<2	<2	<2	<2	<2	<2	<2	<2

Parameter	Unit	ANZECC	DARLING MILLS CREEK 2 - P2								
			24/01/2006	14/03/2006	12/04/2006	10/05/2006	® 4/7/2006	® 30/8/2006	®27/02/2007	19/04/2007	(m)29/5/2007
DO	% or mg/L	90-110%	76.30%	74.80%	60.60%	70.80%	92.80%	88.60%	89.90%	73.50%	
Temp	oC		23.7	22.9	17.9	12	11.8	13.6	20.9	17.5	
pH	pH	6.5-7.5	7.22	6.36	7.65	7.64	6.25	6.44	6.61	6.64	
EC	us/cm	125-2220*	333	182.1	265	285	156	456	338	306	
Faecal	CFU/ 100ml		~930	42	~1	~1	3000	~840	980	67	140
E. Coli	CFU/ 100ml		~930	42	~1	~1	3000	~840	980	67	140
Tot. Nitrogen	mg/L	0.015	0.3	0.28	0.7	0.39	0.51	0.53	1.84	0.22	0.3
Tot. Phosphorous	mg/L	0.02	0.026	0.02	0.032	0.015	0.045	0.025	0.052	0.021	0.018
BOD	mg/L		<2	<2	<2	<2	<2	<2	<2	2	<2
TSS	mg/L		4	5	3	5	15	3	7	14	3

Parameter	Unit	ANZECC	DARLING MILLS CREEK 2 - P2								
			1/09/2009	® (m) 07/10/09	(m) 11/11/09	® (m) 09/12/09	28/01/2010	15/02/2010	17/03/2010	14/04/2010	12/05/2010
DO	% or mg/L	90-110%	75.60%			4.96	4.61	8.43	7.58	8.11	8.74
Temp	oC		11.2	16.1	21.8	22.3	23.3	20.6	21	15.4	12.6
pH	pH	6.5-7.5	7.49	8.22	8.01	n/a	n/a	n/a	n/a	n/a	n/a
EC	us/cm	125-2220*	251	145	310	194	147	277	215	134.9	179
Faecal	CFU/ 100ml		40	~1100	36	~85	780	~1300	1500	380	290
E. Coli	CFU/ 100ml		40	~1100	36	~85	780	~1300	1500	380	290
Tot. Nitrogen	mg/L	0.015	0.43	1.52	0.26	0.45	0.37	1.14	0.37	0.45	0.37
Tot. Phosphorous	mg/L	0.02	0.017	0.067	0.013	0.027	0.034	0.027	0.018	0.02	0.013
BOD	mg/L		<2	<2	<2	<2	<2	<2	<2	<2	<2
TSS	mg/L		3	26	<2	<2	15	5	<2	<2	<2

Parameter	Unit	ANZECC	DARLING MILLS CREEK 2 - P2								
			® 23/06/2010	22/07/2010	11/08/2010	31/08/2010	13/10/2010	4/11/2010	9/12/2010	18/01/2011	10/02/2011
DO	% or mg/L	90-110%	9.45	10.96	9.51	10.15	10.3	9	7.37	7.22	4.6
Temp	oC		12.3	11.2	11.5	13.6	19.2	16.3	23.8	23.1	21.6
pH	pH	6.5-7.5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
EC	us/cm	125-2220*	281	260	132.4	168.6	172.1	214	207	167.8	144
Faecal	CFU/ 100ml		200	490	1800	71	240	170	390	~1000	3100
E. Coli	CFU/ 100ml		200	490	1800	71	240	170	390	~1000	3100
Tot. Nitrogen	mg/L	0.015	0.59	0.51	0.55	0.42	0.47	0.58	0.41	0.33	0.25
Tot. Phosphorous	mg/L	0.02	0.015	0.017	0.032	0.019	0.024	0.039	0.026	0.028	0.015
BOD	mg/L		<2	<2	<2	<2	<2	<2	<2	<2	<2
TSS	mg/L		<2	15	4	<2	<2	4	<2	<2	2

Parameter	Unit	ANZECC	DARLING MILLS CREEK 2 - P2								
			15/03/2011	6/05/2011	6/06/2011	30/06/2011	27/07/2011	17/08/2011	15/09/2011	19/10/2011	30/11/2011

DO	% or mg/L	90-110%	5.35	9.13	9.51	9.77	10.38	10.22	10.02	8.63	7.9
Temp	oC		21.6	14.3	12.1	14	10.19	11.2	13.7	16.6	22.8
pH	pH	6.5-7.5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
EC	us/cm	125-2220*	197.8	425	445	436	418	329	332	514	519
Faecal	CFU/ 100ml		~860	420	~190	500	410	210	53	38	~98
E. Coli	CFU/ 100ml		~860	420	~190	500	410	210	53	38	~98
Tot. Nitrogen	mg/L	0.015	0.26	0.74	1	0.81	1.4	0.43	0.35	0.5	0.88
Tot. Phosphorous	mg/L	0.02	0.013	0.021	0.017	0.024	0.018	0.014	0.013	0.024	0.028
BOD	mg/L		<2	<2	<2	<2	<2	<2	<2	<2	<3
TSS	mg/L		<2	<2	<2	<2	<2	<2	2	<2	2

Parameter	Unit	ANZECC	DARLING MILLS CREEK 2 - P2								
			7/12/2011	20/01/2012	21/02/2012	21/03/2012	24/04/2012	21/05/2012	18/06/2012	16/07/2012	13/08/2012
DO	% or mg/L	90-110%	9.62	7.78	8.29	8.73	8.9	10.16	10.76	10.85	10.27
Temp	oC		16.8	20.1	19.8	19.4	18.2	11.3	11.1	9.7	10.2
pH	pH	6.5-7.5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	7.58
EC	us/cm	125-2220*	365	490	439	387	372	450	325	358	650
Faecal	CFU/ 100ml		47	39	450	330	~880	36	3500	370	76
E. Coli	CFU/ 100ml		47	39	450	330	~880	36	3500	370	76
Tot. Nitrogen	mg/L	0.015	0.41	0.67	0.8	0.7	0.88	0.47	0.99	0.61	0.37
Tot. Phosphorous	mg/L	0.02	0.026	0.028	0.027	0.03	0.029	0.013	0.043	0.017	0.006
BOD	mg/L		<2	<2	<2	<2	<2	<2	<2	<2	<2
TSS	mg/L		2	<2	3	6	11	<2	7	<2	3

Parameter	Unit	ANZECC	DARLING MILLS CREEK 2 - P2								
			12/09/2012	8/10/2012	6/11/2012	4/12/2012	® 7/01/2013	® 11/02/2013	5/03/2013	5/04/2013	® 27/05/2013
DO	% or mg/L	90-110%	9.15	8.3	0.14	6.96	7.2	7.5	92.70%	87.10%	n/a
Temp	oC		12.5	15.4	20.1	20.3	20.8	21.5	19.8	18.3	11.9
pH	pH	6.5-7.5	7.39	7.46	6.69	6.8	7.41	7.88	7.91	7.52	7.57
EC	us/cm	125-2220*	580	389	307	349	295	254	459	212.9	303
Faecal	CFU/ 100ml		37	30	510	310	49	3100	290	2500	200
E. Coli	CFU/ 100ml		37	30	510	310	49	3100	290	2500	200
Tot. Nitrogen	mg/L	0.015	0.3	0.29	0.59	0.36	0.32	0.65	1.04	0.53	0.38
Tot. Phosphorous	mg/L	0.02	0.022	0.026	0.022	0.031	0.03	0.041	0.025	0.038	0.021
BOD	mg/L		3	<2	<2	<2	<2	<2	<2	<2	<2
TSS	mg/L		20	2	30	<2	5	3	<2	11	<2

Parameter	Unit	ANZECC	DARLING MILLS CREEK 2 - P2								
			19/06/2013	22/07/2013	12/08/2013	9/09/2013	15/10/2013	5/11/2013	10/12/2013	6/1/2014	7/2/2014
DO	% or mg/L	90-110%	92.80%	84.60%	83.40%	99.90%	42.00%	39.90%	100.20%	58.20%	46.10%
Temp	oC		10.9	10.2	12.8	17	15.9	16.8	23.9	21.9	18.6
pH	pH	6.5-7.5	7.26	7.52	7.58	7.41	8.06	7.8	8.14	7.56	7.8
EC	us/cm	125-2220*	485	420	385	625	570	489	497	355	421
Faecal	CFU/ 100ml		270	77	~82	31	2100	320	77	470	320
E. Coli	CFU/ 100ml		270	77	~82	31	2100	320	77	470	320
Tot. Nitrogen	mg/L	0.015	0.34	0.46	0.46	0.28	0.69	0.32	0.42	0.31	0.32
Tot. Phosphorous	mg/L	0.02	0.013	0.018	0.017	0.01	0.05	0.014	0.021	0.017	0.014
BOD	mg/L		<2	<2	<2	<2	3	<2	<2	<2	<2
TSS	mg/L		<2	<2	<2	<2	<2	<2	<2	<2	<2

Parameter	Unit	ANZECC	EXCELSIOR CREEK - O2								
			24/01/2006	14/03/2006	12/04/2006	10/05/2006	® 4/7/2006	® 30/8/2006	®27/02/2007	19/04/2007	(m)29/05/2007
DO	% or mg/L	90-110%	79.70%	71.30%	91.20%	84.50%	93.60%	90.40%	91.00%	69.30%	
Temp	oC		23	22	18	13.8	11.5	13.8	21	17.1	
pH	pH	6.5-7.5	7.3	7.07	7.15	7.24	6.23	6.28	6.6	6.3	
EC	us/cm	125-2220*	354	192.8	344	341	135	258	205	353	

Faecal	CFU/ 100ml		120	46	~11	56	3200	4800	1900	21	~72000
E. Coli	CFU/ 100ml		84	46	~11	56	3200	4800	1900	21	~72000
Tot. Nitrogen	mg/L	0.015	0.34	0.23	0.24	1.72	0.53	0.77	1.92	0.29	0.27
Tot. Phosphorous	mg/L	0.02	0.034	0.024	0.011	0.03	0.046	0.05	0.054	0.031	0.017
BOD	mg/L		<2	<2	<2	<2	<2	3	<2	<2	<2
TSS	mg/L		<2	3	19	<2	12	8	5	2	3

Parameter	Unit	ANZECC	EXCELSIOR CREEK - O2								
			24/07/2007	10/10/2007	21/11/2007	11/03/2008	31/03/2008	29/04/2008	3/09/2008	1/10/2008	5/08/2009
DO	% or mg/L	90-110%	84.70%	73.50%	81.30%	94.40%	91.30%	95.50%	84.00%	92.10%	92.40%
Temp	oC		9.5	15.9	22	19.6	15.7	12.2	10.8	14.8	9.1
pH	pH	6.5-7.5	4.75	6.2	6.19	7.97	7.26	6.97	7.65	7.16	5.69
EC	us/cm	125-2220*	580	384	335	303	304	297	207	303	418
Faecal	CFU/ 100ml		2200	40	~26	260	800	~170	88	61	70
E. Coli	CFU/ 100ml		2200	40	~26	260	800	~170	88	61	70
Tot. Nitrogen	mg/L	0.015	2.09	0.38	0.37	1.02	0.73	1	0.46	0.96	0.48
Tot. Phosphorous	mg/L	0.02	0.053	0.03	0.028	0.034	0.038	0.024	0.021	0.1	0.015
BOD	mg/L		<2	<2	<2	<2	<7	<2	<2	<2	<2
TSS	mg/L		<2	4	<2	4	35	<2	<2	90	4

Parameter	Unit	ANZECC	EXCELSIOR CREEK - O2								
			1/09/2009	® (m) 07/10/09	(m) 11/11/09	® (m) 09/12/09	28/01/2010	15/02/2010	17/03/2010	14/04/2010	12/05/2010
DO	% or mg/L	90-110%	86.30%			5.07	5.49	8.72	8	8.67	8.5
Temp	oC		12.3	14.6	19.6	20.9	21.8	20.5	19.2	15.9	12.7
pH	pH	6.5-7.5	7.37	8.22	7.64	n/a	n/a	n/a	n/a	n/a	n/a
EC	us/cm	125-2220*	336	193	322	274	231	330	363	189.2	233
Faecal	CFU/ 100ml		~14	~1800	33	450	29	330	28	44	21
E. Coli	CFU/ 100ml		~14	~1800	33	450	29	330	32	44	21
Tot. Nitrogen	mg/L	0.015	0.34	1.88	0.42	0.47	0.35	1.5	0.51	0.47	0.37
Tot. Phosphorous	mg/L	0.02	0.012	0.056	0.021	0.038	0.044	0.035	0.021	0.027	0.017
BOD	mg/L		<2	<2	<2	<2	<2	<2	<2	<2	<2
TSS	mg/L		<2	12	<2	<2	43	<2	2	4	3

Parameter	Unit	ANZECC	EXCELSIOR CREEK - O2								
			® 23/06/2010	22/07/2010	11/08/2010	31/08/2010	13/10/2010	4/11/2010	9/12/2010	18/01/2011	10/02/2011
DO	% or mg/L	90-110%	10.27	10.95	9.87	9.51	7.32	8.58	5.99	5.88	2.3
Temp	oC		12	12	11.6	13	17.2	16.2	22.7	22.8	23.4
pH	pH	6.5-7.5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
EC	us/cm	125-2220*	374	288	182.2	311	157.4	308	204	185.5	297
Faecal	CFU/ 100ml		570	120	260	~12	~85	490	63	3400	62
E. Coli	CFU/ 100ml		570	120	260	~12	~85	490	63	3400	62
Tot. Nitrogen	mg/L	0.015	0.81	0.62	0.53	0.46	0.43	0.7	0.42	0.54	0.52
Tot. Phosphorous	mg/L	0.02	0.019	0.018	0.022	0.014	0.035	0.043	0.026	0.064	0.076
BOD	mg/L		<2	<2	<2	<2	<2	<2	<2	<2	<2
TSS	mg/L		<2	<2	<2	7	<2	<2	<2	5	9

Parameter	Unit	ANZECC	EXCELSIOR CREEK - O2								
			® 23/06/2010	22/07/2010	11/08/2010	31/08/2010	13/10/2010	4/11/2010	9/12/2010	18/01/2011	10/02/2011
DO	% or mg/L	90-110%	10.27	10.95	9.87	9.51	7.32	8.58	5.99	5.88	2.3
Temp	oC		12	12	11.6	13	17.2	16.2	22.7	22.8	23.4
pH	pH	6.5-7.5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
EC	us/cm	125-2220*	374	288	182.2	311	157.4	308	204	185.5	297
Faecal	CFU/ 100ml		570	120	260	~12	~85	490	63	3400	62
E. Coli	CFU/ 100ml		570	120	260	~12	~85	490	63	3400	62
Tot. Nitrogen	mg/L	0.015	0.81	0.62	0.53	0.46	0.43	0.7	0.42	0.54	0.52
Tot. Phosphorous	mg/L	0.02	0.019	0.018	0.022	0.014	0.035	0.043	0.026	0.064	0.076

BOD	mg/L		<2	<2	<2	<2	<2	<2	<2	<2	<2
TSS	mg/L		<2	<2	<2	7	<2	<2	<2	5	9

Parameter	Unit	ANZECC	EXCELSIOR CREEK - O2								
			15/03/2011	6/05/2011	6/06/2011	30/06/2011	27/07/2011	17/08/2011	15/09/2011	19/10/2011	30/11/2011
DO	% or mg/L	90-110%	4.63	9.39	9.99	10.09	10.19	10.19	9.69	9.02	8.15
Temp	oC		20.8	14	11.7	12.9	10.1	11.3	14.4	16.1	20.6
pH	pH	6.5-7.5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
EC	us/cm	125-2220*	223	537	588	424	500	439	470	608	627
Faecal	CFU/ 100ml		~67	400	220	510	~760	~100	37	65	96
E. Coli	CFU/ 100ml		~84	400	220	510	~760	~100	37	65	96
Tot. Nitrogen	mg/L	0.015	0.28	0.75	1.46	0.83	1.88	0.57	0.41	0.65	1.18
Tot. Phosphorous	mg/L	0.02	0.021	0.016	0.031	0.032	0.022	0.029	0.016	0.015	0.031
BOD	mg/L		<2	<2	<2	<2	<2	<2	<2	<2	<2
TSS	mg/L		6	<2	2	2	<2	<2	<2	<2	<2

Parameter	Unit	ANZECC	EXCELSIOR CREEK - O2								
			7/12/2011	20/01/2012	21/02/2012	21/03/2012	24/04/2012	21/05/2012	18/06/2012	16/07/2012	13/08/2012
DO	% or mg/L	90-110%	8.61	8.49	8.9	8.9	9.43	10.3	10.84	10.84	10.37
Temp	oC		17.8	20.7	19.6	19.8	17.4	11.6	11.3	10.1	10.4
pH	pH	6.5-7.5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	7.77
EC	us/cm	125-2220*	513	569	505	431	418	543	381	424	744
Faecal	CFU/ 100ml		70	42	500	200	470	20	610	600	320
E. Coli	CFU/ 100ml		70	42	500	200	470	20	610	600	320
Tot. Nitrogen	mg/L	0.015	0.45	0.69	1.02	0.91	1.02	0.74	1.05	0.71	0.72
Tot. Phosphorous	mg/L	0.02	0.027	0.029	0.031	0.029	0.023	0.014	0.03	0.016	0.008
BOD	mg/L		<3	<2	<2	<2	<2	<2	<2	<2	<2
TSS	mg/L		<3	<2	5	2	3	<2	3	<2	<2

Parameter	Unit	ANZECC	EXCELSIOR CREEK - O2								
			12/09/2012	8/10/2012	6/11/2012	4/12/2012	® 7/01/2013	® 11/02/2013	5/03/2013	5/04/2013	® 27/05/2013
DO	% or mg/L	90-110%	10.02	8.89	6.95	7.51	7.43	7.48	93.10%	86.80%	n/a
Temp	oC		16.1	14.5	18	19.3	20.2	21.1	19.7	18.4	11.6
pH	pH	6.5-7.5	7.67	7.62	7.27	7.17	7.34	7.59	7.84	7.66	7.47
EC	us/cm	125-2220*	714	593	466	430	345	288	540	247	377
Faecal	CFU/ 100ml		31	61	~7	240	41	2000	210	2700	120
E. Coli	CFU/ 100ml		31	61	~7	240	41	2000	210	2700	120
Tot. Nitrogen	mg/L	0.015	0.37	0.41	0.36	0.4	0.43	0.65	1.21	0.54	0.47
Tot. Phosphorous	mg/L	0.02	0.015	0.028	0.021	0.035	0.034	0.044	0.034	0.033	0.02
BOD	mg/L		<2	<2	<2	<2	<2	<2	<2	<2	<2
TSS	mg/L		<2	<2	<2	<2	<2	2	2	4	<2

Parameter	Unit	ANZECC	EXCELSIOR CREEK - O2								
			19/06/2013	22/07/2013	12/08/2013	9/09/2013	15/10/2013	5/11/2013	10/12/2013	6/1/2014	7/2/2014
DO	% or mg/L	90-110%	92.50%	89.50%	89.20%	89.50%	80.80%	60.60%	82.40%	71.30%	70.90%
Temp	oC		11.4	10.9	11.5	16.5	17.3	15.6	20.2	21.5	19
pH	pH	6.5-7.5	7.01	7.46	7.5	7.31	8.13	7.66	7.66	8.24	7.68
EC	us/cm	125-2220*	555	510	457	748	452	469	519	416	442
Faecal	CFU/ 100ml		500	35	69	760	~1600	~3	~89	23	29
E. Coli	CFU/ 100ml		500	35	69	760	~1600	~3	~89	23	29
Tot. Nitrogen	mg/L	0.015	0.63	0.51	0.43	0.32	0.63	0.37	0.52	0.44	0.29
Tot. Phosphorous	mg/L	0.02	0.02	0.016	0.015	0.014	0.045	0.02	0.023	0.021	0.021
BOD	mg/L		<2	<2	<2	<2	<2	<2	<2	<2	<2
TSS	mg/L		<2	<2	<2	<2	<2	<2	6	<2	<2

Parameter	Unit	ANZECC	Larool Creek, Wareemba Avenue								
			01/08/2014	17/07/2014	30/06/2014	07/06/2014	21/05/2014	12/05/2014	27/04/2014	07/04/2014	18/03/2014
DO	mg/L		6.9	10.8	3.9	7.7	8.5	7.4	7.4	7	7.2
E. Coli	CFU/100ml		0	0	100	600	500	500	400	1400	1800
EC	uS/cm	125-2220*	270	260	350	280	430	340	450	220	560
Turbidity	NTU	2-25									
Temp	0C		12	10.5	10	14	14.5	15	15	17.5	19.5
pH	pH	6.5-7.5	7.5	7	7	8	7	7	7	7	7

Parameter	Unit	ANZECC	Larool Creek, Wareemba Avenue								
			08/03/2014	08/02/2014	18/01/2014	05/12/2013	15/11/2013	25/10/2013	05/10/2013	17/09/2013	11/08/2013
DO	mg/L		6.4	6	5.5	7.2	10.5	Over range	7.4	10.1	8.1
E. Coli	CFU/100ml		2000	1400	200	TNTC	300	20000	300	TNTC	200
EC	uS/cm	125-2220*	430	470	520	180	380	330	400	210	380
Turbidity	NTU	2-25	400	10	10	10	10	10	10	20	10
Temp	0C		21	22	25	19	18.5	17	16.5	15	11
pH	pH	6.5-7.5	7	7	6.5	7	7	7	7	7	7

Parameter	Unit	ANZECC	Larool Creek, Wareemba Avenue								
			15/07/2013	26/06/2013	08/06/2013	18/05/2013	29/04/2013	14/04/2013	24/03/2013	09/03/2013	22/02/2013
DO	mg/L		9.7	8.1	8.2	10.5	8.2	6.8	4.9	6.8	5.9
E. Coli	CFU/100ml		100	500	600	800	800	800	1000	1000	500
EC	uS/cm	125-2220*	430	300	420	380	440	390	410	450	260
Turbidity	NTU	2-25	10	30	15	10	10	10	10	10	10
Temp	0C		10.5	14	14	12.5	15.5	18.5	20	20	21
pH	pH	6.5-7.5	7	7.5	7	7	7	7	7	7	7

Parameter	Unit	ANZECC	Larool Creek, Wareemba Avenue								
			10/02/2013	13/01/2013	29/12/2012	18/11/2012	04/11/2012	20/10/2012	28/09/2012	09/09/2012	10/08/2012
DO	mg/L		5.4	3.7	6.4	7	6.5	7.2	7	5.6	10
E. Coli	CFU/100ml		TNTC	2500	500	600	300	100	300	400	300
EC	uS/cm	125-2220*	440	620	340	310	370	380	480	410	410
Turbidity	NTU	2-25	10	10	10	10	10	10	10	10	10
Temp	0C		22	20.5	19	18	17	19	18	13	11
pH	pH	6.5-7.5	7	7	7	7	7	7	8	7	8

Parameter	Unit	ANZECC	Larool Creek, Wareemba Avenue								
			15/07/2013	26/06/2013	08/06/2013	18/05/2013	29/04/2013	14/04/2013	24/03/2013	09/03/2013	22/02/2013
DO	mg/L		9.7	8.1	8.2	10.5	8.2	6.8	4.9	6.8	5.9
E. Coli	CFU/100ml		100	500	600	800	800	800	1000	1000	500
EC	uS/cm	125-2220*	430	300	420	380	440	390	410	450	260
Turbidity	NTU	2-25	10	30	15	10	10	10	10	10	10
Temp	0C		10.5	14	14	12.5	15.5	18.5	20	20	21
pH	pH	6.5-7.5	7	7.5	7	7	7	7	7	7	7

Parameter	Unit	ANZECC	Larool Creek, Wareemba Avenue								
			10/02/2013	13/01/2013	29/12/2012	18/11/2012	04/11/2012	20/10/2012	28/09/2012	09/09/2012	10/08/2012
DO	mg/L		5.4	3.7	6.4	7	6.5	7.2	7	5.6	10
E. Coli	CFU/100ml		TNTC	2500	500	600	300	100	300	400	300
EC	uS/cm	125-2220*	440	620	340	310	370	380	480	410	410
Turbidity	NTU	2-25	10	10	10	10	10	10	10	10	10
Temp	0C		22	20.5	19	18	17	19	18	13	11
pH	pH	6.5-7.5	7	7	7	7	7	7	8	7	8

Parameter	Unit	ANZECC	Larool Creek, Wareemba Avenue								
			20/07/2012	29/06/2012	22/04/2012	06/04/2012	25/03/2012	20/02/2012	05/02/2012	20/01/2012	01/01/2012
DO	mg/L		10.6	10.7	5.7	7.1	7.3	8.4	5.5	7.3	6.6

E. Coli	CFU/100ml		0	2700	800	700	900	TNTC	1400	600	1400
EC	uS/cm	125-2220*	480	440	400	480	450	330	430	430	380
Turbidity	NTU	2-25	10	10	10	10	10	60	15	10	10
Temp	0C		10	12.5	18	18.5	16.5	20	20	20	19.5
pH	pH	6.5-7.5	7	7	7	7	7	7	7	7	7
Parameter	**Unit**	**ANZECC**					**Larool Creek, Wareemba Avenue**				
			19/12/2011	24/11/2011	28/10/2011	14/10/2011	17/09/2011	15/08/2011	17/07/2011	03/07/2011	20/06/2011
DO	mg/L		7.4	Over range	9.4	9.4	8.8	9.3	8.9	8.5	8.5
E. Coli	CFU/100ml		1100		200	200	0	200	1200	300	300
EC	uS/cm	125-2220*	580	Over range	340	510	510	480	410	410	470
Turbidity	NTU	2-25	10	60	10	10	10	10	10	10	10
Temp	0C		16	17	17	14	16	12	11	11	10
pH	pH	6.5-7.5	7	8.5	7	7.5	7	7	7	7	7.5
Parameter	**Unit**	**ANZECC**					**Larool Creek, Wareemba Avenue**				
			04/06/2011	21/05/2011	02/05/2011	09/04/2011	01/04/2011	13/03/2011	27/02/2011	13/02/2011	28/01/2011
DO	mg/L		7.6	8	7.9	6.5	6.6	2.3	2.2	3.8	7.1
E. Coli	CFU/100ml		300	100	400	10000	190000	4100	100	1400	1400
EC	uS/cm	125-2220*	430	560	460	360	310	190	540	210	530
Turbidity	NTU	2-25	10	10	10	10	10	15	10	15	10
Temp	0C		12	14	16	17.5	17	22	20	20	20.4
pH	pH	6.5-7.5	7	7	7	7	7	7	6.5	6.5	6.5
Parameter	**Unit**	**ANZECC**					**Larool Creek, Wareemba Avenue**				
			14/01/2011	30/12/2010	03/12/2010	14/11/2010	31/10/2010	20/09/2010	06/09/2010	22/08/2010	01/08/2010
DO	mg/L		5.5	8.3	7.29	4.9	6.6	7.8	6.9	7.1	7.9
E. Coli	CFU/100ml		300	100	600	1400	200	200	100	0	200
EC	uS/cm	125-2220*	390	390	440	350	560	510	410	430	430
Turbidity	NTU	2-25	10	10	10	10	10	10	10	10	10
Temp	0C		22	21	19.5	22	17	13.5	14	11	12
pH	pH	6.5-7.5	7	7	7	7	7	7	7	7	7
Parameter	**Unit**	**ANZECC**					**Larool Creek, Wareemba Avenue**				
			19/07/2010	24/05/2010	02/05/2010	12/04/2010	21/03/2010	04/03/2010	02/02/2010	18/01/2010	01/01/2010
DO	mg/L		6.7	2.7	8.2	7.4	6.3	Over range	7.4	4.4	5.1
E. Coli	CFU/100ml		20000	Over range							
EC	uS/cm	125-2220*	530	570	560	780	610	530	190	420	550
Turbidity	NTU	2-25	10	15	10	10	10	10	15	10	10
Temp	0C		10	12	16	17.5	22	18	22	20.5	20
pH	pH	6.5-7.5	7	7	7.5	7	7	7	6.5	7	8
Parameter	**Unit**	**ANZECC**					**Larool Creek, Wareemba Avenue**				
			15/12/2009	23/11/2009	08/11/2009	19/10/2009	05/10/2009	21/09/2009	25/08/2009	09/08/2009	09/07/2009
DO	mg/L		4.2	3	6.7	7.1	7.8	Over range	Over range	10.5	10.1
E. Coli	CFU/100ml										
EC	uS/cm	125-2220*	540	590	420	570	230	310	530	550	340
Turbidity	NTU	2-25	10	10	15	10	10	50	10	10	15
Temp	0C		19.5	20	18.5	14.5	14.5	16	14	13	11
pH	pH	6.5-7.5	6.5	7	7.5	7	7	7	7	7	7
Parameter	**Unit**	**ANZECC**					**Larool Creek, Wareemba Avenue**				
			19/06/2009	30/05/2009	12/05/2009	26/04/2009	13/04/2009	24/03/2009	15/02/2009	03/02/2009	23/12/2008
DO	mg/L		9.9	8.4	9.7	6.8	6.7	5.2	8.8	5.8	7.2
E. Coli	CFU/100ml										
EC	uS/cm	125-2220*	360	260	580	520	610	580	250	560	120
Turbidity	NTU	2-25	15	15	10	10	10	10	10	10	20

Temp	0C		12	13	13.5	15	19	19	19	20	18
pH	pH	6.5-7.5	8	7	7	8	7.5	8	7	7	6

Parameter	**Unit**	**ANZECC**	**Larool Creek, Wareemba Avenue**								
			12/12/2008	23/11/2008	17/11/2008	13/10/2008	28/09/2008	14/09/2008	02/09/2008	18/08/2008	04/08/2008
DO	mg/L		7.2	7			9.1	7.5	9.4	9.5	8.5
E. Coli	CFU/100ml										
EC	uS/cm	125-2220*	120	520	380	600	620	160	450	630	540
Turbidity	NTU	2-25	20	10	15	10	10	30	10	10	10
Temp	0C		18	14.5	17.5	17.5	17.5	15	11	9	9
pH	pH	6.5-7.5	6	6.5	6	7	7.5	7	7	7	7

Parameter	**Unit**	**ANZECC**	**Larool Creek, Wareemba Avenue**								
			21/07/2008	23/06/2008	01/06/2008	11/05/2008	27/04/2008	07/04/2008	24/03/2008	21/02/2008	09/02/2008
DO	mg/L		8.6	10.9	8.3	8.7	7.2	7	5	5.2	8.1
E. Coli	CFU/100ml										
EC	uS/cm	125-2220*	200	520	650	600	470	360	450	520	440
Turbidity	NTU	2-25	30	10	10	10	10	40	10	10	10
Temp	0C		12	12	14.5	14	15	15	18.5	20	18
pH	pH	6.5-7.5	7.5	7.5	8	7.5	7	7	7	8	7

Parameter	**Unit**	**ANZECC**	**Larool Creek, Wareemba Avenue**								
			06/02/2008	21/01/2008	07/01/2008	20/12/2007	13/12/2007	25/11/2007	11/11/2007	11/11/2007	29/10/2007
DO	mg/L		6.6	7.5	3.6	5.9	7.1	5.7	8.9		5.3
E. Coli	CFU/100ml										
EC	uS/cm	125-2220*	440	450	600		410	580	460	460	560
Turbidity	NTU	2-25	10	15	10	10	15	10	15	15	10
Temp	0C		22	20	22	23	18	21	16		21
pH	pH	6.5-7.5	7.5	7.5	7.5	8.5	7.5	7.5	7.5		8

Parameter	**Unit**	**ANZECC**	**Larool Creek, Wareemba Avenue**								
			13/10/2007	02/10/2007	18/09/2007	05/09/2007	21/08/2007	21/07/2007	08/07/2007	24/06/2007	03/06/2007
DO	mg/L		9.2	5.7	8	7.2	8.5	9.9	9.1	8.8	6
E. Coli	CFU/100ml										
EC	uS/cm	125-2220*	460	800	750	640		590	670	530	680
Turbidity	NTU	2-25		10	10	10		10	10	10	10
Temp	0C		15.1	14	13	13	13	10	10	10	13
pH	pH	6.5-7.5	8	8	7	7	7	7.5	8.5	8	8

Parameter	**Unit**	**ANZECC**	**Larool Creek, Wareemba Avenue**								
			16/05/2007	30/04/2007	16/04/2007	02/04/2007	11/03/2007	17/02/2007	07/01/2007	17/12/2006	26/11/2006
DO	mg/L		6.5	8.8	7.6	6.9	8.4	5.3	2.4	4.8	2.6
E. Coli	CFU/100ml										
EC	uS/cm	125-2220*	730	650	630	660	560	690	290	420	450
Turbidity	NTU	2-25	10	10	10	10	10	10	10	10	10
Temp	0C		15.5	16.5	18	17.5	18	20	21	16.5	19.5
pH	pH	6.5-7.5	7	7	7.5	8	7.5	8	6.5	6.5	6.5

Parameter	**Unit**	**ANZECC**	**Larool Creek, Wareemba Avenue**								
			05/11/2006	25/10/2006	01/10/2006	28/08/2006	13/08/2006	27/07/2006	16/07/2006	02/07/2006	24/05/2006
DO	mg/L		7.7	4.9	9.7	7.1	8.1	7.7	9.4	8.3	8.5
E. Coli	CFU/100ml										
EC	uS/cm	125-2220*	200	460	760	500	640	410	280	600	120
Turbidity	NTU	2-25	15	10	10	10	10	10	20	10	10
Temp	0C		16.5	16.5	14.5	11.5	11	13	11	9	12
pH	pH	6.5-7.5	7	7	8	7	8.5	7	7.5	7	7

Parameter	**Unit**	**ANZECC**	**Larool Creek, Wareemba Avenue**

			09/05/2006	25/04/2006	09/04/2006	26/03/2006	05/03/2006	01/02/2006	18/01/2006	02/01/2006	16/12/2005
DO	mg/L		5.4	5.2	6.4	7.9	5.5	4.1	6.4	5.5	9.7
E. Coli	CFU/100ml										
EC	uS/cm	125-2220*	400	330	600	250	440	440	360	180	210
Turbidity	NTU	2-25	10	10	10	200	10	10	15	30	80
Temp	0C		13	14.5	15	20.5	19	22	21	22	21
pH	pH	6.5-7.5	6.5	7	7.5	7	7	7	7	7	6.5

Parameter	**Unit**	**ANZECC**	**Larool Creek, Wareemba Avenue**								
			05/12/2005	25/11/2005	10/11/2005	30/10/2005	17/10/2005	04/10/2005	18/09/2005	30/08/2005	16/08/2005
DO	mg/L		7.1	2.6	4.7	7.3	8.8	5.5	8.2	8.8	7.7
E. Coli	CFU/100ml										
EC	uS/cm	125-2220*	510	330	430	100	120	440	330	540	550
Turbidity	NTU	2-25	15	10	10	30	60	10	10	10	10
Temp	0C		19	17	20	20	15.5	16	12	13	10
pH	pH	6.5-7.5	7.5	7	7	7	8	8	8	8	8

Parameter	**Unit**	**ANZECC**	**Larool Creek, Wareemba Avenue**								
			17/07/2005	07/07/2005	28/03/2005	15/03/2005	28/02/2005	16/02/2005	07/02/2005	03/02/2005	24/07/2004
DO	mg/L		8.2	9.2	6.9	5.3	5.5	5.3	4.7	8	8.5
E. Coli	CFU/100ml										
EC	uS/cm	125-2220*		530	590	640	540	580	680	560	120
Turbidity	NTU	2-25	10	20	10	10	10	10	10	80	10
Temp	0C		8	11.5	16	20	19.5	20.2	18.5	18.5	12
pH	pH	6.5-7.5	8.5	8	8	8	7	8	9	8	7

Parameter	**Unit**	**ANZECC**	**Tedbury Creek, upstream of Pennant Hills High School wetland**								
			23/11/2005	15/10/2005	02/10/2005	22/08/2005	27/07/2005	29/06/2005	13/06/2005	01/05/2005	04/04/2005
DO	mg/L		5.9	6.3	7.4	5.1	8.6		3.7	6.2	4.9
EC	uS/cm	125-2220*	210	180	190	190	160	210	200	210	220
Turbidity	NTU	2-25	10	10	15	10	10	10	10	10	20
Temp	oC		14	16	16	11	10	14	16	17	17
pH	pH	6.5-7.5	7	6.5	6.5	7	7	6.5	6.5	7.5	7

Parameter	**Unit**	**ANZECC**	**Tedbury Creek, upstream of Pennant Hills High School wetland**					**Tedbury Creek, downstream of Pennant Hills High School**			
			21/03/2005	07/03/2005	21/02/2005	05/02/2005	01/02/2005	23/11/2005	15/10/2005	02/10/2005	22/08/2005
DO	mg/L		6.5	6.1	5.3	9	4.3	8.5	8.1	7.5	3
EC	uS/cm	125-2220*	240	220	260	210	240	210	190	190	180
Turbidity	NTU	2-25	10	20	10	10	10	10	10	10	15
Temp	oC		18	23	21	21	26	15	16	16	18
pH	pH	6.5-7.5	7.5	7	6.5	7	7	6.5	7	7	7.5

Parameter	**Unit**	**ANZECC**	**Tedbury Creek, downstream of Pennant Hills High School wetland**							
			24/07/2005	13/06/2005	29/05/2005	01/05/2005	04/04/2005	21/03/2005	07/03/2005	21/02/2005
DO	mg/L		9.5	3.9		8.8	8.7	8.6	4.8	5.8
EC	uS/cm	125-2220*	200	200	200	210	230	240	220	270
Turbidity	NTU	2-25	10	10	10	20	40	15	10	15
Temp	oC		9	14	13	17	18	18	23	21.5
pH	pH	6.5-7.5	6.5	7	7	7.5	7	8	7.5	7.5

Parameter	**Unit**	**ANZECC**	**Blue Gum Creek above Darling Mills co**		**Blue Gum Creek at Lisle Court**						
			27/06/2014	30/05/2014	28/04/2011	20/01/2011	21/10/2010	23/09/2010	26/08/2010	22/07/2010	24/06/2010
DO	mg/L		5.1	2.2	6.4	0	0.7	2.5	1.4	2	4.4
E Coli	CFU/100ml		Not tested	0		0	0	0	0	0	
EC	uS/cm	125-2220*	330	400	220	620	660	740	820	630	560
Turbidty	NTU	2-25	Under range	10	80	10	10	10	10	10	20
Temp	oC		10	14	16	20	14	14	10	9	13

pH	pH	6.5-7.5	6	6	7	7	7	7	7	7	7
CFC	CFU/100ml										0

Parameter	Unit	ANZECC	Blue Gum Creek at Lisle Court								
			27/05/2010	25/03/2010	25/02/2010	21/01/2010	22/12/2009	26/11/2009	22/10/2009	24/09/2009	20/08/2009
DO	mg/L		5.8	0	1.3	0	0	0	0	0	0.2
E Coli	CFU/100ml										
EC	uS/cm	125-2220*	480	980	980	910	1150	1450	1100	970	950
Turbidty	NTU	2-25	40	15	10	20	15	10	10	10	10
Temp	oC		15	19	19	19	20	20	16	15	12
pH	pH	6.5-7.5	7	7	7	7.5	7	7	7	7	7.5
CFC	CFU/100ml		0	0	0	0	0	0	0	0	0

Parameter	Unit	ANZECC	Blue Gum Creek at Lisle Court			
			23/07/2009	25/06/2009	21/05/2009	22/04/2009
DO	mg/L		1.1	4.4	5.2	4.2
E Coli	CFU/100ml					
EC	uS/cm	125-2220*	690	160	510	
Turbidty	NTU	2-25	30	10	30	30
Temp	oC		12	12	16	17
pH	pH	6.5-7.5	7	7.5	7.5	7
CFC	CFU/100ml		0	0	0	

Parameter	Unit	ANZECC	Tedbury Creek, behind Pennant Hills High School								
			07/03/2012	29/02/2012	22/02/2012	06/01/2012	26/12/2011	21/12/2011	13/12/2011	09/12/2011	07/12/2011
DO	mg/L		7.8	5.7	7.8	6.3	5.8	5.2	6.3	5.4	4.4
EC	uS/cm	125-2220*	700	180	260	1990	1990	500	199	199	400
Turbidity	NTU	2-25	15	30	20	10	10	10	10	15	10
Temp	oC		20	22	20	21	21	20	21	18	17
pH	pH	6.5-7.5	8	7	6	7	6	7	7	7	7

Parameter	Unit	ANZECC	Tedbury Creek, behind Pennant Hills High School								
			30/11/2011	09/11/2011	02/11/2011	25/10/2011	30/07/2008	18/06/2008	11/06/2008	21/05/2008	02/04/2008
DO	mg/L		6.6	7.5	2.2	2.7	9.8	6.5	4.9		6
EC	uS/cm	125-2220*	260	390	400	1990	430	770	410	390	
Turbidity	NTU	2-25	20	15	10	10	10	10	10		10
Temp	oC		18	24	17	19	11.5	18	15.5	15	21
pH	pH	6.5-7.5	7	7	6.5	7	7	7	7	6.5	7

Parameter	Unit	ANZECC	Tedbury Creek, behind Pennant Hills High School								
			26/03/2008	11/09/2007	30/07/2007	01/06/2007	28/06/2006	07/06/2006	11/10/2005	09/09/2005	09/09/2005
DO	mg/L		3.4	7.2			4.1	9.9	5.3	7	
EC	uS/cm	125-2220*	300	530	390	400		350	170	200	
Turbidity	NTU	2-25	10	15	15	10	15	10	10		15
Temp	oC		21	14	9	10	12	14	20	19	
pH	pH	6.5-7.5	7.5	7	6.5	7	6	7	7	7	

Parameter	Unit	ANZECC	Tedbury Creek, behind Pennant Hills High School								
			15/04/2003	24/03/2003	03/03/2003	17/02/2003	12/12/2002	12/12/2002	29/10/2002	23/08/2002	06/08/2002
DO	mg/L		4.2	3.6	1.7	0.1	5.7	5.7	4.4	3.4	
EC	uS/cm	125-2220*	221		200		220	250	220		800
Turbidity	NTU	2-25	10	10	10	10	10	10	10		10
Temp	oC		19	20	23	24.5	19	19	22	15	12
pH	pH	6.5-7.5	7	7	7	7.5	7	7	7	7	6.5

Parameter	Unit	ANZECC	Tedbury Creek, behind Pennant Hills High School								
			26/07/2002	26/06/2002	04/06/2002	21/05/2002	26/03/2002	18/03/2002	11/03/2002	19/02/2002	15/02/2002
DO	mg/L			5				7			

EC	uS/cm	125-2220*	800								
Turbidity	NTU	2-25	10	10	10	10	10	10	10	10	10
Temp	oC		14	15	16	15	21	25	22	24	27
pH	pH	6.5-7.5	6.5	7	7	7	7	6	7	6	7
CFU	CFU/100ml		40			100		700			
Total phosphrous	mg/L	0.02		0.25							

Parameter	**Unit**	**ANZECC**				**Tedbury Creek, behind Pennant Hills High School**					
			12/12/2001	26/10/2001	19/10/2001	23/09/2001	15/08/2001	01/08/2001	25/07/2001	26/06/2001	01/06/2001
DO	mg/L		6	10	10	10	7	9	10	10	10
EC	uS/cm	125-2220*									
Turbidity	NTU	2-25	5	10	10	5	5	5	17	10	
Temp	oC		21	20	20	18	16	14	15	19	18
pH	pH	6.5-7.5	7	6	6	6	7	6	6	6.5	7
CFU	CFU/100ml						800				
Total phosphrous	mg/L	0.02				0.25					
BOD	mg/L					6					
TDS	mg/L					115	100	4		10	13

Parameter	**Unit**	**ANZECC**				**Tedbury Creek, behind Pennant Hills High School**					
			21/05/2001	18/05/2001	07/05/2001	04/04/2001	21/03/2001	08/11/2000	01/09/2000	30/08/2000	30/08/2000
DO	mg/L		10	9	10		8	4	12	9	9
Turbidity	NTU	2-25			80	10	10				
Temp	oC		14	16	11	23	20	21	15	16	16
pH	pH	6.5-7.5	6.5	6	7	6	7	7	6	6.5	6.5
CFU	CFU/100ml						230				
Total phosphrous	mg/L	0.02									0.25
BOD	mg/L										
TDS	mg/L		13	13		10	10	9		80	80

Parameter	**Unit**	**ANZECC**				**Tedbury Creek, behind Pennant Hills High School**					
			17/08/2000	10/08/2000	03/08/2000	13/07/2000	29/06/2000	22/06/2000	20/06/2000	18/06/2000	15/06/2000
DO	mg/L		14	11	10	11	7	9	10	10	9
Temp	oC		10	17	14	15	14	12	15	14	16
pH	pH	6.5-7.5	6	7	6	6	6	7	6	7	6
CFU	CFU/100ml				10			4600	40		
TDS	mg/L		210	9	18	10	10	170	9	30	100
Nitrate	mg/L	0.015			0.3	0.1					

Parameter	**Unit**	**ANZECC**				**Tedbury Creek, behind Pennant Hills High School**					
			08/06/2000	01/06/2000	25/05/2000	11/05/2000	05/04/2000	08/03/2000	01/03/2000	16/02/2000	08/12/1999
DO	mg/L		12	11	9	7	8	5	4		11
Temp	oC		9	16	18	14	21	20	23	14.8	25
pH	pH	6.5-7.5	6	6	6	6	6	7		7	7
CFU	CFU/100ml		3000		10000	100					7
Total phosphrous	mg/L	0.02		0							
BOD	mg/L										
TDS	mg/L		3	110	100	10			0.4	3	0.02
Nitrate	mg/L	0.015	0.1								

Parameter	**Unit**	**ANZECC**				**Tedbury Creek, behind Pennant Hills High School**					
			08/09/1999	05/08/1999	28/07/1999	30/06/1999	12/05/1999	12/05/1999	11/12/1998	13/11/1998	29/04/1998
DO	mg/L		11	10	9	12	11	8	10		7
Temp	oC		15	16	12.5	13	21	18	19	16	20
pH	pH	6.5-7.5	6	7	7	6	7	7	7	6	6
CFU	CFU/100ml		480				1	10	1000	18	3000

Total phosphrous	mg/L	0.02	0.25					2	1	1.5	0
BOD	mg/L		4	2		7		0	4	7	3
TDS	mg/L		2	1	7		8	100	20	212	12
Nitrate	mg/L	0.015						0.1			0
Turbidity ratio	JTU/NTU		20					5		140	5
Parameter	**Unit**	**ANZECC**	**Tedbury Creek, behind Pennant Hills High School**								
			18/03/1998	03/03/1998	25/02/1998	11/02/1998	11/11/1997	20/10/1997	22/09/1997	08/08/1997	23/07/1997
DO	mg/L		5	9	3	3	8	3	4	11	11
Temp	oC		22	23	21	23	18	17	14	12	13
pH	pH	6.5-7.5	7	7	7	7	7	7	7	7	7
CFU	CFU/100ml		860	690	150	1400	2000	30		200	60
Total phosphrous	mg/L	0.02	4	1	1.5	1	0	0	0	1	1
BOD	mg/L		1	3	2	0	7	0	1	6	5
TDS	mg/L		70	150	80	90	230	110	100	140	32
Nitrate	mg/L	0.015	0	0	0	0	0	0	0	0.1	0.1
Turbidity ratio	JTU/NTU		5	5	5	24	15	5	5	145	5
Parameter	**Unit**	**ANZECC**	**Tedbury Creek, behind Pennant Hills High School**								
			23/05/1997	11/04/1997	19/02/1997	02/12/1996	20/11/1996	01/11/1996	14/10/1996	23/09/1996	16/09/1996
DO	mg/L		6	10	7	9	7	10	7	10	9
Temp	oC		15	19	23	21	17	16	17	16	17
pH	pH	6.5-7.5	7	7	7	7	7	7	6	6	6
CFU	CFU/100ml		1300	90	7	520	220		130		
Total phosphrous	mg/L	0.02	0.25	0.1	0.25	0.2	0.25	0.25	0.1	0.25	0
BOD	mg/L		5	2	5	4	5	18	1	1	0
TDS	mg/L		80	320	15	9	160	90	350	100	220
Nitrate	mg/L	0.015	0.1	0.1	0.01	0.75	0.1	0.1	0.01	0.1	0.1
Jackson turbidity	JTU					30	5	5	25	5	5
Parameter	**Unit**	**ANZECC**	**Tedbury Creek, behind Pennant Hills High School**								
			29/04/1996	15/04/1996	20/03/1996	13/03/1996	26/02/1996	12/02/1996	23/11/1995	24/08/1995	30/11/1994
DO	mg/L		9	9	7	12	5	10	6	10	5
Temp	oC		17	18	23	20	17	19	11	12	25
pH	pH	6.5-7.5	7	6	6	7	6	6	6	7	6
CFU	CFU/100ml			20	70	370	370	330	300	100	
Total phosphrous	mg/L	0.02	0.25	0	0.25	1	0.25	0.25	0.25	0.25	0.25
BOD	mg/L		3	3	2	3	5	4	5	2	0
TDS	mg/L		85	100	70	220	155	75	77	475	
Nitrate	mg/L	0.015	0.1	0.1	0.1	0.1	0.1	0.25	0.25	1	0.1
Jackson turbidity	JTU		5	5	5	10	25	5		5	5
Parameter	**Unit**	**ANZECC**	**Tedbury Creek, behind Pennant Hills High School**								
			26/11/1993	15/11/1993	11/10/1993	27/08/1993	23/08/1993	12/07/1993	18/05/1993	26/02/1993	10/02/1993
DO	mg/L		15	8	10		9	8	8		
Temp	oC		18		14	14	12	13			
pH	pH	6.5-7.5	7	6	7	6	6	6	6	8.5	7
CFU	CFU/100ml		600	400	200		160	2400	6000	157	1000
Total phosphrous	mg/L	0.02	1.5	3	0.25	1.5	1.5	1.5	3	0.5	0.5
BOD	mg/L		4	3	2	0	1	1	4	0	24
TDS	mg/L		180	150	305	150	300	150	315	225	190
Nitrate	mg/L	0.015	0.1	0.1	0.1	0.1	0.1	0.2	0.25	0.1	0.1
Jackson turbidity	JTU		10	5	5	15	5	10	5	5	10
Parameter	**Unit**	**ANZECC**	**Tedbury Creek, behind Pennant Hills High School**								
			07/12/1992	16/09/1992	09/09/1992	02/09/1992	12/08/1992	29/07/1992	24/06/1992	09/06/1992	28/05/1992

DO	mg/L						12			12	
Temp	oC			13	12	14					
pH	pH	6.5-7.5	7	6	7	7	7	7	7	7	6
CFU	CFU/100ml				630	220	120	120	7	42	
Total phosphrous	mg/L	0.02	0	0.75	0.5	0.25	0.25	0.25	0.25	0	0.25
BOD	mg/L		0	0	8	0	1	1	3	2	1
TDS	mg/L				210	6	230	350	330	320	235
Nitrate	mg/L	0.015	0.1	0.4	0.1	0.1	0.1	0.5	0.3	0.2	0.1
Jackson turbidity	JTU		60	15	40		5	5	5	5	5

DO = dissolved oxygen, EC = electrical conductivity, CFU = colony forming units, BOD = biological oxygen demand, TDS = total dissolved solids, Total suspened solids.

exceedance of ANZECC 2000 guideline values for upland rivers / 95% protection levels

* = value for lowland river

Analytes	Unit	ANZECC guidelines	BH001	BH002	BH004	BH006	BH008	BH012	BH014	BH018	BH021	BH023	BH025
Date			29/07/13	29/07/13	29/07/13	30/07/13	30/07/13	29/07/13	29/07/13	30/07/13	30/07/13	30/07/13	30/07/13
Field parameters													
Temperature	˚C	-	18.1	19.2	19			18.8	18.7	17.8	18.2	18.8	19
Dissolved oxygen	mg/L	-	1.51	3.58	3.41			1.18	1.98	2.5	6.4	1.8	0.87
Electrical conductivity	µS/cm	125-2200	1113	1487	2216			1211	1380	1740	1820	895	4050
pH	pH units	6.5-7.5*	5.2	5.5	5.9			5.4	5.6	7.8	11.7	6.1	3.4
Oxidation reduction potential	mV	-	179	245	203			217	202	34	-79	90	376
Laboratory Electrical conductivity	µS/cm	125-2200	1380	1800	2710	4420	3310	1290	1480	2230	1680	1060	4850
Alkalinity													
Bicarbonate	mg/L	-	213	345	1120	309	455	315	192	63	<1	160	<1
Cations & anions													
Sulphate	mg/L	-	229	345	1120			146	81	221	135	76	68
Chloride	mg/L	-	112	279	163			90	282	346	186	167	1320
Calcium	mg/L	-	13	168	126			30	61	5	1	18	3
Magnesium	mg/L	-	10	51	297			11	27	25	<1	13	88
Sodium	mg/L	-	225	14	6			230	203	440	242	160	676
Potassium	mg/L	-	8	280	368			28	16	49	63	8	6
Dissolved metals													
Arsenic	mg/L	0.013	<0.001	<0.001	0.002	0.001	<0.001	0.001	<0.001	0.018	0.004	<0.001	0.001
Cadmium	mg/L	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0003
Chromium	mg/L	0.001	<0.001	0.07	0.007	<0.001	<0.001	<0.001	<0.001	0.057	0.077	<0.001	0.001
Copper	mg/L	0.0014	<0.001	0.003	0.009	0.001	0.006	0.002	0.001	0.003	0.003	<0.001	0.061
Nickel	mg/L	0.011	0.032	0.102	0.114	0.026	0.018	0.082	0.091	0.029	<0.001	0.04	0.055
Lead	mg/L	0.0034	<0.001	<0.001	<0.001	<0.001	<0.001	0.004	<0.001	<0.001	<0.001	<0.001	0.003
Zinc	mg/L	0.008	0.036	0.106	0.098	0.031	0.053	0.03	0.017	<0.005	<0.005	0.02	0.097
Mercury	mg/L	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Ferrous Iron	mg/L	-		<0.05							<0.05	<0.05	
Nutrients													
Kjedldahl Nitrogen Total	mg/L	-		0.9							0.9	17.8	
Nitrate (as N)	mg/L	0.015*		1							0.9	17.8	
Nitrite (as N)	mg/L	0.015*		0.13							0.02	<0.01	

Analytes	Unit	ANZECC guidelines	BH001	BH002	BH004	BH006	BH008	BH012	BH014	BH018	BH021	BH023	BH025
Ferric Iron	mg/L	-	213	345	1120	309	455	315	192	63	<1	160	<1
TPH													
TRH C6-C10 less BTEX	µg/L	-								**70**			
TRH>C10-C16	µg/L	-		<100					<100	<100			
TRH>C16-C34	µg/L	-		**330**					**420**	<100			
TRH>C34-C40	µg/L	-		<100					<100	<100			
MAH													
Monocylclic Aromatic Hydrocarbons	µg/L	-								<5			
PCB													
PCBs	µg/L	-		<1					<1	<1			
BTEX		-											
Benzene	µg/L	-		<1					<1	<1			
Ethylbenzene	µg/L	-		<2					<2	<2			
Toluene	µg/L	-		<2					<2	<2			
Total Xylene	µg/L	-		<2					<2	<2			
PAHs													
Acenaphthane	µg/L	-		<1					<1	<1			
Acenaphthylene	µg/L	-		<1					<1	<1			
Anthracene	µg/L	-		<1					<1	<1			
Benz(a)anthracene	µg/L	-		<1					<1	<1			
Benzo(b)&(k)fluoranthene	µg/L	-		<1					<1	<1			
Benso(b)fluororanthene	µg/L	-		<1					<1	<1			
Benzo(g,h,l)perylene	µg/L	-		<1					<1	<1			
Benzo(k)fluoranthene	µg/L	-		<1					<1	<1			
Chrysene	µg/L	-		<1					<1	<1			
Diberz(a,h)anthracene	µg/L	-		<1					<1	<1			
Fluoranthene	µg/L	-		<1					<1	<1			
Fluorene	µg/L	-		<0.5					<0.5	<0.5			
Indeno(1,2,3-c,d)pyrene	µg/L	-		<1					<1	<1			
Napthelene	µg/L	-		<1					<1	<1			
Phenanthene	µg/L	-		<1					<1	<1			

Analytes	Unit	ANZECC guidelines	BH001	BH002	BH004	BH006	BH008	BH012	BH014	BH018	BH021	BH023	BH025
PAHs (Sum of Total)	µg/L	-		<0.5					<0.5	<0.5			
Pesticides													
OCPs	µg/L	-		<0.5					<0.5	<0.5			
"Ops	µg/L	-		<0.5					<0.5	<0.5			

ANZECC 2000 guidelines - 95% protection for freshwater species

* = guideline value for upland/lowland rivers

Bold = significant result

Site ID	Groundwater levels (mAHD)					
	24/07/2013	26/07/2013	7/08/2013	2/10/2013	15/10/2013	24/10/2013
BH001	120.68	124.67	124.58	123.68	123.28	123.28
BH002	121.36	112.78	117.42	117.42	116.92	116.72
BH003						127.68
BH004	132.52	122.35	130.27	132.37	133.57	133.27
BH005	148.79	128.2	142.49	143.69	143.29	143.19
BH006	150.4	121.07	124.5	119.8	118.6	120.4
BH008	177.16		136.26	131.66	134.66	
BH012	141.08	139.52	139.81	139.91	139.61	139.71
BH014	138.49	138.21	137.99	138.09	138.69	137.79
BH016					162.08	163.48
BH018	151.33	150.55	150.63	150.83	150.43	150.63
BH021	158.42	147.93	147.72	147.52	147.02	147.62
BH023	182.26	174.2	179.01	179.11	178.71	178.81
BH025						178.54
BH101	187.26	187.52	187.46	187.16	186.66	186.76
BH103					115.45	105.45
BH103A					131.89	121.69
BH104					121.63	118.23
BH111					140.66	135.26
BH112					172.47	148.87
BH114					182.31	172.01
BH116						145.54

"This page has been intentionally left blank"

Appendix B Baseline surface water monitoring data

Analytes	LOR	UNITS	ANZECC guidelines	SW01 - surface water						
Date				22/08/14	19/09/14	16/10/14	06/11/14	17/11/14	02/12/14	15/12/14
Sampling method				Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable
Field parameters										
Temperature	0.1	oC	-	14.2	11.8	15.5	17.3	17.1	20.2	19.7
Dissolved oxygen	0.1	mg/L	-	40.4	10.6	26.88	13.16	5.02	13.44	23.9
Electrical conductivty	0.1	uS/cm	125-2200	517	1027	871	535.5	591	279.4	839
pH	0.01	pH units	6.5-7.5*	7.19	7.25	8.27	8.34	8.15	8.01	7.76
Oxidation reduction potential	0.1	mV	-	232.4	197	70.6	111.1		104.5	70
Laboratory results										
Alkalinity										
Hydroxide alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1	<1	<1	<1
Carbonate alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1	<1	<1	<1
Bicarbonate alkalinity as CaCO3	1	mg/L	-	63	158	89	90	99	56	129
Total alkalinity as CaCO3	1	mg/L	-	63	158	89	90	99	56	129
Cations & anions										
Sulfate	1	mg/L	-	35	103	41	28	<1	14	66
Chloride	1	mg/L	-	99	169	160	62	84	35	132
Calcium	1	mg/L	-	26	47	31	24	33	15	49
Magnesium	1	mg/L	-	7	17	9	6	8	3	14
Sodium	1	mg/L	-	64	158	112	49	63	23	105
Potassium	1	mg/L	-	5	10	7	7	7	3	8
Dissolved metals										
Arsenic	0.001	mg/L	0.013	<0.001	<0.001	0.001	0.001	0.001	<0.001	<0.001
Cadmium	0.0001	mg/L	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	<0.0001	<0.0001
Chromium	0.001	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	0.001	mg/L	0.0014	0.006	0.007	0.007	0.019	0.016	0.011	0.006
Lead	0.001	mg/L	0.0034	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	0.001	mg/L	0.011	0.002	0.002	0.002	0.003	0.004	0.002	0.002
Zinc	0.005	mg/L	0.008	0.053	0.027	0.035	0.117	0.14	0.046	0.037

Analytes	LOR	UNITS	ANZECC guidelines	SW01 - surface water						
Manganese	0.001	mg/L	1.9		0.204	0.134	0.181	0.106	0.037	0.139
Iron	0.05	mg/L	ID	0.09	0.05	0.12	<0.05	0.05	0.11	0.1
Nutrients										
Ammonia as N	0.01	mg/L	0.013*	0.13	0.1	0.08	<0.01	<0.01	0.03	0.07
Nitrite as N	0.01	mg/L	0.015*	0.05	0.04	0.02	0.04	<0.01	<0.01	0.02
Nitrate as N	0.01	mg/L	0.015*	1.28	0.97	1.5	0.42	0.26	0.41	0.77
Nitrite + nitrate	0.01	mg/L	-	1.33	1.01	1.52	0.46	0.26	0.41	0.79
Total phosphorous as P	0.01	mg/L	0.02*	0.09	0.07	0.06	0.3	0.21	0.11	0.06
Reactive phosphorous	0.01	mg/L	-	0.04	0.05	0.01	0.07	0.08	0.06	0.03
Ionic balance										
Total anions	0.01	meq/L	-	4.78	10.1	7.15	4.13	4.53	2.4	7.68
Total cations	0.01	meq/L	-	4.79	10.9	7.34	4	5.22	2.07	8.37
Ionic balance	0.01	%	-	0.05	3.83	1.33	1.58	7.36	1.16	4.32
Total petroleum hydrocarbons										
C6 - C9 fraction	20	µg/L	-	<20	<20	<20	<20	<20	<20	<20
C10 - C14 fraction	50	µg/L	-	<50	<50	<50	<50	<50	<50	<50
C15 - C28 fraction	100	µg/L	-	<100	<100	<100	**250**	<100	<100	<100
C29 - C36 fraction	50	µg/L	-	<50	<50	<50	**120**	<50	<50	<50
C10 - C36 fraction sum	50	µg/L	-	<50	<50	<50	**370**	<50	<50	<50
Total recoverable hydrocarbons										
C6 - C10 fraction	20	µg/L	-	<20	<20	<20	<20	<20	<20	<20
C6 - C10 fraction minus BTEX	20	µg/L	-	<20	<20	<20	<20	<20	<20	<20
>C10 - C16 fraction	100	µg/L	-	<100	<100	<100	<100	<100	<100	<100
>C16 - C34 fraction	100	µg/L	-	<100	<100	<100	**320**	<100	<100	<100
>C34 - C40 fraction	100	µg/L	-	<100	<100	<100	<100	<100	<100	<100
>C10 - C40 fraction sum	100	µg/L	-	<100	<100	<100	**320**	<100	<100	<100
>C10 - C16 fraction minus apthalene	100	µg/L	-	<100	<100	<100	<100	<100	<100	<100
BTEXN										
Benzene	1	µg/L	950	<1	<1	<1	<1	<1	<1	<1
Toluene	2	µg/L	ID	<2	<2	<2	<2	<2	<2	<2
Ethylbenzene	2	µg/L	ID	<2	<2	<2	<2	<2	<2	<2

Analytes	LOR	UNITS	ANZECC guidelines	SW01 - surface water						
meta-xylene	2	µg/L	ID	<2	<2	<2	<2	<2	<2	<2
ortho-xylene	2	µg/L	350	<2	<2	<2	<2	<2	<2	<2
Total xylenes	2	µg/L	ID	<2	<2	<2	<2	<2	<2	<2
Sum of BTEX	1	µg/L	-	<1	<1	<1	<1	<1	<1	<1
Naphthalene	5	µg/L	16	<5	<5	<5	<5	<5	<5	<5

ANZECC 2000 guidelines - 95% protection for freshwater species

* = guideline value for lowland rivers

ID = insifficent data to create value

Bold = significant result

Analytes	LOR	UNITS	ANZECC guidelines	SW02 - surface water						
Date				22/08/14	19/09/14	16/10/14	06/11/14	17/11/14	02/12/14	15/12/14
Sampling method				Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable
Field parameters										
Temperature	0.1	oC	-	14.8	12.7	16.2	18.4	19.1	20.1	20.1
Dissolved oxygen	0.1	mg/L	-	13.97	10.1	10.14	13.76	17.83	13.3	15.5
Electrical conductivty	0.1	uS/cm	125-2200	319	396	459.7	292.7	279	149.3	451.2
pH	0.01	pH units	6.5-7.5*	7.26	7.56	8.17	8.29	8.27	7.84	8.14
Oxidation reduction potential	0.1	mV	-	177.1	201	-18.2	-65.1	-38.8	101	-75.3
Laboratory results										
Alkalinity										
Hydroxide alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1	<1	<1	<1
Carbonate alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1	<1	<1	<1
Bicarbonate alkalinity as CaCO3	1	mg/L	-	50	77	54	83	67	34	101
Total alkalinity as CaCO3	1	mg/L	-	50	77	54	83	67	34	101
Cations & anions										
Sulfate	1	mg/L	-	23	13	27	<10	<1	5	8
Chloride	1	mg/L	-	46	62	67	26	37	7	66
Calcium	1	mg/L	-	20	24	23	22	26	10	38
Magnesium	1	mg/L	-	6	8	7	6	6	2	10
Sodium	1	mg/L	-	32	37	36	17	17	6	41
Potassium	1	mg/L	-	2	3	3	4	4	3	4
Dissolved metals										
Arsenic	0.001	mg/L	0.013	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Cadmium	0.0001	mg/L	0.0002	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	0.001	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	0.001	mg/L	0.0014	0.004	0.002	0.002	0.002	0.002	0.007	0.004
Lead	0.001	mg/L	0.0034	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001
Nickel	0.001	mg/L	0.011	<0.001	<0.001	0.001	0.001	0.001	0.001	0.001
Zinc	0.005	mg/L	0.008	0.045	0.03	0.048	0.056	0.021	0.039	0.018

Analytes	LOR	UNITS	ANZECC guidelines	SW02 - surface water						
Manganese	0.001	mg/L	1.9		0.193	0.054	0.27	0.241	0.034	0.277
Iron	0.05	mg/L	ID	0.2	0.06	0.3	2.15	2.06	0.35	1.33
Nutrients										
Ammonia as N	0.01	mg/L	0.013*	0.05	0.14	0.07	0.07	0.08	<0.01	0.16
Nitrite as N	0.01	mg/L	0.015*	0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01
Nitrate as N	0.01	mg/L	0.015*	0.6	0.01	0.7	<0.01	<0.01	0.08	0.02
Nitrite + nitrate	0.01	mg/L	-	0.61	0.01	0.71	<0.01	<0.01	0.08	0.03
Total phosphorous as P	0.01	mg/L	0.02*	0.03	0.35	0.03	0.36	0.28	0.09	0.23
Reactive phosphorous	0.01	mg/L	-	<0.01	0.03	<0.01	0.09	0.08	0.03	0.03
Ionic balance										
Total anions	0.01	meq/L	-	2.78	3.56	3.53	2.39	2.38	0.98	4.05
Total cations	0.01	meq/L	-	2.93	3.54	3.37	2.43	2.63	1	4.6
Ionic balance	0.01	%	-	-	0.22	2.38			0.98	6.47
Total petroleum hydrocarbons										
C6 - C9 fraction	20	µg/L	-	<20	<20	<20	<20	<20	<20	<20
C10 - C14 fraction	50	µg/L	-	<50	<50	<50	<50	<50	<50	<50
C15 - C28 fraction	100	µg/L	-	<100	<100	<100	<100	<100	<100	<100
C29 - C36 fraction	50	µg/L	-	<50	<50	<50	<50	<50	<50	<50
C10 - C36 fraction sum	50	µg/L	-	<50	<50	<50	<50	<50	<50	<50
Total recoverable hydrocarbons										
C6 - C10 fraction	20	µg/L	-	<20	<20	<20	<20	<20	<20	<20
C6 - C10 fraction minus BTEX	20	µg/L	-	<20	<20	<20	<20	<20	<20	<20
>C10 - C16 fraction	100	µg/L	-	<100	<100	<100	<100	<100	<100	<100
>C16 - C34 fraction	100	µg/L	-	<100	<100	<100	<100	<100	<100	<100
>C34 - C40 fraction	100	µg/L	-	<100	<100	<100	<100	<100	<100	<100
>C10 - C40 fraction sum	100	µg/L	-	<100	<100	<100	<100	<100	<100	<100
>C10 - C16 fraction minus apthalene	100	µg/L	-	<100	<100	<100	<100	<100	<100	<100
BTEXN										
Benzene	1	µg/L	950	<1	<1	<1	<1	<1	<1	<1
Toluene	2	µg/L	ID	<2	<2	<2	<2	<2	<2	<2
Ethylbenzene	2	µg/L	ID	<2	<2	<2	<2	<2	<2	<2

Analytes	LOR	UNITS	ANZECC guidelines	SW02 - surface water						
meta-xylene	2	µg/L	ID	<2	<2	<2	<2	<2	<2	<2
ortho-xylene	2	µg/L	350	<2	<2	<2	<2	<2	<2	<2
Total xylenes	2	µg/L	ID	<2	<2	<2	<2	<2	<2	<2
Sum of BTEX	1	µg/L	-	<1	<1	<1	<1	<1	<1	<1
Naphthalene	5	µg/L	16	<5	<5	<5	<5	<5	<5	<5

ANZECC 2000 guidelines - 95% protection for freshwater species

* = guideline value for lowland rivers

ID = insifficent data to create value

Bold = significant result

Analytes	LOR	UNITS	ANZECC guidelines	SW03 - surface water						
Date				22/08/14	19/09/14	16/10/14	06/11/14	17/11/14	02/12/14	15/12/14
Sampling method				Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable
Field parameters										
Temperature	0.1	oC	-	14.1	12.8	15.2	20	22.2	20.8	19.6
Dissolved oxygen	0.1	mg/L	-	20.1	10.05	13.31	15.45	9.79	7.96	13.57
Electrical conductivty	0.1	uS/cm	125-2200	381.8	791	620	557	526.5	251.3	692
pH	0.01	pH units	6.5-7.5*	7.48	7.67	7.86	7.9	8.16	7.91	7.63
Oxidation reduction potential	0.1	mV	-	164.7	196	38.4	-65.7	63.9	104.7	-47.3
Laboratory results										
Alkalinity										
Hydroxide alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1	<1	<1	<1
Carbonate alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1	<1	<1	<1
Bicarbonate alkalinity as CaCO3	1	mg/L	-	46	74	63	83	92	54	75
Total alkalinity as CaCO3	1	mg/L	-	46	74	63	83	92	54	75
Cations & anions										
Sulfate	1	mg/L	-	38	38	36	21	<1	16	38
Chloride	1	mg/L	-	64	175	98	81	76	33	138
Calcium	1	mg/L	-	24	35	32	24	28	17	41
Magnesium	1	mg/L	-	7	13	9	8	7	3	12
Sodium	1	mg/L	-	41	95	56	51	54	18	80
Potassium	1	mg/L	-	4	6	6	6	6	5	6
Dissolved metals										
Arsenic	0.001	mg/L	0.013	<0.001	<0.001	0.001	<0.001	0.001	<0.001	<0.001
Cadmium	0.0001	mg/L	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	0.001	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	0.001	mg/L	0.0014	0.005	0.002	0.003	0.01	0.009	0.008	0.003
Lead	0.001	mg/L	0.0034	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	<0.001
Nickel	0.001	mg/L	0.011	0.001	<0.001	0.002	0.002	0.002	0.002	0.003
Zinc	0.005	mg/L	0.008	0.041	0.018	0.033	0.044	0.023	0.036	0.04

Analytes	LOR	UNITS	ANZECC guidelines	SW03 - surface water						
Manganese	0.001	mg/L	1.9		0.194	0.08	0.209	0.171	0.04	0.16
Iron	0.05	mg/L	ID	0.21	<0.05	0.19	1.71	0.37	0.24	0.25
Nutrients										
Ammonia as N	0.01	mg/L	0.013*	0.02	0.17	0.1	0.55	1.85	0.03	0.09
Nitrite as N	0.01	mg/L	0.015*	<0.01	<0.01	0.02	<0.01	0.02	<0.01	<0.01
Nitrate as N	0.01	mg/L	0.015*	1.91	0.08	2.51	0.08	0.09	0.53	0.24
Nitrite + nitrate	0.01	mg/L	-	1.91	0.08	2.53	0.08	0.11	0.53	0.24
Total phosphorous as P	0.01	mg/L	0.02*	0.05	0.36	0.1	0.46	0.96	0.2	0.14
Reactive phosphorous	0.01	mg/L	-	0.02	0.05	0.02	0.2	0.4	0.12	0.06
Ionic balance										
Total anions	0.01	meq/L	-	3.52	7.21	4.77	4.38	4.12	2.34	6.18
Total cations	0.01	meq/L	-	3.66	7.1	4.93	4.23	4.48	2.01	6.67
Ionic balance	0.01	%	-	2.01	0.73	1.6	1.77	4.19	1.16	3.78
Total petroleum hydrocarbons										
C6 - C9 fraction	20	µg/L	-	<20	<20	<20	**20**	<20	<20	<20
C10 - C14 fraction	50	µg/L	-	<50	<50	<50	<50	**80**	<50	<50
C15 - C28 fraction	100	µg/L	-	<100	<100	<100	<100	**630**	<100	<100
C29 - C36 fraction	50	µg/L	-	<50	<50	<50	<50	**230**	<50	<50
C10 - C36 fraction sum	50	µg/L	-	<50	<50	<50	<50	**940**	<50	<50
Total recoverable hydrocarbons										
C6 - C10 fraction	20	µg/L	-	<20	<20	<20	**30**	<20	<20	<20
C6 - C10 fraction minus BTEX	20	µg/L	-	<20	<20	<20	**30**	<20	<20	<20
>C10 - C16 fraction	100	µg/L	-	<100	<100	<100	<100	**120**	<100	<100
>C16 - C34 fraction	100	µg/L	-	<100	<100	<100	<100	**740**	<100	<100
>C34 - C40 fraction	100	µg/L	-	<100	<100	<100	<100	<100	<100	<100
>C10 - C40 fraction sum	100	µg/L	-	<100	<100	<100	<100	**860**	<100	<100
>C10 - C16 fraction minus apthalene	100	µg/L	-	<100	<100	<100	<100	**120**	<100	<100
BTEXN										
Benzene	1	µg/L	950	<1	<1	<1	<1	<1	<1	<1
Toluene	2	µg/L	ID	<2	<2	<2	**3**	**6**	<2	<2
Ethylbenzene	2	µg/L	ID	<2	<2	<2	<2	<2	<2	<2

Analytes	LOR	UNITS	ANZECC guidelines	SW03 - surface water						
meta-xylene	2	µg/L	ID	<2	<2	<2	<2	<2	<2	<2
ortho-xylene	2	µg/L	350	<2	<2	<2	<2	<2	<2	<2
Total xylenes	2	µg/L	ID	<2	<2	<2	<2	<2	<2	<2
Sum of BTEX	1	µg/L	-	<1	<1	<1	**3**	**6**	<1	<1
Naphthalene	5	µg/L	16	<5	<5	<5	<5	<5	<5	<5

ANZECC 2000 guidelines - 95% protection for freshwater species

* = guideline value for lowland rivers

ID = insifficent data to create value

Bold = significant result

Analytes	LOR	UNITS	ANZECC guidelines	SW04 - surface water						
Date				22/08/14	19/09/14	16/10/14	06/11/14	17/11/14	02/12/14	15/12/14
Sampling method				Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable
Field parameters										
Temperature	0.1	oC	-	14.3	12.6	15.6	16.6	17.6	24	20
Dissolved oxygen	0.1	mg/L	-	19.7	10.08	19.16	6.03	11.05	10.81	21.57
Electrical conductivty	0.1	uS/cm	125-2200	434.6	600	674	624	543	205.9	489.7
pH	0.01	pH units	6.5-7.5*	4.6	6.58	7.93	8.14	8.16	7.97	7.94
Oxidation reduction potential	0.1	mV	-	160.5	192	39.7	-3.1	-59.2	81.2	9.1
Laboratory results										
Alkalinity										
Hydroxide alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1	<1	<1	<1
Carbonate alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1	<1	<1	<1
Bicarbonate alkalinity as CaCO3	1	mg/L	-	40	49	44	39	46	50	68
Total alkalinity as CaCO3	1	mg/L	-	40	49	44	39	46	50	68
Cations & anions										
Sulfate	1	mg/L	-	29	24	31	18	<1	10	22
Chloride	1	mg/L	-	94	142	140	143	137	29	110
Calcium	1	mg/L	-	22	20	24	16	22	15	32
Magnesium	1	mg/L	-	6	9	9	7	8	3	10
Sodium	1	mg/L	-	56	74	76	80	70	14	72
Potassium	1	mg/L	-	4	1	2	6	7	2	2
Dissolved metals										
Arsenic	0.001	mg/L	0.013	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001
Cadmium	0.0001	mg/L	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	0.001	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	0.001	mg/L	0.0014	0.005	0.002	0.002	0.002	0.002	0.006	0.005
Lead	0.001	mg/L	0.0034	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	0.001	mg/L	0.011	0.001	0.003	0.002	0.004	0.005	0.002	0.002
Zinc	0.005	mg/L	0.008	0.023	0.056	0.07	0.04	0.028	0.031	0.031

Analytes	LOR	UNITS	ANZECC guidelines	SW04 - surface water						
Manganese	0.001	mg/L	1.9		0.084	0.054	0.34	0.254	0.008	0.025
Iron	0.05	mg/L	ID	0.2	0.06	0.11	<0.05	0.07	0.12	<0.05
Nutrients										
Ammonia as N	0.01	mg/L	0.013*	0.02	0.02	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrite as N	0.01	mg/L	0.015*	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate as N	0.01	mg/L	0.015*	0.86	0.41	0.15	<0.01	<0.01	0.12	0.09
Nitrite + nitrate	0.01	mg/L	-	0.86	0.41	0.15	<0.01	<0.01	0.12	0.09
Total phosphorous as P	0.01	mg/L	0.02*	0.05	0.16	0.1	0.43	0.68	0.04	0.04
Reactive phosphorous	0.01	mg/L	-	0.01	<0.01	<0.01	0.36	0.54	0.01	0.01
Ionic balance										
Total anions	0.01	meq/L	-	4.05	5.48	5.47	5.19	4.78	2.03	4.92
Total cations	0.01	meq/L	-	4.13	4.98	5.3	5.01	4.98	1.66	5.6
Ionic balance	0.01	%	-	0.92	4.79	1.66	1.77	2.02	1.22	6.49
Total petroleum hydrocarbons										
C6 - C9 fraction	20	µg/L	-	<20	<20	<20	<20	<20	<20	<20
C10 - C14 fraction	50	µg/L	-	<50	<50	<50	**70**	**410**	<50	<50
C15 - C28 fraction	100	µg/L	-	<100	<100	<100	**150**	**720**	<100	<100
C29 - C36 fraction	50	µg/L	-	<50	<50	<50	<50	<50	<50	<50
C10 - C36 fraction sum	50	µg/L	-	<50	<50	<50	**220**	**1130**	<50	<50
Total recoverable hydrocarbons										
C6 - C10 fraction	20	µg/L	-	<20	<20	<20	<20	<20	<20	<20
C6 - C10 fraction minus BTEX	20	µg/L	-	<20	<20	<20	<20	<20	<20	<20
>C10 - C16 fraction	100	µg/L	-	<100	<100	<100	<100	**480**	<100	<100
>C16 - C34 fraction	100	µg/L	-	<100	<100	<100	**130**	**630**	<100	<100
>C34 - C40 fraction	100	µg/L	-	<100	<100	<100	<100	<100	<100	<100
>C10 - C40 fraction sum	100	µg/L	-	<100	<100	<100	**130**	**1110**	<100	<100
>C10 - C16 fraction minus apthalene	100	µg/L	-	<100	<100	<100	<100	**480**	<100	<100
BTEXN										
Benzene	1	µg/L	950	<1	<1	<1	<1	<1	<1	<1
Toluene	2	µg/L	ID	<2	<2	<2	<2	<2	<2	<2
Ethylbenzene	2	µg/L	ID	<2	<2	<2	<2	<2	<2	<2

Analytes	LOR	UNITS	ANZECC guidelines	SW04 - surface water						
meta-xylene	2	µg/L	ID	<2	<2	<2	<2	<2	<2	<2
ortho-xylene	2	µg/L	350	<2	<2	<2	<2	<2	<2	<2
Total xylenes	2	µg/L	ID	<2	<2	<2	<2	<2	<2	<2
Sum of BTEX	1	µg/L	-	<1	<1	<1	<1	<1	<1	<1
Naphthalene	5	µg/L	16	<5	<5	<5	<5	<5	<5	<5

ANZECC 2000 guidelines - 95% protection for freshwater species
* = guideline value for lowland rivers
ID = insifficent data to create value
Bold = significant result

Analytes	LOR	UNITS	ANZECC guidelines	SW05 - surface water						
Date				22/08/14	19/09/14	16/10/14	06/11/14	17/11/14	02/12/14	15/12/14
Sampling method				Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable
Field parameters										
Temperature	0.1	oC	-	14.1	13.5	15.7	17.4	18.1	22	19.1
Dissolved oxygen	0.1	mg/L	-	23.1	9.02	16.43	15.17	16.05	8.02	24.74
Electrical conductivty	0.1	uS/cm	125-2200	390.2	572	469.9	296.9	317.3	254.7	553
pH	0.01	pH units	6.5-7.5*	7.64	7.51	8.04	8.16	8.11	7.81	8.13
Oxidation reduction potential	0.1	mV	-	171.2	196	55.4	94.6	57.4	89.9	18.2
Laboratory results										
Alkalinity										
Hydroxide alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1	<1	<1	<1
Carbonate alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1	<1	<1	<1
Bicarbonate alkalinity as CaCO3	1	mg/L	-	44	60	48	49	42	30	55
Total alkalinity as CaCO3	1	mg/L	-	44	60	48	49	42	30	55
Cations & anions										
Sulfate	1	mg/L	-	41	44	30	14	<1	6	38
Chloride	1	mg/L	-	71	105	72	39	55	24	88
Calcium	1	mg/L	-	24	29	26	16	20	9	38
Magnesium	1	mg/L	-	5	7	6	4	5	2	8
Sodium	1	mg/L	-	48	60	38	25	28	10	53
Potassium	1	mg/L	-	5	4	4	5	4	3	5
Dissolved metals										
Arsenic	0.001	mg/L	0.013	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002
Cadmium	0.0001	mg/L	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001
Chromium	0.001	mg/L	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	0.001	mg/L	0.0014	0.005	0.003	0.004	0.011	0.007	0.008	0.009
Lead	0.001	mg/L	0.0034	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001
Nickel	0.001	mg/L	0.011	<0.001	<0.001	0.002	0.002	0.002	0.001	0.002
Zinc	0.005	mg/L	0.008	0.038	0.034	0.052	0.05	0.042	0.031	0.054

Analytes	LOR	UNITS	ANZECC guidelines	SW05 - surface water						
Manganese	0.001	mg/L	1.9		0.024	0.011	0.042	0.07	0.012	0.027
Iron	0.05	mg/L	ID	0.16	<0.05	0.17	0.21	0.35	0.11	0.15
Nutrients										
Ammonia as N	0.01	mg/L	0.013*	0.08	0.03	0.02	<0.01	<0.01	<0.01	0.17
Nitrite as N	0.01	mg/L	0.015*	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	0.02
Nitrate as N	0.01	mg/L	0.015*	1	0.28	0.8	0.22	0.28	0.39	0.35
Nitrite + nitrate	0.01	mg/L	-	1.05	0.28	0.8	0.22	0.28	0.39	0.37
Total phosphorous as P	0.01	mg/L	0.02*	0.04	0.06	0.08	0.08	0.09	0.1	0.07
Reactive phosphorous	0.01	mg/L	-	0.01	0.01	<0.01	0.01	0.02	0.04	0.02
Ionic balance										
Total anions	0.01	meq/L	-	3.74	5.08	3.61	2.37	2.39	1.4	4.37
Total cations	0.01	meq/L	-	3.82	4.74	3.55	2.34	2.73	1.13	4.99
Ionic balance	0.01	%	-	1.18	3.48	0.94			1.24	6.59
Total petroleum hydrocarbons										
C6 - C9 fraction	20	µg/L	-	<20	<20	<20	<20	<20	<20	<20
C10 - C14 fraction	50	µg/L	-	<50	<50	<50	<50	<50	<50	<50
C15 - C28 fraction	100	µg/L	-	<100	<100	<100	<100	<100	<100	<100
C29 - C36 fraction	50	µg/L	-	<50	<50	<50	<50	<50	<50	<50
C10 - C36 fraction sum	50	µg/L	-	<50	<50	<50	<50	<50	<50	<50
Total recoverable hydrocarbons										
C6 - C10 fraction	20	µg/L	-	<20	<20	<20	<20	<20	<20	<20
C6 - C10 fraction minus BTEX	20	µg/L	-	<20	<20	<20	<20	<20	<20	<20
>C10 - C16 fraction	100	µg/L	-	<100	<100	<100	<100	<100	<100	<100
>C16 - C34 fraction	100	µg/L	-	<100	<100	<100	<100	<100	<100	<100
>C34 - C40 fraction	100	µg/L	-	<100	<100	<100	<100	<100	<100	<100
>C10 - C40 fraction sum	100	µg/L	-	<100	<100	<100	<100	<100	<100	<100
>C10 - C16 fraction minus apthalene	100	µg/L	-	<100	<100	<100	<100	<100	<100	<100
BTEXN										
Benzene	1	µg/L	950	<1	<1	<1	<1	<1	<1	<1
Toluene	2	µg/L	ID	<2	<2	<2	<2	<2	<2	<2
Ethylbenzene	2	µg/L	ID	<2	<2	<2	<2	<2	<2	<2

Analytes	LOR	UNITS	ANZECC guidelines	SW05 - surface water						
meta-xylene	2	µg/L	ID	<2	<2	<2	<2	<2	<2	<2
ortho-xylene	2	µg/L	350	<2	<2	<2	<2	<2	<2	<2
Total xylenes	2	µg/L	ID	<2	<2	<2	<2	<2	<2	<2
Sum of BTEX	1	µg/L	-	<2	<1	<1	<1	<1	<1	<1
Naphthalene	5	µg/L	16	<5	<5	<5	<5	<5	<5	<5

ANZECC 2000 guidelines - 95% protection for freshwater species

* = guideline value for lowland rivers

ID = insifficent data to create value

Bold = significant result

Analytes	LOR	UNITS	ANZECC guidelines	SW06 - surface water					
Date				18/09/14	16/10/14	06/11/14	17/11/14	02/12/14	15/12/14
Sampling method				Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable
Field parameters									
Temperature	0.1	oC	-	12.5	12.8	16.8	17.3	21.8	18.9
Dissolved oxygen	0.1	mg/L	-	9.9	15.7	16.32	13.5	8.22	42.98
Electrical conductivty	0.1	uS/cm	125-2200	245	534.8	497	286.7	131.3	591
pH	0.01	pH units	6.5-7.5*	8.12	9.29	8.57	8.52	7.87	7.88
Oxidation reduction potential	0.1	mV	-	149.6	33.2	134.6	131.6	68.6	56
Laboratory results									
Alkalinity									
Hydroxide alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1	<1	<1
Carbonate alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1	<1	<1
Bicarbonate alkalinity as CaCO3	1	mg/L	-	96	60	63	44	32	75
Total alkalinity as CaCO3	1	mg/L	-	96	60	63	44	32	75
Cations & anions									
Sulfate	1	mg/L	-	42	28	18	<1	4	36
Chloride	1	mg/L	-	132	83	90	46	22	111
Calcium	1	mg/L	-	30	22	17	16	8	35
Magnesium	1	mg/L	-	12	7	5	4	2	12
Sodium	1	mg/L	-	82	52	61	29	10	76
Potassium	1	mg/L	-	6	4	6	4	2	6
Dissolved metals									
Arsenic	0.001	mg/L	0.013	<0.001	<0.001	<0.001	<0.001	<0.001	0.002
Cadmium	0.0001	mg/L	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001
Chromium	0.001	mg/L	0.001	<0.001	0.003	<0.001	<0.001	<0.001	<0.001
Copper	0.001	mg/L	0.0014	0.003	0.004	0.008	0.007	0.005	0.01
Lead	0.001	mg/L	0.0034	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	0.001	mg/L	0.011	<0.001	0.003	0.002	0.001	<0.001	0.002
Zinc	0.005	mg/L	0.008	0.029	0.026	0.074	0.04	0.024	0.032

Analytes	LOR	UNITS	ANZECC guidelines	SW06 - surface water					
Manganese	0.001	mg/L	1.9	0.036	0.021	0.077	0.086	0.014	0.048
Iron	0.05	mg/L	ID	<0.05	0.15	0.2	0.3	0.17	0.16
Nutrients									
Ammonia as N	0.01	mg/L	0.013*	0.06	<0.01	<0.01	<0.01	0.07	0.04
Nitrite as N	0.01	mg/L	0.015*	<0.01	<0.01	0.03	<0.01	<0.01	<0.01
Nitrate as N	0.01	mg/L	0.015*	0.28	2.37	0.39	0.08	0.16	0.45
Nitrite + nitrate	0.01	mg/L	-	0.28	2.37	0.42	0.08	0.16	0.45
Total phosphorous as P	0.01	mg/L	0.02*	0.02	0.07	0.08	0.09	0.07	0.03
Reactive phosphorous	0.01	mg/L	-	<0.01	<0.01	<0.01	0.02	0.04	0.01
Ionic balance									
Total anions	0.01	meq/L	-	6.52	4.12	4.17	2.18	1.34	5.38
Total cations	0.01	meq/L	-	6.2	4.04	4.07	2.49	1.05	6.19
Ionic balance	0.01	%	-	2.45	1.04	1.29		1.28	7.04
Total petroleum hydrocarbons									
C6 - C9 fraction	20	µg/L	-	<20	<20	<20	<20	<20	<20
C10 - C14 fraction	50	µg/L	-	<50	<50	<50	<50	<50	<50
C15 - C28 fraction	100	µg/L	-	<100	<100	<100	<100	<100	<100
C29 - C36 fraction	50	µg/L	-	<50	<50	<50	<50	<50	<50
C10 - C36 fraction sum	50	µg/L	-	<50	<50	<50	<50	<50	<50
Total recoverable hydrocarbons									
C6 - C10 fraction	20	µg/L	-	<20	<20	<20	<20	<20	<20
C6 - C10 fraction minus BTEX	20	µg/L	-	<20	<20	<20	<20	<20	<20
>C10 - C16 fraction	100	µg/L	-	<100	<100	<100	<100	<100	<100
>C16 - C34 fraction	100	µg/L	-	<100	<100	<100	<100	<100	<100
>C34 - C40 fraction	100	µg/L	-	<100	<100	<100	<100	<100	<100
>C10 - C40 fraction sum	100	µg/L	-	<100	<100	<100	<100	<100	<100
>C10 - C16 fraction minus apthalene	100	µg/L	-	<100	<100	<100	<100	<100	<100
BTEXN									
Benzene	1	µg/L	950	<1	<1	<1	<1	<1	<1
Toluene	2	µg/L	ID	<2	<2	<2	<2	<2	<2
Ethylbenzene	2	µg/L	ID	<2	<2	<2	<2	<2	<2

Analytes	LOR	UNITS	ANZECC guidelines	SW06 - surface water					
meta-xylene	2	µg/L	ID	<2	<2	<2	<2	<2	<2
ortho-xylene	2	µg/L	350	<2	<2	<2	<2	<2	<2
Total xylenes	2	µg/L	ID	<2	<2	<2	<2	<2	<2
Sum of BTEX	1	µg/L	-	<1	<1	<1	<1	<1	<1
Naphthalene	5	µg/L	16	<5	<5	<5	<5	<5	<5

ANZECC 2000 guidelines - 95% protection for freshwater species

* = guideline value for lowland rivers

ID = insifficent data to create value

Bold = significant result

Analytes	LOR	UNITS	ANZECC guidelines	SW07 - surface water					
Date				18/09/14	16/10/14	06/11/14	17/11/14	02/12/14	15/12/14
Sampling method				Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable
Field parameters									
Temperature	0.1	oC	-	14	13.1	16.9	18.3	24.1	19.1
Dissolved oxygen	0.1	mg/L	-	10.04	22.6	30.42	11.15	9.24	75.8
Electrical conductivty	0.1	uS/cm	125-2200	588	433.5	735	452.2	149	564
pH	0.01	pH units	6.5-7.5*	7.89	8.76	8.54	8.45	7.92	7.41
Oxidation reduction potential	0.1	mV	-	204	55.8	93.7	126.6	99.1	79
Laboratory results									
Alkalinity									
Hydroxide alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1	<1	<1
Carbonate alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1	<1	<1
Bicarbonate alkalinity as CaCO3	1	mg/L	-	60	39	66	43	27	52
Total alkalinity as CaCO3	1	mg/L	-	60	39	66	43	27	52
Cations & anions									
Sulfate	1	mg/L	-	31	23	20	<1	4	32
Chloride	1	mg/L	-	128	76	155	90	26	120
Calcium	1	mg/L	-	21	17	24	20	6	30
Magnesium	1	mg/L	-	9	6	9	6	2	11
Sodium	1	mg/L	-	70	41	86	47	12	74
Potassium	1	mg/L	-	4	4	6	4	2	5
Dissolved metals									
Arsenic	0.001	mg/L	0.013	<0.001	<0.001	<0.001	<0.001	<0.001	0.002
Cadmium	0.0001	mg/L	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001
Chromium	0.001	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Copper	0.001	mg/L	0.0014	0.003	0.004	0.004	0.006	0.004	0.012
Lead	0.001	mg/L	0.0034	<0.001	<0.001	0.001	<0.001	<0.001	<0.001
Nickel	0.001	mg/L	0.011	<0.001	0.001	0.001	0.002	<0.001	0.002
Zinc	0.005	mg/L	0.008	0.023	0.02	0.022	0.014	0.013	0.026

Analytes	LOR	UNITS	ANZECC guidelines	SW07 - surface water					
Manganese	0.001	mg/L	1.9	0.018	0.015	0.028	0.016	0.006	0.026
Iron	0.05	mg/L	ID	0.05	0.26	0.94	0.19	0.21	0.3
Nutrients									
Ammonia as N	0.01	mg/L	0.013*	<0.01	<0.01	<0.01	<0.01	0.02	<0.01
Nitrite as N	0.01	mg/L	0.015*	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate as N	0.01	mg/L	0.015*	0.15	1.2	0.25	0.38	0.18	0.48
Nitrite + nitrate	0.01	mg/L	-	0.15	1.2	0.25	0.38	0.18	0.48
Total phosphorous as P	0.01	mg/L	0.02*	<0.01	0.03	0.05	0.06	0.05	0.01
Reactive phosphorous	0.01	mg/L	-	<0.01	<0.01	<0.01	<0.01	0.01	<0.01
Ionic balance									
Total anions	0.01	meq/L	-	5.45	3.4	6.11	3.46	1.36	5.09
Total cations	0.01	meq/L	-	4.94	3.27	5.83	3.64	1.04	5.75
Ionic balance	0.01	%	-	5	1.92	2.3	2.48	1.31	6.08
Total petroleum hydrocarbons									
C6 - C9 fraction	20	µg/L	-	<20	<20	<20	<20	<20	<20
C10 - C14 fraction	50	µg/L	-	<50	<50	<50	<50	<50	<50
C15 - C28 fraction	100	µg/L	-	<100	<100	<100	<100	<100	<100
C29 - C36 fraction	50	µg/L	-	<50	<50	<50	<50	<50	<50
C10 - C36 fraction sum	50	µg/L	-	<50	<50	<50	<50	<50	<50
Total recoverable hydrocarbons									
C6 - C10 fraction	20	µg/L	-	<20	<20	<20	<20	<20	<20
C6 - C10 fraction minus BTEX	20	µg/L	-	<20	<20	<20	<20	<20	<20
>C10 - C16 fraction	100	µg/L	-	<100	<100	<100	<100	<100	<100
>C16 - C34 fraction	100	µg/L	-	<100	<100	<100	<100	<100	<100
>C34 - C40 fraction	100	µg/L	-	<100	<100	<100	<100	<100	<100
>C10 - C40 fraction sum	100	µg/L	-	<100	<100	<100	<100	<100	<100
>C10 - C16 fraction minus apthalene	100	µg/L	-	<100	<100	<100	<100	<100	<100
BTEXN									
Benzene	1	µg/L	950	<1	<1	<1	<1	<1	<1
Toluene	2	µg/L	ID	<2	<2	<2	<2	<2	<2
Ethylbenzene	2	µg/L	ID	<2	<2	<2	<2	<2	<2

Analytes	LOR	UNITS	ANZECC guidelines	SW07 - surface water					
meta-xylene	2	µg/L	ID	<2	<2	<2	<2	<2	<2
ortho-xylene	2	µg/L	350	<2	<2	<2	<2	<2	<2
Total xylenes	2	µg/L	ID	<2	<2	<2	<2	<2	<2
Sum of BTEX	1	µg/L	-	<1	<1	<1	<1	<1	<1
Naphthalene	5	µg/L	16	<5	<5	<5	<5	<5	<5

ANZECC 2000 guidelines - 95% protection for freshwater species

* = guideline value for lowland rivers

ID = insifficent data to create value

Bold = significant result

Analytes	LOR	UNITS	ANZECC guidelines	SW08 - surface water					
Date				18/09/14	16/10/14	06/11/14	17/11/14	02/12/14	15/12/14
Sampling method				Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable	Bucket & cable
Field parameters									
Temperature	0.1	oC	-	14.1	13.3	17.2	17.8	23.2	19.5
Dissolved oxygen	0.1	mg/L	-	9.85	16	37.99	31.95	10.99	67.04
Electrical conductivty	0.1	uS/cm	125-2200	374	405.1	748	454	140	550
pH	0.01	pH units	6.5-7.5*	8.25	8.56	8.29	8.32	7.85	8.01
Oxidation reduction potential	0.1	mV	-	202	66.1	98.6	100.1	95.7	78.2
Laboratory results									
Alkalinity									
Hydroxide alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1	<1	<1
Carbonate alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1	<1	<1
Bicarbonate alkalinity as CaCO3	1	mg/L	-	60	38	58	46	28	52
Total alkalinity as CaCO3	1	mg/L	-	60	38	58	46	28	52
Cations & anions									
Sulfate	1	mg/L	-	29	22	17	<1	4	32
Chloride	1	mg/L	-	121	71	162	93	28	114
Calcium	1	mg/L	-	20	16	25	19	7	30
Magnesium	1	mg/L	-	9	6	9	6	2	11
Sodium	1	mg/L	-	68	43	88	48	12	74
Potassium	1	mg/L	-	4	4	6	5	2	5
Dissolved metals									
Arsenic	0.001	mg/L	0.013	<0.001	<0.001	<0.001	<0.001	<0.001	0.002
Cadmium	0.0001	mg/L	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0002
Chromium	0.001	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	0.001	mg/L	0.0014	0.002	0.004	0.004	0.007	0.006	0.012
Lead	0.001	mg/L	0.0034	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Nickel	0.001	mg/L	0.011	<0.001	<0.001	0.001	0.002	<0.001	0.002
Zinc	0.005	mg/L	0.008	0.014	0.017	0.036	0.028	0.02	0.049

Analytes	LOR	UNITS	ANZECC guidelines	SW08 - surface water					
Manganese	0.001	mg/L	1.9	0.015	0.012	0.019	0.02	0.006	0.024
Iron	0.05	mg/L	ID	0.06	0.24	0.11	0.2	0.25	0.3
Nutrients									
Ammonia as N	0.01	mg/L	0.013*	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrite as N	0.01	mg/L	0.015*	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate as N	0.01	mg/L	0.015*	0.12	1.13	0.22	0.12	0.15	0.54
Nitrite + nitrate	0.01	mg/L	-	0.12	1.13	0.22	0.12	0.15	0.54
Total phosphorous as P	0.01	mg/L	0.02*	<0.01	0.03	0.03	0.07	0.04	0.02
Reactive phosphorous	0.01	mg/L	-	<0.01	<0.01	<0.01	<0.01	0.01	<0.01
Ionic balance									
Total anions	0.01	meq/L	-	5.22	3.22	6.08	3.54	1.43	4.92
Total cations	0.01	meq/L	-	4.8	3.26	5.97	3.66	1.09	5.75
Ionic balance	0.01	%	-	4.17	0.69	0.94	1.6	1.31	7.76
Total petroleum hydrocarbons									
C6 - C9 fraction	20	µg/L	-	<20	<20	<20	<20	<20	<20
C10 - C14 fraction	50	µg/L	-	<50	<50	<50	<50	<50	<50
C15 - C28 fraction	100	µg/L	-	<100	<100	<100	<100	<100	<100
C29 - C36 fraction	50	µg/L	-	<50	<50	<50	<50	<50	<50
C10 - C36 fraction sum	50	µg/L	-	<50	<50	<50	<50	<50	<50
Total recoverable hydrocarbons									
C6 - C10 fraction	20	µg/L	-	<20	<20	<20	<20	<20	<20
C6 - C10 fraction minus BTEX	20	µg/L	-	<20	<20	<20	<20	<20	<20
>C10 - C16 fraction	100	µg/L	-	<100	<100	<100	<100	<100	<100
>C16 - C34 fraction	100	µg/L	-	<100	<100	<100	<100	<100	<100
>C34 - C40 fraction	100	µg/L	-	<100	<100	<100	<100	<100	<100
>C10 - C40 fraction sum	100	µg/L	-	<100	<100	<100	<100	<100	<100
>C10 - C16 fraction minus apthalene	100	µg/L	-	<100	<100	<100	<100	<100	<100
BTEXN									
Benzene	1	µg/L	950	<1	<1	<1	<1	<1	<1
Toluene	2	µg/L	ID	<2	<2	<2	<2	<2	<2
Ethylbenzene	2	µg/L	ID	<2	<2	<2	<2	<2	<2

Analytes	LOR	UNITS	ANZECC guidelines	SW08 - surface water					
meta-xylene	2	µg/L	ID	<2	<2	<2	<2	<2	<2
ortho-xylene	2	µg/L	350	<2	<2	<2	<2	<2	<2
Total xylenes	2	µg/L	ID	<2	<2	<2	<2	<2	<2
Sum of BTEX	1	µg/L	-	<1	<1	<1	<1	<1	<1
Naphthalene	5	µg/L	16	<5	<5	<5	<5	<5	<5

ANZECC 2000 guidelines - 95% protection for freshwater species

* = guideline value for lowland rivers

ID = insifficent data to create value

Bold = significant result

Analytes	LOR	UNITS	ANZECC guidelines	SW09 - surface water	
Date				06/11/14	02/12/14
Sampling method				Bucket & cable	Bucket & cable
Field parameters					
Temperature	0.1	oC	-	17.2	24
Dissolved oxygen	0.1	mg/L	-	17.38	10.81
Electrical conductivty	0.1	uS/cm	125-2200	328	205.9
pH	0.01	pH units	6.5-7.5*	8.46	7.97
Oxidation reduction potential	0.1	mV	-	113.4	81.2
Laboratory results					
Alkalinity					
Hydroxide alkalinity as CaCO3	1	mg/L	-	<1	<1
Carbonate alkalinity as CaCO3	1	mg/L	-	<1	<1
Bicarbonate alkalinity as CaCO3	1	mg/L	-	70	50
Total alkalinity as CaCO3	1	mg/L	-	70	50
Cations & anions					
Sulfate	1	mg/L	-	14	10
Chloride	1	mg/L	-	40	29
Calcium	1	mg/L	-	19	15
Magnesium	1	mg/L	-	5	3
Sodium	1	mg/L	-	28	14
Potassium	1	mg/L	-	4	2
Dissolved metals					
Arsenic	0.001	mg/L	0.013	<0.001	<0.001
Cadmium	0.0001	mg/L	0.0002	<0.0001	<0.0001
Chromium	0.001	mg/L	0.001	<0.001	<0.001
Copper	0.001	mg/L	0.0014	0.005	0.006
Lead	0.001	mg/L	0.0034	<0.001	<0.001
Nickel	0.001	mg/L	0.011	0.001	0.002
Zinc	0.005	mg/L	0.008	0.057	0.031

Analytes	LOR	UNITS	ANZECC guidelines	SW09 - surface water	
Manganese	0.001	mg/L	1.9	0.028	0.008
Iron	0.05	mg/L	ID	0.07	0.12
Nutrients					
Ammonia as N	0.01	mg/L	0.013*	<0.01	<0.01
Nitrite as N	0.01	mg/L	0.015*	<0.01	<0.01
Nitrate as N	0.01	mg/L	0.015*	0.03	0.12
Nitrite + nitrate	0.01	mg/L	-	0.03	0.12
Total phosphorous as P	0.01	mg/L	0.02*	0.09	0.04
Reactive phosphorous	0.01	mg/L	-	<0.01	0.01
Ionic balance					
Total anions	0.01	meq/L	-	2.82	2.03
Total cations	0.01	meq/L	-	2.68	1.66
Ionic balance	0.01	%	-		1.22
Total petroleum hydrocarbons					
C6 - C9 fraction	20	µg/L	-	<20	<20
C10 - C14 fraction	50	µg/L	-	<50	<50
C15 - C28 fraction	100	µg/L	-	<100	<100
C29 - C36 fraction	50	µg/L	-	<50	<50
C10 - C36 fraction sum	50	µg/L	-	<50	<50
Total recoverable hydrocarbons					
C6 - C10 fraction	20	µg/L	-	<20	<20
C6 - C10 fraction minus BTEX	20	µg/L	-	<20	<20
>C10 - C16 fraction	100	µg/L	-	<100	<100
>C16 - C34 fraction	100	µg/L	-	<100	<100
>C34 - C40 fraction	100	µg/L	-	<100	<100
>C10 - C40 fraction sum	100	µg/L	-	<100	<100
>C10 - C16 fraction minus apthalene	100	µg/L	-	<100	<100
BTEXN					
Benzene	1	µg/L	950	<1	<1
Toluene	2	µg/L	ID	<2	<2
Ethylbenzene	2	µg/L	ID	<2	<2

Analytes	LOR	UNITS	ANZECC guidelines	SW09 - surface water	
meta-xylene	2	µg/L	ID	<2	<2
ortho-xylene	2	µg/L	350	<2	<2
Total xylenes	2	µg/L	ID	<2	<2
Sum of BTEX	1	µg/L	-	<1	<1
Naphthalene	5	µg/L	16	<5	<5

ANZECC 2000 guidelines - 95% protection for freshwater species
* = guideline value for lowland rivers
ID = insifficent data to create value
Bold = significant result

"This page has been intentionally left blank"

Appendix C Baseline groundwater monitoring data

Analytes	LOR	UNITS	ANZECC guidelines	BH025 - groundwater			
Date				18/09/14	16/10/14	17/11/14	16/12/14
Borehole information							
Screened formation				Shale	Shale	Shale	Shale
SWL (mbgl)				5.33	9.66	5.45	5.1
Total depth (m)				29.13			
Sampling method				Submersible pump	Submersible pump	Submersible pump	Submersible pump
Volume purged (L)				50	40	80	50
Field parameters							
Temperature	0.1	oC	-	18.1	22	21.3	21.3
Dissolved oxygen	0.1	mg/L	-	9.01	10.42	11.26	3.91
Electrical conductivty	0.1	uS/cm	125-2200	953	2897	4462	3722
pH	0.01	pH units	6.5-7.5*		4.17	4.37	3.33
Oxidation reduction potential	0.1	mV	-	193	288.4	357.2	319.8
Laboratory results							
Alkalinity							
Hydroxide alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1
Carbonate alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1
Bicarbonate alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1
Total alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1
Cations & anions							
Sulfate	1	mg/L	-	88	84	93	84
Chloride	1	mg/L	-	1320	1260	1040	1080
Calcium	1	mg/L	-	<1	<1	3	2
Magnesium	1	mg/L	-	80	73	73	73
Sodium	1	mg/L	-	720	655	604	601
Potassium	1	mg/L	-	6	5	4	4
Dissolved metals							
Arsenic	0.001	mg/L	0.013	0.001	0.002	<0.001	0.001
Cadmium	0.0001	mg/L	0.0002	0.0002	0.0002	0.0003	0.0003

Analytes	LOR	UNITS	ANZECC guidelines	BH025 - groundwater			
Chromium	0.001	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Copper	0.001	mg/L	0.0014	0.136	0.205	0.172	0.162
Lead	0.001	mg/L	0.0034	0.014	0.012	0.006	0.006
Nickel	0.001	mg/L	0.011	0.016	0.02	0.018	0.015
Zinc	0.005	mg/L	0.008	0.166	0.176	0.155	0.146
Manganese	0.001	mg/L	1.9	0.041	0.038	0.042	0.038
Iron	0.05	mg/L	ID	1.76	1.61	1.59	1.64
Nutrients							
Ammonia as N	0.01	mg/L	0.013*	0.04	0.05	0.05	0.04
Nitrite as N	0.01	mg/L	0.015*	<0.01	<0.01	<0.01	<0.01
Nitrate as N	0.01	mg/L	0.015*	<0.01	0.04	<0.01	0.06
Nitrite + nitrate	0.01	mg/L	-	<0.01	0.04	<0.01	0.06
Total phosphorous as P	0.01	mg/L	0.02*	0.26	0.11	0.01	<0.01
Reactive phosphorous	0.01	mg/L	-	0.01	<0.01	<0.01	<0.01
Ionic balance							
Total anions	0.01	meq/L	-	39.1	37.3	31.3	32.2
Total cations	0.01	meq/L	-	38.1	34.6	32.5	32.4
Ionic balance	0.01	%	-	1.33	3.72	1.95	0.19
Total petroleum hydrocarbons							
C6 - C9 fraction	20	µg/L	-	<20	<20	<20	<20
C10 - C14 fraction	50	µg/L	-	<50	<50	<50	<50
C15 - C28 fraction	100	µg/L	-	<100	<100	<100	<100
C29 - C36 fraction	50	µg/L	-	<50	<50	<50	<50
C10 - C36 fraction sum	50	µg/L	-	<50	<50	<50	<50
Total recoverable hydrocarbons							
C6 - C10 fraction	20	µg/L	-	<20	<20	<20	<20
C6 - C10 fraction minus BTEX	20	µg/L	-	<20	<20	<20	<20
>C10 - C16 fraction	100	µg/L	-	<100	<100	<100	<100
>C16 - C34 fraction	100	µg/L	-	<100	<100	<100	<100
>C34 - C40 fraction	100	µg/L	-	<100	<100	<100	<100
>C10 - C40 fraction sum	100	µg/L	-	<100	<100	<100	<100

Analytes	LOR	UNITS	ANZECC guidelines	BH025 - groundwater			
>C10 - C16 fraction minus apthalene	100	µg/L	-	<100	<100	<100	<100
BTEXN							
Benzene	1	µg/L	950	**2**	**3**	**3**	**2**
Toluene	2	µg/L	ID	<2	<2	<2	<2
Ethylbenzene	2	µg/L	ID	<2	<2	<2	<2
meta-xylene	2	µg/L	ID	<2	<2	<2	<2
ortho-xylene	2	µg/L	350	<2	<2	<2	<2
Total xylenes	2	µg/L	ID	<2	<2	<2	<2
Sum of BTEX	1	µg/L	-	**2**	**3**	**3**	**2**
Naphthalene	5	µg/L	16	<5	<5	<5	<5

ANZECC 2000 guidelines - 95% protection for freshwater species
* = guideline value for lowland rivers
ID = insifficent data to create value
Bold = significant result

Analytes	LOR	UNITS	ANZECC guidelines	BH023 - groundwater			
Date				18/09/14	16/10/14	17/11/14	16/12/14
Borehole information							
Screened formation				Sandstone	Sandstone	Sandstone	Sandstone
SWL (mbgl)				9.79	14.47	9.61	9.67
Total depth (m)				18.11			
Sampling method				Submersible pump	Submersible pump	Submersible pump	Submersible pump
Volume purged (L)				30	53	50	30
Field parameters							
Temperature	0.1	oC	-	18.8	20.8	28.3	22.4
Dissolved oxygen	0.1	mg/L	-	8.71	12.64	3.02	4.9
Electrical conductivty	0.1	uS/cm	125-2200	1817	2174	2353	1845
pH	0.01	pH units	6.5-7.5*		6.13	7.06	4.84
Oxidation reduction potential	0.1	mV	-	187	-81.7	-111.2	-15.8
Laboratory results							
Alkalinity							
Hydroxide alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1
Carbonate alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1
Bicarbonate alkalinity as CaCO3	1	mg/L	-	288	190	189	109
Total alkalinity as CaCO3	1	mg/L	-	288	190	189	109
Cations & anions							
Sulfate	1	mg/L	-	23	38	60	66
Chloride	1	mg/L	-	398	522	480	481
Calcium	1	mg/L	-	14	13	17	14
Magnesium	1	mg/L	-	32	37	43	37
Sodium	1	mg/L	-	361	372	343	312
Potassium	1	mg/L	-	15	12	13	11
Dissolved metals							
Arsenic	0.001	mg/L	0.013	0.002	0.002	0.001	0.002
Cadmium	0.0001	mg/L	0.0002	<0.0001	<0.0001	<0.0001	<0.0001

Analytes	LOR	UNITS	ANZECC guidelines	BH023 - groundwater			
Chromium	0.001	mg/L	0.001	<0.001	<0.001	0.004	<0.001
Copper	0.001	mg/L	0.0014	<0.001	<0.001	<0.001	0.001
Lead	0.001	mg/L	0.0034	<0.001	<0.001	0.006	<0.001
Nickel	0.001	mg/L	0.011	0.001	0.006	0.031	0.03
Zinc	0.005	mg/L	0.008	0.014	0.024	0.065	0.042
Manganese	0.001	mg/L	1.9	1.47	1.46	1.84	1.52
Iron	0.05	mg/L	ID	11.6	**20.7**	**28**	9.64
Nutrients							
Ammonia as N	0.01	mg/L	0.013*	0.21	0.15	0.14	0.03
Nitrite as N	0.01	mg/L	0.015*	<0.01	<0.01	<0.01	<0.01
Nitrate as N	0.01	mg/L	0.015*	<0.01	0.06	<0.01	0.02
Nitrite + nitrate	0.01	mg/L	-	<0.01	0.06	<0.01	0.02
Total phosphorous as P	0.01	mg/L	0.02*	0.29	0.11	0.52	0.02
Reactive phosphorous	0.01	mg/L	-	<0.01	<0.01	<0.02	<0.01
Ionic balance							
Total anions	0.01	meq/L	-	17.5	19.3	18.6	17.1
Total cations	0.01	meq/L	-	19.4	20.2	19.6	17.6
Ionic balance	0.01	%	-	5.28	2.18	2.79	1.35
Total petroleum hydrocarbons							
C6 - C9 fraction	20	µg/L	-	<20	<20	<20	<20
C10 - C14 fraction	50	µg/L	-	<50	<50	<50	<50
C15 - C28 fraction	100	µg/L	-	<100	<100	**1020**	<100
C29 - C36 fraction	50	µg/L	-	<50	<50	**360**	<50
C10 - C36 fraction sum	50	µg/L	-	<50	<50	**1380**	<50
Total recoverable hydrocarbons							
C6 - C10 fraction	20	µg/L	-	<20	<20	<20	<20
C6 - C10 fraction minus BTEX	20	µg/L	-	<20	<20	<20	<20
>C10 - C16 fraction	100	µg/L	-	<100	<100	<100	<100
>C16 - C34 fraction	100	µg/L	-	<100	<100	**1200**	<100
>C34 - C40 fraction	100	µg/L	-	<100	<100	**140**	<100
>C10 - C40 fraction sum	100	µg/L	-	<100	<100	**1340**	<100

Analytes	LOR	UNITS	ANZECC guidelines	BH023 - groundwater			
>C10 - C16 fraction minus apthalene	100	µg/L	-	<100	<100	<100	<100
BTEXN							
Benzene	1	µg/L	950	<1	<1	<1	<1
Toluene	2	µg/L	ID	<2	<2	<2	<2
Ethylbenzene	2	µg/L	ID	<2	<2	<2	<2
meta-xylene	2	µg/L	ID	<2	<2	<2	<2
ortho-xylene	2	µg/L	350	<2	<2	<2	<2
Total xylenes	2	µg/L	ID	<2	<2	<2	<2
Sum of BTEX	1	µg/L	-	<1	<1	<1	<1
Naphthalene	5	µg/L	16	<5	<5	<5	<5

ANZECC 2000 guidelines - 95% protection for freshwater species

* = guideline value for lowland rivers

ID = insifficent data to create value

Bold = significant result

Analytes	LOR	UNITS	ANZECC guidelines	BH021 - groundwater			
Date				10/09/14	17/10/14	18/11/14	16/12/14
Borehole information							
Screened formation				Sandstone	Sandstone	Sandstone	Sandstone
SWL (mbgl)				26.63	26.11	26.45	24.3
Total depth (m)				30.2			
Sampling method				Bailer	Submersible pump	Submersible pump	Submersible pump
Volume purged (L)				12	15	15	12
Field parameters							
Temperature	0.1	oC	-	18.3	16.9	21.8	22.1
Dissolved oxygen	0.1	mg/L	-	10	35.6	2.41	6.16
Electrical conductivty	0.1	uS/cm	125-2200	2013	2757	3831	1101
pH	0.01	pH units	6.5-7.5*	7.62	7.13	6.74	5.77
Oxidation reduction potential	0.1	mV	-	-11.4	-48.8	-96	-47.7
Laboratory results							
Alkalinity							
Hydroxide alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1
Carbonate alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1
Bicarbonate alkalinity as CaCO3	1	mg/L	-	284	305	403	263
Total alkalinity as CaCO3	1	mg/L	-	284	305	403	263
Cations & anions							
Sulfate	1	mg/L	-	70	82	116	38
Chloride	1	mg/L	-	442	699	747	169
Calcium	1	mg/L	-	30	48	58	54
Magnesium	1	mg/L	-	23	38	50	16
Sodium	1	mg/L	-	317	493	568	129
Potassium	1	mg/L	-	27	33	30	21
Dissolved metals							
Arsenic	0.001	mg/L	0.013	0.004	0.001	0.003	0.003
Cadmium	0.0001	mg/L	0.0002	<0.0001	<0.0001	<0.0001	<0.0001

Analytes	LOR	UNITS	ANZECC guidelines	BH021 - groundwater			
Chromium	0.001	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Copper	0.001	mg/L	0.0014	0.001	0.001	<0.001	0.004
Lead	0.001	mg/L	0.0034	0.002	<0.001	<0.001	<0.001
Nickel	0.001	mg/L	0.011	<0.001	0.003	0.002	0.011
Zinc	0.005	mg/L	0.008	0.01	0.038	0.038	0.033
Manganese	0.001	mg/L	1.9		0.839	1.29	0.351
Iron	0.05	mg/L	ID	0.11	0.3	1.69	0.44
Nutrients							
Ammonia as N	0.01	mg/L	0.013*	0.07	0.04	0.1	<0.01
Nitrite as N	0.01	mg/L	0.015*	<0.01	<0.01	<0.01	<0.01
Nitrate as N	0.01	mg/L	0.015*	<0.01	0.06	0.06	0.01
Nitrite + nitrate	0.01	mg/L	-	<0.01	0.06	0.06	0.01
Total phosphorous as P	0.01	mg/L	0.02*	0.66	0.28	0.14	0.28
Reactive phosphorous	0.01	mg/L	-	<0.01	<0.01	<0.01	<0.01
Ionic balance							
Total anions	0.01	meq/L	-	19.6	27.5	31.5	10.8
Total cations	0.01	meq/L	-	17.9	27.8	32.5	10.2
Ionic balance	0.01	%	-	4.64	0.51	1.45	3.12
Total petroleum hydrocarbons							
C6 - C9 fraction	20	µg/L	-	<20	<20	<20	<20
C10 - C14 fraction	50	µg/L	-	<50	**120**	<50	**160**
C15 - C28 fraction	100	µg/L	-	**1100**	**1220**	**390**	**350**
C29 - C36 fraction	50	µg/L	-	**140**	**160**	**80**	<50
C10 - C36 fraction sum	50	µg/L	-	**1240**	**1500**	**470**	**510**
Total recoverable hydrocarbons							
C6 - C10 fraction	20	µg/L	-	<20	<20	<20	<20
C6 - C10 fraction minus BTEX	20	µg/L	-	<20	<20	<20	<20
>C10 - C16 fraction	100	µg/L	-	<100	**120**	<100	**150**
>C16 - C34 fraction	100	µg/L	-	**1150**	**1320**	**440**	**350**
>C34 - C40 fraction	100	µg/L	-	<100	<100	<100	<100
>C10 - C40 fraction sum	100	µg/L	-	**1150**	**1440**	**440**	**500**

Analytes	LOR	UNITS	ANZECC guidelines	BH021 - groundwater			
>C10 - C16 fraction minus apthalene	100	µg/L	-	<100	**120**	<100	**150**
BTEXN							
Benzene	1	µg/L	950	<1	<1	<1	<1
Toluene	2	µg/L	ID	**7**	**2**	<2	<2
Ethylbenzene	2	µg/L	ID	<2	<2	<2	<2
meta-xylene	2	µg/L	ID	<2	<2	<2	<2
ortho-xylene	2	µg/L	350	<2	<2	<2	<2
Total xylenes	2	µg/L	ID	<2	<2	<2	<2
Sum of BTEX	1	µg/L	-	**7**	**2**	<1	<1
Naphthalene	5	µg/L	16	<5	<5	<5	<5

ANZECC 2000 guidelines - 95% protection for freshwater species
* = guideline value for lowland rivers
ID = insifficent data to create value
Bold = significant result

Analytes	LOR	UNITS	ANZECC guidelines	BH014 - groundwater			
Date				10/09/14	17/10/14	18/11/14	16/12/14
Borehole information							
Screened formation				Sandstone	Sandstone	Sandstone	Sandstone
SWL (mbgl)				24.57	24.68	24.54	24.57
Total depth (m)				28			
Sampling method				Bailer	Submersible pump	Submersible pump	Submersible pump
Volume purged (L)				8.1	32	12	12
Field parameters							
Temperature	0.1	oC	-	20	18.1	24.6	24.6
Dissolved oxygen	0.1	mg/L	-	10.7	11.62	5.41	7.02
Electrical conductivty	0.1	uS/cm	125-2200	903	954	946	863
pH	0.01	pH units	6.5-7.5*	7.29	7.02	6.39	5.6
Oxidation reduction potential	0.1	mV	-	29.3	34.6	55.2	95
Laboratory results							
Alkalinity							
Hydroxide alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1
Carbonate alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1
Bicarbonate alkalinity as CaCO3	1	mg/L	-	79	60	56	50
Total alkalinity as CaCO3	1	mg/L	-	79	60	56	50
Cations & anions							
Sulfate	1	mg/L	-	23	22	23	21
Chloride	1	mg/L	-	215	230	209	205
Calcium	1	mg/L	-	15	11	13	12
Magnesium	1	mg/L	-	25	25	26	26
Sodium	1	mg/L	-	106	116	119	109
Potassium	1	mg/L	-	4	4	4	3
Dissolved metals							
Arsenic	0.001	mg/L	0.013	<0.001	<0.001	<0.001	<0.001
Cadmium	0.0001	mg/L	0.0002	<0.0001	<0.0001	<0.0001	0.0003

Analytes	LOR	UNITS	ANZECC guidelines	BH014 - groundwater			
Chromium	0.001	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Copper	0.001	mg/L	0.0014	0.002	<0.001	0.002	0.032
Lead	0.001	mg/L	0.0034	0.016	<0.001	<0.001	<0.001
Nickel	0.001	mg/L	0.011	<0.001	0.019	0.015	0.016
Zinc	0.005	mg/L	0.008	0.046	0.077	0.128	0.151
Manganese	0.001	mg/L	1.9		0.583	0.54	0.589
Iron	0.05	mg/L	ID	2.32	1.86	3.34	0.11
Nutrients							
Ammonia as N	0.01	mg/L	0.013*	0.03	<0.01	<0.01	<0.01
Nitrite as N	0.01	mg/L	0.015*	<0.01	<0.01	<0.01	<0.01
Nitrate as N	0.01	mg/L	0.015*	0.02	0.2	0.03	0.03
Nitrite + nitrate	0.01	mg/L	-	0.02	0.2	0.03	0.03
Total phosphorous as P	0.01	mg/L	0.02*	1.62	0.25	0.13	0.05
Reactive phosphorous	0.01	mg/L	-	<0.01	<0.01	<0.01	<0.01
Ionic balance							
Total anions	0.01	meq/L	-	8.12	8.14	7.49	7.22
Total cations	0.01	meq/L	-	7.52	7.75	8.07	7.56
Ionic balance	0.01	%	-	3.87	2.47	3.67	2.27
Total petroleum hydrocarbons							
C6 - C9 fraction	20	µg/L	-	<20	<20	<20	<20
C10 - C14 fraction	50	µg/L	-	<50	<50	**70**	<50
C15 - C28 fraction	100	µg/L	-	**740**	**200**	**300**	<100
C29 - C36 fraction	50	µg/L	-	**210**	<50	**140**	<50
C10 - C36 fraction sum	50	µg/L	-	**950**	**200**	**510**	<50
Total recoverable hydrocarbons							
C6 - C10 fraction	20	µg/L	-	<20	<20	<20	<20
C6 - C10 fraction minus BTEX	20	µg/L	-	<20	<20	<20	<20
>C10 - C16 fraction	100	µg/L	-	<100	<100	<100	<100
>C16 - C34 fraction	100	µg/L	-	**870**	**230**	**380**	<100
>C34 - C40 fraction	100	µg/L	-	**120**	<100	<100	<100
>C10 - C40 fraction sum	100	µg/L	-	**990**	**230**	**380**	<100

Analytes	LOR	UNITS	ANZECC guidelines	BH014 - groundwater			
>C10 - C16 fraction minus apthalene	100	µg/L	-	<100	<100	<100	<100
BTEXN							
Benzene	1	µg/L	950	<1	<1	<1	<1
Toluene	2	µg/L	ID	<2	<2	<2	<2
Ethylbenzene	2	µg/L	ID	<2	<2	<2	<2
meta-xylene	2	µg/L	ID	<2	<2	<2	<2
ortho-xylene	2	µg/L	350	<2	<2	<2	<2
Total xylenes	2	µg/L	ID	<2	<2	<2	<2
Sum of BTEX	1	µg/L	-	<1	<1	<1	<1
Naphthalene	5	µg/L	16	<5	<5	<5	<5

ANZECC 2000 guidelines - 95% protection for freshwater species

* = guideline value for lowland rivers

ID = insifficent data to create value

Bold = significant result

Analytes	LOR	UNITS	ANZECC guidelines	BH004 - groundwater			
Date				10/09/14	17/10/14	18/11/14	16/12/14
Borehole information							
Screened formation				Shale	Shale	Shale	Shale
SWL (mbgl)				1.54	1.55	4.04	3.23
Total depth (m)				24.1			
Sampling method				Submersible pump	Submersible pump	Submersible pump	Submersible pump
Volume purged (L)				40	40	50	30
Field parameters							
Temperature	0.1	oC	-	18.7	19.2	20.4	24.9
Dissolved oxygen	0.1	mg/L	-	6.72	10.93	3.54	12.87
Electrical conductivty	0.1	uS/cm	125-2200	778	1365	1356	1758
pH	0.01	pH units	6.5-7.5*	9.36	7.11	9.29	8.61
Oxidation reduction potential	0.1	mV	-	-159	-129.6	-179.3	-158.5
Laboratory results							
Alkalinity							
Hydroxide alkalinity as CaCO3	1	mg/L	-	<1	<1	<1	<1
Carbonate alkalinity as CaCO3	1	mg/L	-	66	<1	78	86
Bicarbonate alkalinity as CaCO3	1	mg/L	-	175	238	100	38
Total alkalinity as CaCO3	1	mg/L	-	241	238	178	124
Cations & anions							
Sulfate	1	mg/L	-	55	171	260	264
Chloride	1	mg/L	-	76	115	162	330
Calcium	1	mg/L	-	29	11	13	23
Magnesium	1	mg/L	-	2	4	3	<1
Sodium	1	mg/L	-	121	259	256	419
Potassium	1	mg/L	-	10	7	11	13
Dissolved metals							
Arsenic	0.001	mg/L	0.013	0.003	0.002	0.002	0.019
Cadmium	0.0001	mg/L	0.0002	<0.0001	<0.0001	<0.0001	<0.0001

Analytes	LOR	UNITS	ANZECC guidelines	BH004 - groundwater			
Chromium	0.001	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Copper	0.001	mg/L	0.0014	0.002	<0.001	0.002	<0.001
Lead	0.001	mg/L	0.0034	0.002	<0.001	<0.001	<0.001
Nickel	0.001	mg/L	0.011	<0.001	0.003	0.001	0.005
Zinc	0.005	mg/L	0.008	0.012	0.011	0.02	0.017
Manganese	0.001	mg/L	1.9		0.87	0.11	0.004
Iron	0.05	mg/L	ID	0.35	5.87	0.2	0.1
Nutrients							
Ammonia as N	0.01	mg/L	0.013*	0.25	0.12	0.16	0.5
Nitrite as N	0.01	mg/L	0.015*	<0.01	0.12	<0.01	<0.01
Nitrate as N	0.01	mg/L	0.015*	0.02	<0.01	0.01	<0.01
Nitrite + nitrate	0.01	mg/L	-	0.02	0.05	0.01	<0.01
Total phosphorous as P	0.01	mg/L	0.02*	0.56	0.38	0.41	0.59
Reactive phosphorous	0.01	mg/L	-	0.19	0.11	0.18	0.07
Ionic balance							
Total anions	0.01	meq/L	-	8.1	11.6	13.5	17.3
Total cations	0.01	meq/L	-	7.13	12.3	12.3	19.7
Ionic balance	0.01	%	-	6.42	3.15	4.78	6.52
Total petroleum hydrocarbons							
C6 - C9 fraction	20	µg/L	-	<20	<20	<20	<20
C10 - C14 fraction	50	µg/L	-	**60**	<50	<50	**130**
C15 - C28 fraction	100	µg/L	-	**1360**	<100	**240**	**360**
C29 - C36 fraction	50	µg/L	-	**140**	<50	<50	<50
C10 - C36 fraction sum	50	µg/L	-	**1560**	<50	**240**	**490**
Total recoverable hydrocarbons							
C6 - C10 fraction	20	µg/L	-	<20	<20	<20	<20
C6 - C10 fraction minus BTEX	20	µg/L	-	<20	<20	<20	<20
>C10 - C16 fraction	100	µg/L	-	**1120**	<100	<100	**140**
>C16 - C34 fraction	100	µg/L	-	**480**	<100	**300**	**360**
>C34 - C40 fraction	100	µg/L	-	<100	<100	<100	<100
>C10 - C40 fraction sum	100	µg/L	-	**1600**	<100	**300**	**500**

Analytes	LOR	UNITS	ANZECC guidelines	BH004 - groundwater			
>C10 - C16 fraction minus apthalene	100	µg/L	-	1120	<100	<100	**140**
BTEXN							
Benzene	1	µg/L	950	<1	<1	<1	<1
Toluene	2	µg/L	ID	**3**	<2	<2	<2
Ethylbenzene	2	µg/L	ID	<2	<2	<2	<2
meta-xylene	2	µg/L	ID	<2	<2	<2	<2
ortho-xylene	2	µg/L	350	<2	<2	<2	<2
Total xylenes	2	µg/L	ID	<2	<2	<2	<2
Sum of BTEX	1	µg/L	-	**3**	<1	<1	<1
Naphthalene	5	µg/L	16	<5	<5	<5	<5

ANZECC 2000 guidelines - 95% protection for freshwater species

* = guideline value for lowland rivers

ID = insifficent data to create value

Bold = significant result

Analytes	LOR	UNITS	ANZECC guidelines	BH1009 - groundwater		
Date				17/10/14	18/11/14	16/12/14
Borehole information						
Screened formation				Sandstone	Sandstone	Sandstone
SWL (mbgl)				35.00	35.04	35.10
Total depth (m)					68	
Sampling method				Bailer	Bailer	Bailer
Volume purged (L)				66	90	60
Field parameters						
Temperature	0.1	oC	-	20.8	21.4	21.4
Dissolved oxygen	0.1	mg/L	-	24.44	7.5	5.49
Electrical conductivty	0.1	uS/cm	125-2200	6127	6004	5371
pH	0.01	pH units	6.5-7.5*	7	7.24	6.35
Oxidation reduction potential	0.1	mV	-	37.2	-82.3	-93
Laboratory results						
Alkalinity						
Hydroxide alkalinity as CaCO3	1	mg/L	-	<1	<1	<1
Carbonate alkalinity as CaCO3	1	mg/L	-	<1	<1	<1
Bicarbonate alkalinity as CaCO3	1	mg/L	-	424	431	432
Total alkalinity as CaCO3	1	mg/L	-	424	431	432
Cations & anions						
Sulfate	1	mg/L	-	220	240	242
Chloride	1	mg/L	-	1490	1200	1380
Calcium	1	mg/L	-	75	96	76
Magnesium	1	mg/L	-	122	129	121
Sodium	1	mg/L	-	950	1040	955
Potassium	1	mg/L	-	26	25	21
Dissolved metals						
Arsenic	0.001	mg/L	0.013	<0.001	0.004	0.014
Cadmium	0.0001	mg/L	0.0002	<0.0001	<0.0001	<0.0001

Analytes	LOR	UNITS	ANZECC guidelines	BH1009 - groundwater		
Chromium	0.001	mg/L	0.001	<0.001	<0.001	<0.001
Copper	0.001	mg/L	0.0014	0.001	<0.001	<0.001
Lead	0.001	mg/L	0.0034	<0.001	<0.001	<0.001
Nickel	0.001	mg/L	0.011	0.024	0.025	0.024
Zinc	0.005	mg/L	0.008	0.095	0.028	0.037
Manganese	0.001	mg/L	1.9	0.682	0.906	1.03
Iron	0.05	mg/L	ID	<0.05	4.65	6.76
Nutrients						
Ammonia as N	0.01	mg/L	0.013*	0.08	0.09	0.12
Nitrite as N	0.01	mg/L	0.015*	<0.01	<0.01	<0.01
Nitrate as N	0.01	mg/L	0.015*	0.24	0.02	0.07
Nitrite + nitrate	0.01	mg/L	-	0.24	0.02	0.07
Total phosphorous as P	0.01	mg/L	0.02*	0.35	0.39	0.06
Reactive phosphorous	0.01	mg/L	-	0.05	<0.01	<0.01
Ionic balance						
Total anions	0.01	meq/L	-	55.1	47.5	52.6
Total cations	0.01	meq/L	-	55.8	61.3	55.8
Ionic balance	0.01	%	-	0.6	12.7	2.96
Total petroleum hydrocarbons						
C6 - C9 fraction	20	µg/L	-	<20	<20	<20
C10 - C14 fraction	50	µg/L	-	<50	<50	<50
C15 - C28 fraction	100	µg/L	-	<100	<100	<100
C29 - C36 fraction	50	µg/L	-	<50	<50	<50
C10 - C36 fraction sum	50	µg/L	-	<50	<50	<50
Total recoverable hydrocarbons						
C6 - C10 fraction	20	µg/L	-	<20	<20	<20
C6 - C10 fraction minus BTEX	20	µg/L	-	<20	<20	<20
>C10 - C16 fraction	100	µg/L	-	<100	<100	<100
>C16 - C34 fraction	100	µg/L	-	<100	<100	<100
>C34 - C40 fraction	100	µg/L	-	<100	<100	<100
>C10 - C40 fraction sum	100	µg/L	-	<100	<100	<100

Analytes	LOR	UNITS	ANZECC guidelines	BH1009 - groundwater		
>C10 - C16 fraction minus apthalene	100	µg/L	-	<100	<100	<100
BTEXN						
Benzene	1	µg/L	950	<1	<1	<1
Toluene	2	µg/L	ID	<2	<2	<2
Ethylbenzene	2	µg/L	ID	<2	<2	<2
meta-xylene	2	µg/L	ID	<2	<2	<2
ortho-xylene	2	µg/L	350	<2	<2	<2
Total xylenes	2	µg/L	ID	<2	<2	<2
Sum of BTEX	1	µg/L	-	<1	<1	<1
Naphthalene	5	µg/L	16	<5	<5	<5

ANZECC 2000 guidelines - 95% protection for freshwater species

* = guideline value for lowland rivers

ID = insifficent data to create value

Bold = significant result

Analytes	LOR	UNITS	ANZECC guidelines	BH1017 - groundwater		
Date				17/10/14	18/11/14	16/12/14
Borehole information						
Screened formation				Sandstone	Sandstone	Sandstone
SWL (mbgl)				55.03	54.99	54.95
Total depth (m)					91	
Sampling method				Bailer	Bailer	Bailer
Volume purged (L)				90	105	90
Field parameters						
Temperature	0.1	oC	-	18.1	18.9	21.3
Dissolved oxygen	0.1	mg/L	-	8.75	3.66	3.55
Electrical conductivty	0.1	uS/cm	125-2200	3169	3116	3074
pH	0.01	pH units	6.5-7.5*	6.69	6.49	5.26
Oxidation reduction potential	0.1	mV	-	-11.02	-100.2	-95.3
Laboratory results						
Alkalinity						
Hydroxide alkalinity as CaCO3	1	mg/L	-	<1	<1	<1
Carbonate alkalinity as CaCO3	1	mg/L	-	<1	<1	<1
Bicarbonate alkalinity as CaCO3	1	mg/L	-	170	197	128
Total alkalinity as CaCO3	1	mg/L	-	170	197	128
Cations & anions						
Sulfate	1	mg/L	-	76	58	102
Chloride	1	mg/L	-	783	668	845
Calcium	1	mg/L	-	47	38	45
Magnesium	1	mg/L	-	60	61	71
Sodium	1	mg/L	-	456	412	514
Potassium	1	mg/L	-	12	10	11
Dissolved metals						
Arsenic	0.001	mg/L	0.013	0.017	0.026	0.032
Cadmium	0.0001	mg/L	0.0002	<0.0001	<0.0001	<0.0001

Analytes	LOR	UNITS	ANZECC guidelines	BH1017 - groundwater		
Chromium	0.001	mg/L	0.001	0.001	<0.001	<0.001
Copper	0.001	mg/L	0.0014	<0.001	<0.001	<0.001
Lead	0.001	mg/L	0.0034	<0.001	<0.001	<0.001
Nickel	0.001	mg/L	0.011	0.032	0.013	0.016
Zinc	0.005	mg/L	0.008	0.026	0.036	0.023
Manganese	0.001	mg/L	1.9	1.53	1.37	1.51
Iron	0.05	mg/L	ID	**45.4**	**37**	**42**
Nutrients						
Ammonia as N	0.01	mg/L	0.013*	0.76	0.61	<0.10
Nitrite as N	0.01	mg/L	0.015*	0.01	<0.01	<0.01
Nitrate as N	0.01	mg/L	0.015*	0.13	0.02	0.06
Nitrite + nitrate	0.01	mg/L	-	0.14	0.02	0.06
Total phosphorous as P	0.01	mg/L	0.02*	1.11	2.3	1.69
Reactive phosphorous	0.01	mg/L	-	<0.10	<0.02	<0.01
Ionic balance						
Total anions	0.01	meq/L	-	27.1	24	28.5
Total cations	0.01	meq/L	-	27.4	25.1	30.7
Ionic balance	0.01	%	-	0.64	2.24	3.72
Total petroleum hydrocarbons						
C6 - C9 fraction	20	µg/L	-	60	**40**	<20
C10 - C14 fraction	50	µg/L	-	**880**	**740**	**260**
C15 - C28 fraction	100	µg/L	-	**130**	**2360**	**150**
C29 - C36 fraction	50	µg/L	-	<50	**430**	<50
C10 - C36 fraction sum	50	µg/L	-	**1010**	**3530**	**410**
Total recoverable hydrocarbons						
C6 - C10 fraction	20	µg/L	-	**60**	**50**	<20
C6 - C10 fraction minus BTEX	20	µg/L	-	**20**	**30**	<20
>C10 - C16 fraction	100	µg/L	-	**870**	**770**	**240**
>C16 - C34 fraction	100	µg/L	-	**140**	**2510**	**190**
>C34 - C40 fraction	100	µg/L	-	<100	**300**	<100
>C10 - C40 fraction sum	100	µg/L	-	**1010**	**3580**	**430**

Analytes	LOR	UNITS	ANZECC guidelines	BH1017 - groundwater		
>C10 - C16 fraction minus apthalene	100	µg/L	-	**870**	**770**	**240**
BTEXN						
Benzene	1	µg/L	950	<1	<1	<1
Toluene	2	µg/L	ID	**16**	**9**	**5**
Ethylbenzene	2	µg/L	ID	**2**	<2	<2
meta-xylene	2	µg/L	ID	**12**	**7**	**4**
ortho-xylene	2	µg/L	350	**5**	**3**	<2
Total xylenes	2	µg/L	ID	**17**	**10**	**4**
Sum of BTEX	1	µg/L	-	**35**	**19**	**9**
Naphthalene	5	µg/L	16	<5	<5	<5

ANZECC 2000 guidelines - 95% protection for freshwater species
* = guideline value for lowland rivers
ID = insifficent data to create value
Bold = significant result

"This page has been intentionally left blank"

Appendix D NorthConnex Tunnel - Groundwater spring census

Ground Floor, Suite 01, 20 Chandos Street
St Leonards, NSW, 2065
PO Box 21
St Leonards, NSW, 1590

T +61 2 9493 9500
F +61 2 9493 9599
E info@emgamm.com

www.emgamm.com

11 December 2014

Mark Trudgett
Environmental Manager
Lend Lease
Sent via email to Mark.Trudgett@lendlease.com

Re: NorthConnex Tunnel – Groundwater spring census

Dear Mark,

1 Introduction

EMM were commissioned by the Lend Lease Bouygues Joint Venture (LLBJV) to undertake a field investigation to assess the surface expression of groundwater, specifically groundwater springs, within the NorthConnex Tunnel study area (the study area). This work was completed to satisfy, in part, a requirement to monitor potential impacts to water resources and wetlands, during construction and operation stages of the proposed project (Condition TC24 of the Tender Baseline Conditions of Approval for the M1-M2 project).

This letter report details the investigation including a summary and discussion of the results.

2 Background

Ecosystems that are supported by the subsurface presence of groundwater or the surface expression of groundwater are classified as groundwater dependant ecosystems (GDEs). Springs and wetlands are common examples of GDEs that are supported by the surface expression of groundwater.

In the Sydney Basin, the surface expression of groundwater typically occurs under the following conditions:

- in low lying areas where the water table intersects the surface;
- along geological contacts where groundwater flow is impeded; or
- in confined formations where district fractures outcrop at the surface.

3 Method

3.1 Desktop review

A desktop review was undertaken to identify locations where there was potential for the surface expression of groundwater. The study area encompassed a 2 km radius extending from the proposed corridor for the NorthConnex tunnel (Figure 1).

The following publically available resources were reviewed:

- the regional geology map (NSW Department of Mineral Resources 1983);
- vegetation mapping in the EIS (Eco Logical Australia 2013);
- topography (Land and Property Information 2014); and
- existing surface water monitoring locations (Draft Water Quality Monitoring Program 2014).

Potential sites were then prioritised, with locations where streams coincided with shale/sandstone geological boundaries given the highest priority. Sites that also contained Blue Gum High Forest critically endangered ecological community and/or Sydney Turpentine Ironbark Forest endangered ecological community were also prioritised for investigation as they are tall open forests that can be dependent on shallow groundwater.

3.2 Field survey

A three day site visit was completed by a hydrogelogist and an ecologist over the period 19 November to 21 November 2014. Leading up to and during the field survey, rainfall was below the monthly average with a total of 12.4 mm at the Wahroonga (Ada Avenue Bureau of Meteorology (BoM) gauging station. The average rainfall recorded at the gauging station for the month of November was 113.6 mm (November 2010-November 2014), indicating that the field survey was completed during a dry month.

A total of 27 individual sites were assessed during this period. Representative photographs were taken at each site where groundwater activity (or potential activity) was identified, and the vegetation was characterised to assess its dependence on groundwater (Table 2).

Where groundwater springs were identified, key water quality indicators were measured and recorded using a multi-parameter water quality meter (Table 1). Results are tabulated in Table 3 and discussed in Section 5 of this report. The water quality meter was calibrated daily to ensure accurate measurements.

Table 1 Water quality field parameters

Parameter	Units
pH	pH units
Electrical conductivity (EC)	µs/cm
Dissolved oxygen	mg/L
Temperature	ºC
Oxidation reduction potential (redox)	mV

Where conditions were suitable, the groundwater discharge rate (flow rate) was measured and recorded. This task was completed by recording the time to fill a vessel of known volume (10L bucket).

A Rapid Appraisal of Riparian Condition (Jansen *et al* 2007) was also completed at each flowing stream where springs were identified. This provides a quantitative assessment of baseline of stream condition and allows for follow-up monitoring if needed.

4 Results

Twenty seven individual sites were assessed in the field, with groundwater springs identified at 13 of these locations. An additional four sites were assessed as likely spring sites. However, these were not flowing under the current climatic conditions (Figure 2). Ten sites showed no sign of groundwater activity.

Of the 13 identified groundwater springs:

- ten were observed at the geological contact between Ashfield shale and Hawkesbury Sandstone;
- two were observed discharging from discrete fractures within the sandstone below the contact of the overlying shale; and
- one was observed to be discharging from weathered shale deposits.

Nine of the 13 groundwater discharges were associated with the presence of orange/brown flocculants. This is due to the oxidation of ferrous iron by iron-precipitating bacteria (Crenothrix) forming ferric hydroxide which gives the water an orange/brown colour. Ferric hydroxide and associated iron precipitating bacteria are common along springlines in the Hawkesbury Sandstone aquifer due to its high concentration of iron and manganese (Dr Wendy McLean, pers comm, 26 November 2014).

Native vegetation at five of the sites where springs were identified indicate the presence of two threatened ecological communities listed under the *Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999*, comprising Blue Gum High Forest (critically endangered) and Sydney Turpentine-Ironbark Forest (endangered). Other non-threatened vegetation types were also found at spring sites. Given the high rainfall in Sydney, this terrestrial vegetation is likely to only have a seasonal dependence on groundwater when rainfall is low (ie during winter).

With the exception of a spring observed at Cockle Creek, all springs exhibited slow groundwater discharge (<0.1 L/sec) with contributions to stream flow considered to be negligible. However, the spring located on Cockle Creek had an estimated continuous flow rate of 0.2 L/s. This spring is considered to contribute to stream flow at Cockle Creek.

Two GDEs were identified during the surveys, comprising terrestrial vegetation which is likely to access shallow groundwater along creek lines, and base flow in streams which provides water for aquatic vegetation, macroinvertebrates, fish and terrestrial fauna.

Table 2 Springs within 2km of proposed M1 tunnel

Site	Photo	Surface expression of groundwater	Vegetation description and potential groundwater dependence	Water quality	RARC score
Camp Creek near George Street (CAM-01)		No surface expression of groundwater observed. Potential spring location with aquatic weeds observed growing at the headwater of the stream on shale soils overlying sandstone rock. Presence of Blue Gums indicates shallow groundwater level.	Blue Gum (*Eucalyptus saligna*), Turpentine (*Syncarpia glomulifera*), Elephant Ears (*Colocasia esculenta**). Site is indicative of Blue Gum High Forest Critically Endangered Ecological Community (CEEC) in poor condition. Vegetation may be seasonally dependent on groundwater (ie when rainfall is low).	No spring identified	N/A

Table 2 Springs within 2km of proposed M1 tunnel

Site	Photo	Surface expression of groundwater	Vegetation description and potential groundwater dependence	Water quality	RARC score
Coups Creek near Hewitt Avenue (COU-01, COU-02 and COU-03)		Three springs observed flowing out of creek bank in clay soil near geological boundary with sandstone. Heavy weed growth near spring. Iron flocculation observed in spring discharge.	Turpentine, Grey Ironbark (*E. paniculata*), Blackbutt (*E. pilularis*), Smooth-barked Apple (*Angophora costata*), Native Peach (*Trema tomentosa*) and Tree Ferns (*Cyathea* spp.) Site indicative of Sydney Turpentine Ironbark Forest Endangered Ecological Community (EEC). Vegetation may be seasonally dependent on groundwater. Springs classified as minor contributors to stream flow.	Spring discharge presenting high concentration of ferric iron. pH outside of ANZECC guideline values for freshwater species. Low EC indicates relatively young groundwater source (short residence time).	Average
Coups Creek near the Comenarra Parkway (COU-04)	N/A	None identified.			

Table 2 Springs within 2km of proposed M1 tunnel

Site	Photo	Surface expression of groundwater	Vegetation description and potential groundwater dependence	Water quality	RARC score
Devlins Creek near Copeland Road (DEV-01)		No surface expression of groundwater observed. Tall vegetation clumped in a depression at the stream headwater indicates that a spring may be present.	Blue Gum, White Stringybark (*E. globoidea*) and Cocos Palm (*Cocos nucifera**). Site is indicative of Blue Gum High Forest CEEC in poor condition. Vegetation may be seasonally dependent on groundwater.	No spring identified.	N/A
Devlins Creek near York Street (DEV-02)	N/A	None identified.			

Table 2 Springs within 2km of proposed M1 tunnel

Site	Photo	Surface expression of groundwater	Vegetation description and potential groundwater dependence	Water quality	RARC score
Darling Mills Creek (near Westmore Drive) (DAR-01)		Groundwater seeping slowly out of fracture in sandstone and pooling next to creek.	Blackbutt, Turpentine, Smooth-barked Apple, Christmas Bush (*Ceratopetalum gummiferum*), Tree Fern, Sweet Pittosporum (*Pittosporum undulatum*). Site is indicative of Sydney Sandstone Gully Forest (non-threatened vegetation). Vegetation is a dry sclerophyll forest and therefore unlikely to be dependent on groundwater.	Water stagnating within pool. No sample taken.	N/A
Darling Mills Creek near Lisle Court (DAR-02)	N/A	None identified.			

Table 2 Springs within 2km of proposed M1 tunnel

Site	Photo	Surface expression of groundwater	Vegetation description and potential groundwater dependence	Water quality	RARC score
Jimmy Banks Creek near Lisgar Road (JIM-01)		Spring seeping (<0.1 L/sec) from sandstone above creek at the boundary with shale soils.	Blackbutt, Turpentine, Smooth-barked Apple, Christmas Bush, Tree Fern, Sweet Pittosporum, Large-leaved Privet, Maiden Hair Fern (*Adiantum aethiopicum*), Ginger Lily (*Hedychium gardenerianum**) and Giant Reed (*Arundo donax**). Site is indicative of Sydney Sandstone Gully Forest (non-threatened vegetation). Vegetation is a dry sclerophyll forest and therefore unlikely to be dependent on groundwater.	No presence of Ferric iron. pH outside of ANZECC guideline values for freshwater species. Low EC indicates relatively young groundwater source (short residence time).	Good
Scout Creek near Sutherland Rd (SCO-01)		Groundwater seeping from shale soil on creek bank overlying sandstone (<0.1 L/sec).	Grey Ironbark, Blue Gum, Turpentine, Large-leaved Privet, Tree Fern, Rainbow Fern (*Calochlaena dubia*), Water Fern (*Blechnum* spp.). Site is indicative of Sydney Turpentine Ironbark Forest EEC.	No presence of Ferric iron. pH outside of ANZECC guideline values for freshwater species. Low EC indicates relatively young groundwater source (short residence time).	Excellent

Table 2 Springs within 2km of proposed M1 tunnel

Site	Photo	Surface expression of groundwater	Vegetation description and potential groundwater dependence	Water quality	RARC score
Scout Creek near Tristania Way (SCO-02)		Spring observed in grassed area above the headwater of Scout Creek. Water is pooled and seeping slowly up through the shale soil which overlies sandstone.	Blue Gums with a weedy understorey including Lantana (*Lantana camara**), Balloon Vine (*Cardiospermum grandiflorum**), Crofton Weed (*Ageratina adenophora**), Morning Glory (*Ipomaea indica**), Paspalum (*Paspalum distichum**) and Sorrel (*Acetosella vulgaris**). Site is indicative of Blue Gum High Forest CEEC in poor condition. Potential seasonal groundwater dependence when rainfall is low.	No presence of ferric iron. pH outside of ANZECC guideline values for freshwater species. Low EC indicates relatively young groundwater source (short residence time).	N/A
Scout Creek near Pomona Street (SCO-03)	N/A	None identified.			

Table 2 Springs within 2km of proposed M1 tunnel

Site	Photo	Surface expression of groundwater	Vegetation description and potential groundwater dependence	Water quality	RARC score
Cockle Creek near Coonabarra Road (COC-01)		Spring observed in headwaters of Cockle Creek. Flow estimated at 0.2 L/sec out of deep shale creek bank overlying sandstone. High concentration of iron flocculation in spring disharge.	The site is heavily dominated by weeds including Giant Reed, Coral Tree (*Erythrina x sykesii**), and Bamboo (*Phyllostachys* spp.) with occasional native trees and shrubs including Smooth-barked Apple, Tree Fern and Sweet Pittosporum.	Spring supporting moderate flows. High concentration of ferric iron at discharge location. pH outside of ANZECC guideline values for freshwater species. Low EC indicates relatively young groundwater source (short residence time).	Very poor at spring, poor downstream
Tedbury Creek near Red Gum Avenue (TED-01, TED-02, TED-03 and TED-04)		Four springs observed in creek bed at shale/sandstone boundary. High concentration of ferric iron settled on creek bed. A weir noted at the creek headwaters restricting surface flow.	The site is heavily dominated by Large-leaved Privet, but contains several Prickly-leaved Paperbarks (*Melaleuca styphelioides*).	No presence of Ferric iron. pH outside of ANZECC guideline values for freshwater species. Low EC indicates relatively young groundwater source (short residence time). Low redox indicative of a reducing environment.	Poor

Table 2 Springs within 2km of proposed M1 tunnel

Site	Photo	Surface expression of groundwater	Vegetation description and potential groundwater dependence	Water quality	RARC score
Waitara Creek near Clovelly Avenue (WAI-01)		Spring observed seeping out of sandstone (<0.1 L/sec). Ferric iron observed in discharged groundwater.	The site is heavily weed infested including Large-leaved Privet and Camphor Laurel (*Cinnamomum camphora**), but contains some native species including Illawarra Flame Tree (*Brachychiton acerifolius*) and Blueberry Ash (*Elaeocarpus reticulatus*)	pH outside of ANZECC guideline values for freshwater species. Low EC indicates relatively young groundwater source (short residence time).	Very poor
Waitara Creek near Malisbury Avenue (WAI-02)	N/A	None identified.			

Table 2 Springs within 2km of proposed M1 tunnel

Site	Photo	Surface expression of groundwater	Vegetation description and potential groundwater dependence	Water quality	RARC score
Waitara Creek near Normanhurst Park (WAI-03)		None identified. Possible perennial spring location indicated by water in shallow pools.	Blackbutt, Smooth-barked Apple, Sweet Pittosporum, Bracken. Site is indicative of Sydney Sandstone Gully Forest (non-threatened vegetation). Vegetation is a dry sclerophyll forest and therefore unlikely to be dependent on groundwater.	N/A	N/A
Culvert in Elouera Bushland Reserve (ELO-01)		Ferric iron staining noted on culvert. Culvert flowing out of inaccessible private property. The presence of upstream springs is considered likely.	N/A	N/A	N/A
Berbers	N/A	None identified.			

Table 2 Springs within 2km of proposed M1 tunnel

Site	Photo	Surface expression of groundwater	Vegetation description and potential groundwater dependence	Water quality	RARC score
Creek near new Farm Road (BER-01)					
Berowra Creek near Boundary Road (BEW-01)	N/A	None identified.			
Berowra Creek near Kitchener Road (BEW-02)	N/A	None identified.			
Zig Zag Creek in Elouera Bushland Reserve (ZIG-01)	N/A	None identified.			
Larool Creek near Larool Crescent (LAR-01)	N/A	None identified.			

Table 3 Water quality field parameters

	Units	ANZECC guidelines	Coups Creek near Hewitt Ave	Jimmy Banks Creek near Lisgar Rd	Scout Creek near Sutherland Rd	Scout Creek near Tristania Way	Cockle Creek near Coonabarra Rd	Tedbury Creek near Red Gum Ave	Waitara Creek near Clovelly Avenue
Date and time			19/11/14 10:30	20/11/14 14:10	19/11/14 08:40	19/11/14 10:00	19/11/14 12:30	21/11/14 09:30	21/11/14 12:00
Field parameters									
pH	pH units	6.5-7.5*	8.64	7.61	8.21	8.28	7.81	8.16	8.65
Electrical conductivity	µs/cm	125-2200	429.7	548.6	345.3	265.3	250.1	371.7	1092
Dissolved oxygen	mg/L	-	27.3	28.49	19.1	11.9	18.2	3.51	15.73
Temperature	°C	-	18.2	17.6	17.4	23.3	17.9	22.1	19.2
Oxidation reduction potential	mV	-	-2.9	17.9	15.3	273.1	-34.3	-60	59.7

Notes: 1.ANZECC 2000 guidelines – 95% protection for freshwater species

*2. * = guideline value for lowland rivers*

5 Discussion

The Hawkesbury Sandstone aquifer is known to provide baseflow contributions to many streams across the Sydney Basin. The combination of geological deposition, deformation and the steeply incised topography across the basin provides avenues for groundwater to discharge at the surface as either seeps or springs.

The site visit identified springs at 13 of the surveyed locations. A further four sites indicated presence of GDEs, however did not present surface expressions of groundwater. Flow from the identified springs was the result of discrete fractures and geological contacts. Measured flow was minimal at <0.1L/s at all but one site (Cockle Creek) which had an estimated flow of 0.2L/s.

The water quality measured at the spring discharge locations determined water to be generally of potable quality. This assessment of quality is based upon a limited number of analytes and is therefore only considered an indication of spring water quality. The presence of ferric iron at many of the spring locations is indicative of Hawkesbury Sandstone groundwater quality and provided further evidence of groundwater contributions to the surface water systems.

Yours sincerely

Katie Whiting
Senior Ecologist
kwhiting@emgamm.com

Sean Cassidy
Hydrogeologist
scassidy@emgamm.com

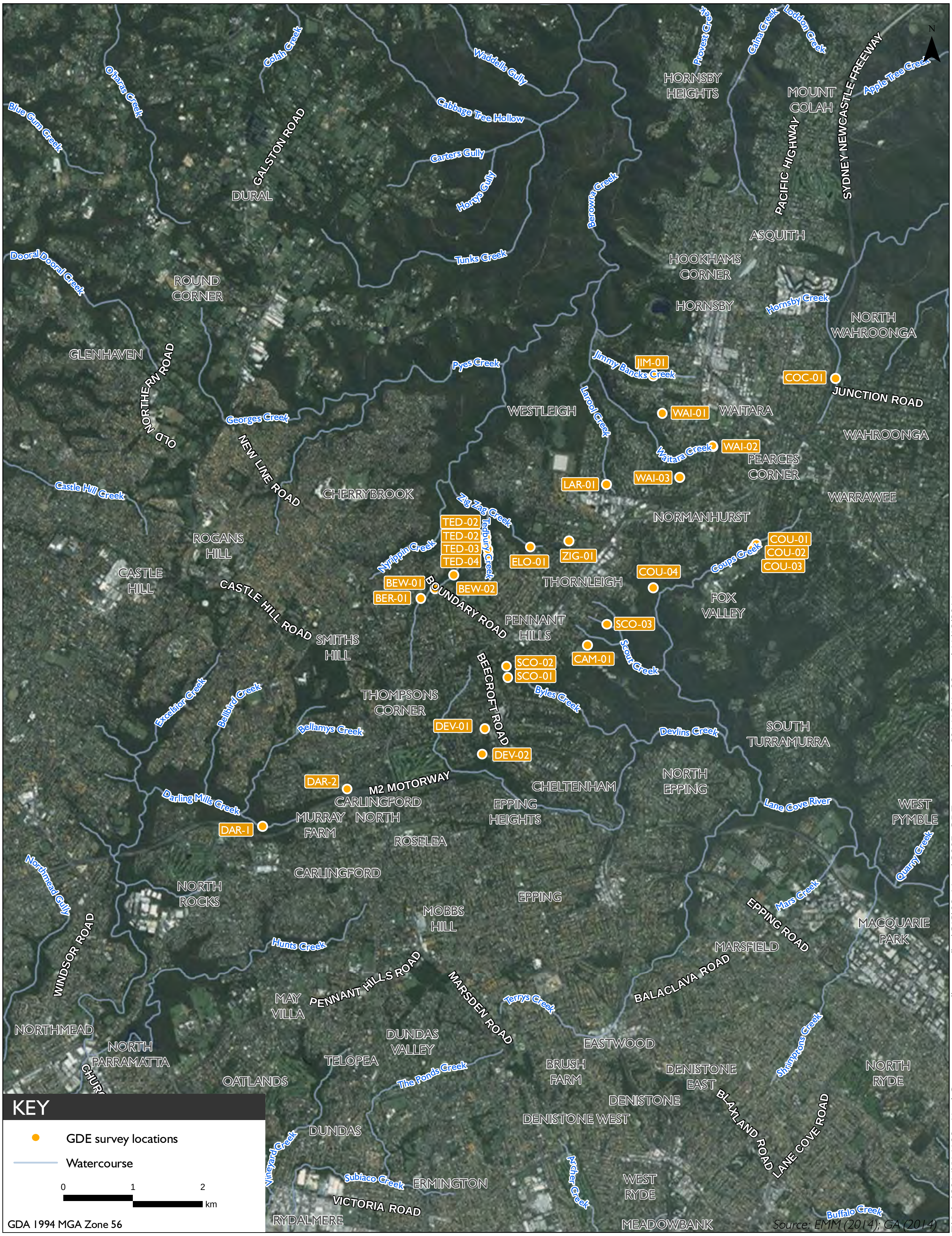
6 References

NSW Department of Mineral Resources 1983, *Sydney 1: 100,000 Geological Sheet (9130) First Edition,* Department of Mineral Resources, Sydney

Eco Logical Australia 2013, *NorthConnex Technical Working Paper: Biodiversity,* report prepared for AECOm on behalf of Roads and Maritime Services

Land and Property Information 2014, *NSW Spatial Information Exchange (SIX),* https://maps.six.nsw.gov.au, viewed 17 November 2014

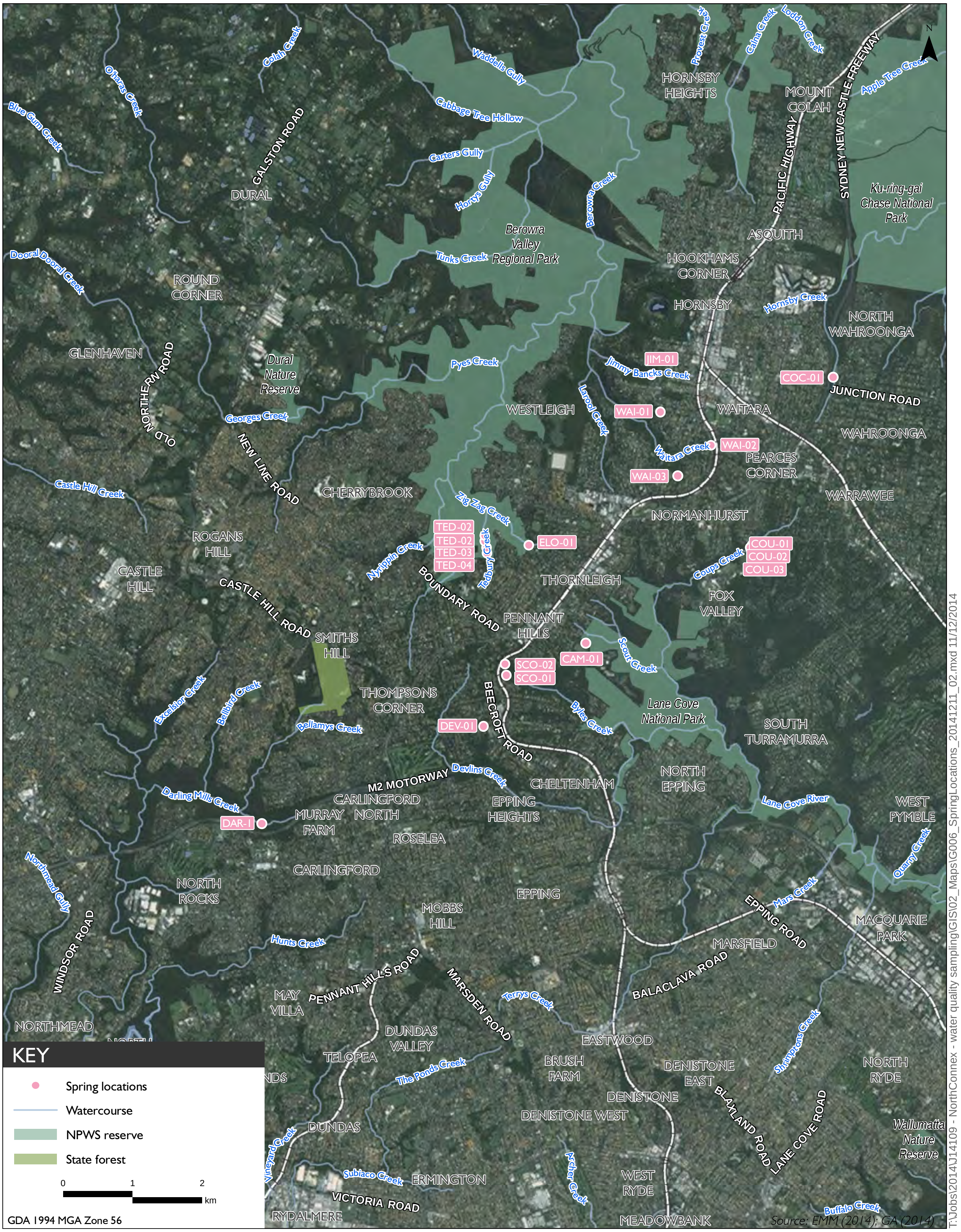
Jansen A, Robertson A, Thompson L, Wilson A and Flanery F 2007, *Rapid Appraisal of Riparian Condition, Technical Guideline for the southern tablelands of New South Wales,* Land and Water Australia, Canberra



T:\Jobs\2014\J14109 - NorthConnex - water quality sampling\GIS\02_Maps\G005_GDEsurveysites_20141211_02.mxd 11/12/2014

GDE survey sites

Northconnex
Water quality sampling
Figure 1



EMM
EMGA Mitchell McLennan

Spring locations

Northconnex
Water quality sampling
Figure 2

"This page has been intentionally left blank"

Appendix E Groundwater model report

REPORT

29 September 2016

NORTHCONNEX

Groundwater Impact Modelling

Submitted to:
Philippe Bourdon
LLBJV/Bouygues Construction Australia

Report Number. 1536023-700-01-R-Rev1

Table of Contents

TABLES

FIGURES

APPENDICES

User Note: This Table of Contents section acts as a reference point for the Record of Issue, Executive Summary and Study Limitations sections as and when they might be required. Therefore, the structure of this section must not be altered in any way.

1.0 INTRODUCTION

1.1 Background

The NorthConnex Project (NCX) will provide twin motorway tunnels connecting the Hills M2 Motorway at West Pennant Hills and the M1 Pacific Motorway at Wahroonga. The tunnels are approximately nine kilometres in length and twelve meters in width with a height of eight meters. Each tunnel will be built with long term capacity for three lanes, but will operate with two lanes and a breakdown lane in each direction. Associated permanent underground structures comprises cross passages, ventilation/vent shafts and adits, and caverns. The twin-tunnels and all associated underground structures are designed as fully drained structures allowing groundwater to seep into the underground voids.

1.2 Related work

Golder Associates Pty Ltd (Golder) has previously developed for the Aurecon Australasia Pty Ltd & SMEC Australia Pty Ltd (ASJV) a three-dimensional (3D) numerical groundwater flow model (the Groundwater Inflow Model) to provide groundwater inflow estimates to the operational twin-tunnel and permanent underground structures. The development of the Groundwater Inflow Model and predictive inflow results from various simulations have been presented in the Lend Lease Bouygues Joint Venture (LLBJV) Inflow Model report “Groundwater Model and Hydrogeological Assessment”[1] (dated 12 February, 2016), including:

- Hydrogeological and groundwater observational data
- Conceptual hydrogeology of the tunnel corridor and adjacent catchment areas
- Conceptual water balance (recharge and discharge)
- Three-dimensional hydrogeological model
- Three-dimensional numerical groundwater flow model details such as
  - Model domain construction, layout, resolution and extent
  - Boundary conditions (including tunnel representation)
  - Calibrated model parameters
- Excavation schedule for tunnels and permanent structures
- Transient predictions of groundwater tunnel inflow rates for several grouting scenarios (spatially and temporally distributed)
- Sensitivity of inflows to certain hydraulic parameters and hydrogeological features.

1.3 This report

The purpose of this report is to estimate the groundwater drawdown to be expected along the alignment, which was previously assessed during the Environmental Impact Assessment (EIA), through a two-dimensional (2D) model. This assessment takes into account all available data since the EIA, including the recent development of the design and the results of site investigation.

The model used in assessing the groundwater drawdown (referred to as the Groundwater Impact Model) is based on the Groundwater Inflow Model, which was previously developed to assess the groundwater inflow into the tunnels. The scope of the Groundwater Inflow Model report[1] did not include estimates of potential changes in the regional potentiometric head due to drainage of the twin-tunnels during operation.

[1] LLBJV Document NCX-ASJ-01-1060-GH-RP-0001, Revision 03, 15 June 2016.

2.0 OBJECTIVES

The work presented in this report compliments the objectives of the previous work (Section 1.2). The Groundwater Impact Model has been used to compute groundwater drawdown at selected locations including selected registered wells, monitoring bores, creeks, springs and groundwater dependent ecosystems (GDEs), in order to estimate:

- Impacts of tunnel drainage on groundwater levels at the first day of tunnel operation and for the long-term (quasi steady state) at the registered water bore locations in Table 7-170 of the Environmental Impact Statement (Ref.: AECOM Australia Pty Ltd. 2014, Environmental Impact Assessment – Volume 1B: Section 7.8 Hydrogeology and soils) that were identified as 'operational' in a survey recently conducted by LLBJV.
- Impacts of tunnel drainage on groundwater levels at the first day of tunnel operation and for the long-term (quasi steady state) at the locations of the seven (7) LLBJV groundwater monitoring bores utilised for calibration of the Groundwater Inflow Model (BH004, BH1009, BH1017, BH014, BH021, BH023, BH025).
- Change in total interflow between the Hawkesbury Sandstone and the Ashfield Shale at the first day of tunnel operation and for the long-term (quasi steady state).
- Spring discharge rates and change in groundwater levels at locations in Table 1. Spring discharge rates for these locations are computed at the first day of tunnel operation and for the long-term (quasi steady state).

Table 1: GDE[1] sites included in the Impact Modelling. Source: NorthConnex M1-M2 Water Quality Plan and Monitoring Program[2] (2015)

Site	GDE[1]	Spring	Site	GDE[1]	Spring
CAM-01	YES	NO	**TED-01**	NO	YES
COU-01	NO	YES	**TED-02**	NO	YES
COU-02	NO	YES	**TED-03**	NO	YES
COU-03	NO	YES	**TED-04**	NO	YES
COU-04	NO	NO	**WAI-01**	NO	YES
DEV-01	NO	NO	**WAI-02**	NO	NO
DEV-02	NO	NO	**WAI-03**	NO	NO
DAR-01	NO	NO	**ELO-01**	NO	NO
DAR-02	NO	YES	**BER-01**	NO	NO
JIM-01	NO	YES	**BEW-01**	NO	NO
SCO-01	YES	YES	**BER-02**	NO	NO
SCO-02	NO	YES	**ZIG-01**	NO	NO
SCO-03	NO	NO	**LAR-01**	NO	NO
COC-01	NO	YES			

[1]GDE: Groundwater Dependent Ecosystem

[2] LLBJV Document ALL-LLB-01-0001-QA-PL-0062, Appendix E, Revision 4, 29 May 2015.

3.0 DATA REVIEW

Springs and Groundwater Dependent Ecosystems

Table 1 lists spring and groundwater dependent ecosystem (GDE) locations within the groundwater impact model domain. At three sites (COU-01, SCO-03 and TED-02), multiple springs have been observed and are designated “A”, “B”, “C” etc. Appendix A presents the data available from the 2015/2016 groundwater spring census[2] at the locations in Table 1.

Of the 27 spring/GDE sites in Table 1,

- 14 sites presented no signs of surface groundwater expression (i.e., spring discharge)
- 9 sites had no discharge rates recorded
- For the remaining sites, small discharge rates (<0.1 L/s, 0.2 L/s) have been recorded.

Groundwater levels

Data available for registered water bore usage, groundwater levels and construction details (screen depth, screen interval, bore depth) of operational water bores within the model domain is presented in Appendix B.

Of the 19 registered bores listed,

- No bores have any groundwater level data available and therefore comparisons with computed groundwater levels cannot be made at these locations
- 5 bores have no construction (depth or screen interval) details
- For inclusion in the impact model, 6 bores required the assumption that their screens are positioned at the bottom of the bore hole with the geological formation (Hawkesbury Sandstone or Ashfield Shale) monitored determined by the screen depth and the geological model.
- 8 bores have depth and screen position information (and are represented in the groundwater impact model.

As there is no groundwater level data available for the registered (non project) bores, this report will present the estimated change in groundwater levels at those locations. For the 5 bores with no depth/screen data, the estimated change in groundwater level at those bore locations is provided for two cases – in the first case, it is assumed the bores are screened in the Hawkesbury Sandstone, in the second case the bores are assumed to be screened in the Ashfield Shale.

Groundwater levels at seven groundwater monitoring bores (BH004, BH1009, BH1017, BH014, BH021, BH023 and BH025) with groundwater level records from 2013 to 2016 were used for calibration purposes during the development of the Groundwater Flow Model (the calibration process is described in the Inflow Model report[1]). The seven bores are referred to as groundwater monitoring bores in the remainder of this report and hydrographs for those bores are shown in Figure 1.

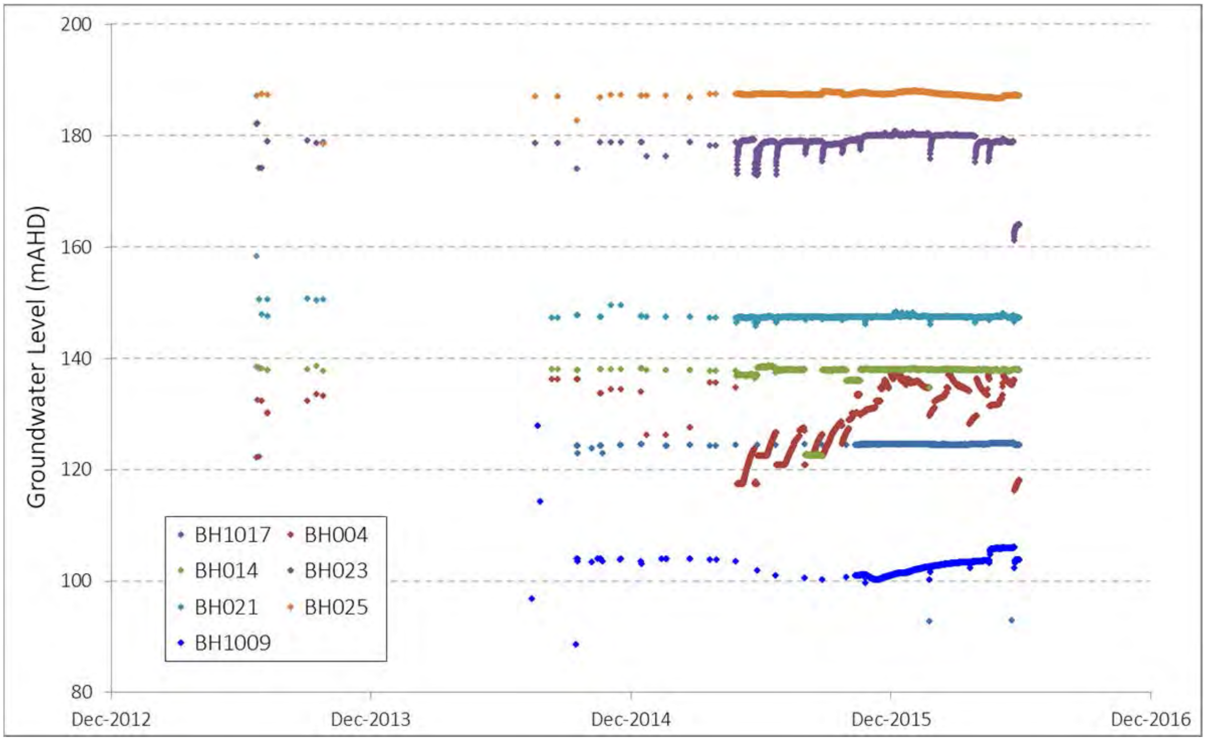


Figure 1: Observed Groundwater Levels at Monitoring Bores

4.0 REFINED NUMERICAL GROUNDWATER FLOW MODEL

4.1 Summary of Groundwater Inflow Model

The numerical code selected for the Groundwater Inflow Model was Modflow NWT developed by US Geological Survey. The Groundwater Impact Model is based on the Groundwater Inflow Model.

4.1.1 Model assumptions

The following assumptions apply to the Groundwater Inflow Model and the Groundwater Impact Model.

- The rock mass hydraulic conductivity of the Hawkesbury Sandstone, Mittagong Formation and Ashfield Shale can be approximated by the hydraulic conductivity of a homogeneous equivalent porous media.
- Flow of groundwater is assumed to mainly follow along open bedding partings and to a lesser extent along sub-vertical joints. This anisotropy in the flow is accounted for by adopting separate hydraulic conductivity values for horizontal and vertical flow within each homogeneous hydrogeological unit (vertical hydraulic conductivity may be locally enhanced along major geological structures).
- Average horizontal hydraulic conductivity estimates for the Hawkesbury Sandstone and Ashfield Shale – Mittagong Formation units assume log-normal distribution of water pressure test results. Our estimate assumes the average horizontal hydraulic conductivity estimate is representative for a rock mass volume.
- The aquifer is bounded at depth by an impervious layer.
- Recharge to the water table from above applies uniformly across 28 recharge regions (although recharge varies with the spatially varying soil and rock conditions above the water table and the enhanced recharge along drainage lines during storm events). The water table in the Hawkesbury Sandstone receives some recharge from water percolating through the unsaturated Ashfield Shale along most parts of the alignment.

- For steady state modelling, recharge was assumed to be constant across all 28 recharge regions.
- Rivers and creeks at the model boundaries are modelled as constant heads with groundwater discharging when groundwater table elevations are above the water levels in the creeks or rivers. For ephemeral streams and creeks a groundwater water table elevation derived from groundwater level observation – ground elevation correlations are used for defining the constant head elevation at the model boundary.
- All underground works are drained. Any impediment to tunnel inflow caused by temporary or permanent structures and support is not included in the model if not otherwise stated. This includes restrictions of flow from the rock face due to shotcrete that has a lower permeability than the adjacent rock.

4.1.2 Model set-up

The Groundwater Inflow Model is based on the following information and assumptions:

- Three-dimensional stratigraphic layers (geological) model developed by Golder with Earth Volumetric Studio (EVS). The Modflow model uses 1 layer to represent the Fill / Top Soil, 2 layers for the Ashfield Shale - Mittagong Formation and 8 layers for the Hawkesbury Sandstone. The number of layers for the Hawkesbury Sandstone is determined by the need to improve the vertical model resolution along the tunnel alignment and for simulating the excavation of the shafts. The layers representing these formations are shown in the table below.

Table 2 Numerical model layers

Model Layer	Hydrogeological Unit	Thickness (m)
1	Fill/Residual	0.5 to 14
2 – 3	Ashfield Shale and Mittagong Formation	0.25 to 50
4 – 9	Hawkesbury Sandstone	1 to 20
10	Hawkesbury Sandstone	1 to 70
11	Hawkesbury Sandstone	500

The Groundwater Inflow Model takes into consideration:

- Variable ground conditions along the alignment by modelling the subsurface as three stacked hydrogeological layers: 1) Residual Soil / Fill, 2) Ashfield Shale – Mittagong Formation and 3) Hawkesbury Sandstone, each with characteristic hydrogeological parameters and a spatially variable thickness defined by the 3D Geological Model. The ground surface is defined by a 30 m by 30 m Digital Terrain Model. For each layer a horizontal equivalent rock mass hydraulic conductivity value is adopted that varies with the depth of cover.
- Ground elevation dependent groundwater recharge and drainage by delineating recharge areas based on land use (vegetated and build areas) and catchment boundaries. A recharge model is applied to each of the recharge areas that takes into account groundwater recharge from rainfall infiltration within vegetated areas, groundwater depth dependent evaporation losses, exfiltration from sewers and leakage from water mains in built up areas. Recharge and evaporation loss factors controlling the volume of deep recharge received from vegetated areas are estimated by calibrating computed groundwater heads to time-averaged groundwater levels observations.
- Long year average monthly total rainfall and pan-evaporation records from the nearest Bureau of Meteorology (BoM) climatic stations to derive a time variant factor that is applied to the individual recharge and drainage areas and provides time varying recharge and drainage terms of the transient model.

- Near surface, perched groundwater in the Ashfield Shale, by using MODFLOW-NWT model code that allows a better simulation of groundwater-surface water interaction and transitions between saturated and unsaturated flow.
- Estimates of losses from sewers and water mains have been derived from public available documents (including Sydney Water reports).
- Vegetation and build areas derived from NearMap high-resolution aerial imagery.
- Groundwater level records of the groundwater monitoring bores BH004, BH1009, BH1017, BH014, BH021, BH023, BH025.
- Groundwater level and ground elevation data at other bore locations across the model domain sourced from Golder database.
- The model domain (within the perimeter) covers an area of 97 km^2. It is divided with a finite difference rectangular grid, with spacing variable from 200 x 200 m to 50 x 50 m.
- The drained underground structures of the tunnel project are represented in the model at a spatial resolution of 50 m lateral and 50 m along the alignment. The 50 m x 50 m cell size is sufficient to incorporate the twin tunnel, cross passages, shafts, ventilation tunnels and caverns and to account for the groundwater drainage of these structures. In the model, the cells in which these features occur are simulated as drains by setting the cells as drain cells with a drain cells level set to the elevation specified by tunnel invert levels.
- The excavation of the tunnel and shafts were modelled using drain cells that were successively activated in accordance with the excavation schedule allowing groundwater to exit the model domain.
- For simulating shaft excavation drain cells of successive model layers at the shaft locations were activated as shaft excavation progressed to the depth of the next layer. At the conclusion of a shaft excavation simulation of tunnel excavation commenced. Tunnel excavations in opposite directions were simulated at STN 3750, 6250 and 8750.
- The excavation schedule for M120 is identical to M110 with a possible time lag between both excavation schedules of 1 to 2 weeks, this time difference is considered inconsequential to the modelling impact so similar excavation timings have been used for the mainline tunnels.

4.1.3 Model calibration

The Groundwater Inflow Model was calibrated to existing steady state conditions. A groundwater system is said to be in a steady state when the flow processes are (at least to a good approximation) constant with time[3].

The calibrated model includes:

- What has been inferred to be the Thornleigh Dyke extending across the NorthConnex tunnel alignment at around STN 5700 m as a separate, highly permeable zone across the tunnel alignment
- A zone with increased permeability across the tunnel alignment along the lineaments at Spring Street, approximately between STN 3300 m and 3600 m (BH 1017, Wilson Road shaft).

The model supports the presence of a dyke and a zone with increased permeability however, the model calibration does not provide evidence for additional features.

The model is calibrated to time averaged groundwater level observations of seven (7) monitoring bores (F3M2-BH004, NCX-BH1009, NCX-BH1017, F3M2-BH014, F3M2-BH021, F3M2-BH023, F3M2-BH025) located along the alignment and calibration is in line with the linear correlation between groundwater level observations and ground elevations established from 132 groundwater observation locations across the

[3] Australian Government, National Water Commission, 2012, Australian Groundwater Modelling Guidelines, Waterlines Report Series 82, June 2012, p. 8.

model. The goodness-of fit between groundwater level observations and groundwater results (correlation coefficient of 0.9) computed with the calibrated model demonstrate that the model is capable to replicate groundwater conditions within the project corridor.

The model parameters: 1) total groundwater recharge and evaporation loss factors, 2) hydraulic conductivity of the Residual Soil/Fill layer and 3) the ratio between vertical and horizontal hydraulic conductivity of the Ashfield Shale – Mittagong Formation and Hawkesbury Sandstone units are systematically adjusted, until computed groundwater heads closely matches time-averaged water level observations at the groundwater monitoring bores.

The groundwater recharge values adopted for the three-dimensional numerical groundwater model after model calibration range between 0.8 and 1.5% with an average of 1.3%. This value is inline supported by values published by McNally (2004).

Comparison of model results to groundwater observations at the calibration bores are shown in the table below.

Table 3 Observed and computed groundwater levels

Monitoring Bore	Observed Groundwater Level# (mAHD)	Computed Groundwater Level (mAHD)
BH004	130.8	107.2
BH1009	103.7	117.5
BH1017	124.3	132.4
BH014	137.9	137.5
BH021	148.5	148.5
BH023	177.8	159.2
BH025	186.8	163.2

#Average groundwater level from July 2013 to April 2016

Additionally, bores located outside the project corridor but still within the model domain were used (where data was available) to evaluate the predictive capability of the model. Table 3 compares groundwater observations to those predicted by the groundwater impact model (in steady-state conditions, prior to excavation), showing that model predictions have a 89.5% correlation with field observations, with a residual mean of 13.49 m and a scaled RMS error of 0.158. This level of model calibration is considered reasonable for a Class 2 groundwater model (classification in accordance with the Australian Groundwater Modelling Guideline[4]).

[4] National Water Commission, 2012, Australian groundwater modelling guidelines, June 2012.

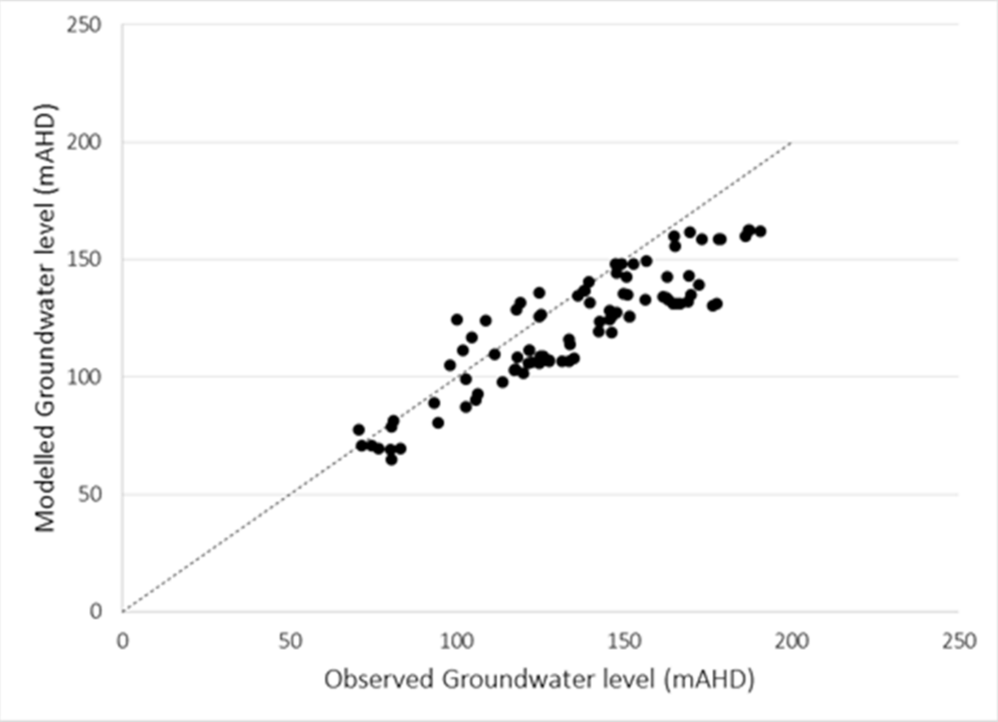


Figure 2: Observed versus Modelled Groundwater Levels

4.1.4 Base Case

The calibrated model developed in accordance with Sections 4.1.2 and 4.1.3 is referred to as the 'Base Case'. The Base Case is considered the most likely scenario based on the project geotechnical information. The calibrated hydraulic parameters are shown in the table below.

Table 4 Base Case - calibrated parameter values (steady state)

Hydrogeological Unit	Horizontal Hydraulic Conductivity K_h(m/s)	Ratio K_h/Kv	Specific Yield (%)
Fill / Residual	$5x10^{-7}$	1	5
Ashfield Shale / Mittagong Formation	$5x10^{-8}$	20	1
Hawkesbury Sandstone (Weathered)	$1.1x10^{-7}$	2	1
Hawkesbury Sandstone (Shallow, < 40 m depth)	$1.02x10^{-7}$	2	1
Hawkesbury Sandstone (Deep, ≥ 40 m depth)	$3.54x10^{-8}$	5	0.8
Higher-Permeability Zones (Structures)	$1.1x10^{-6}$	5	0.1

4.2 Model refinement – Groundwater Impact Model

Model refinement has involved increasing the resolution of the numerical model grid of the Groundwater Inflow Model in locations of interest, namely the sites of the monitoring bores, springs and GDEs at which predictions of impact are required. The Groundwater Inflow Model domain was divided with a finite difference rectangular grid, with model cell sizes variable from 200 m by 200 m to 50 m by 50 m. For the Groundwater Impact Model, individual cell sizes have been reduced by up to a factor of 4 (i.e., a 75% reduction in the area of an individual model cell) at the sites of interest in order to increase accuracy of prediction of groundwater drawdown at those sites. This is most noticeable at sites of interest at further distances from the tunnel corridor (Figure 3). Because the model domain area remains unchanged, the Groundwater Impact Model has more than 27,000 additional active model cells (as compared to the Groundwater Inflow Model).

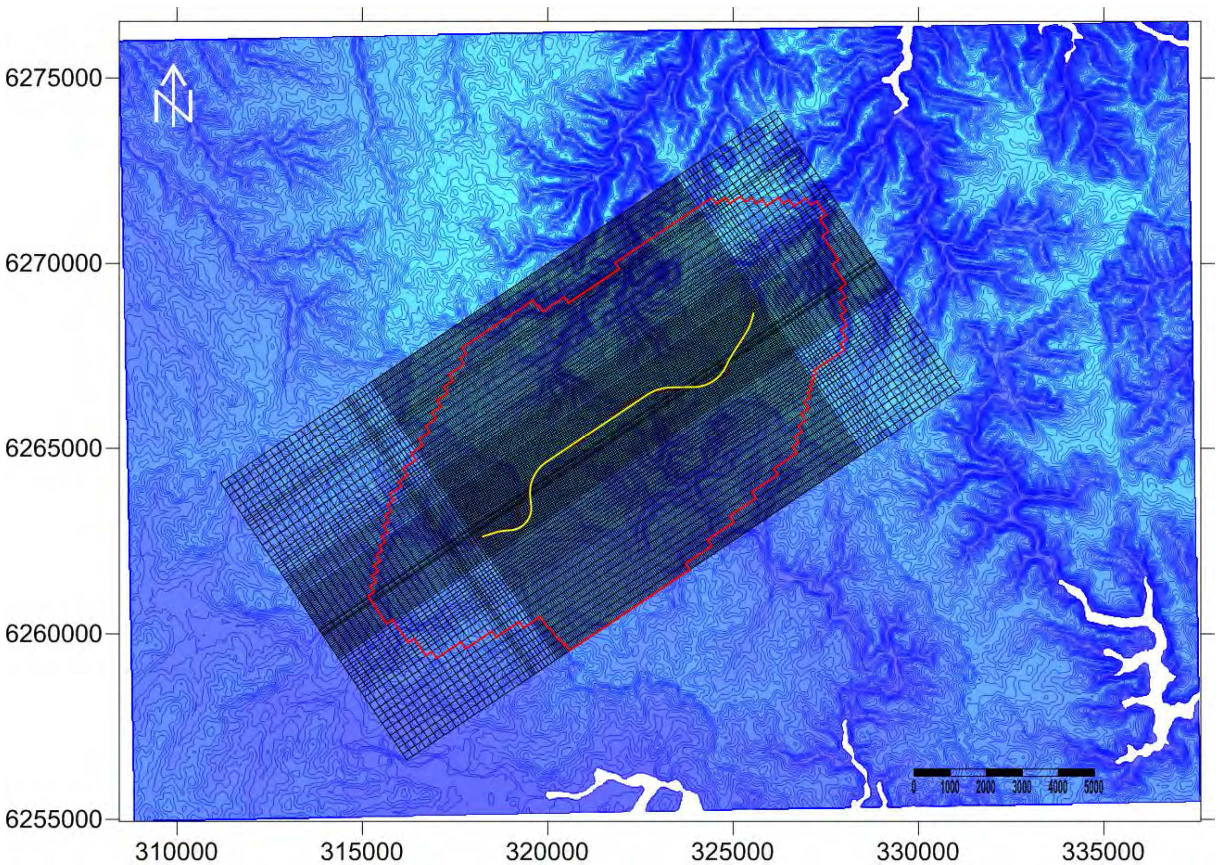


Figure 3: Refined grid of the Groundwater Impact Model

4.3 Predictive simulations

Predictive groundwater impact simulations have been conducted using the tunnel excavation schedule for the Base Case and four sensitivity scenarios (Cases A, B, C and D). The sensitivity cases assessed include variation in Hawkesbury Sandstone storage (specific yield), number of permeable structures crossing the tunnel alignment and effect of grouting selected permeable structures on inflow estimates and are summarised in Table 5.

Table 5: Predictive Simulation Scenarios

Scenario	Major Permeable Structures Intersecting Tunnel		Minor Permeable Structures Intersecting Tunnel		Hawkesbury Sandstone Specific Yield
	Description	Grouted[a]	Description	Grouted[a]	
Base Case	Spring Street Structure and Thornleigh Dyke	No	-	-	1% at < 40 m depth 0.8% at ≥ 40 m depth
Sensitivity Case A	Same as Base Case	No	3 in south-west 3 in north-east	No	Same as Base Case
Sensitivity Case B	Same as Base Case	No	-	-	1.5% at < 40 m depth 1.2% at ≥ 40 m depth
Sensitivity Case C	Same as Base Case	Yes	3 in south-west 3 in north-east	No	Same as Base Case
Sensitivity Case D	Same as Base Case	Yes	3 in south-west 3 in north-east	Yes (south-west) No (north-east)	Same as Base Case

[a] to a background permeability of 5 Lugeon

5.0 GROUNDWATER IMPACTS

5.1 Groundwater levels and drawdown

Estimates of groundwater levels and drawdown (change in potentiometric head) due to tunnel drainage are presented at two points in time:

- at the commencement of tunnel operation (November 2019) and
- in the long term (quasi steady state), after 45 years of operation.

To calculate drawdown, a pair of simulations is conducted – one simulation includes the drained NCX twin-tunnels and associated underground structures, and one simulation does not. Drawdown is then calculated as the difference in groundwater levels at corresponding times.

Computed groundwater drawdown at the groundwater monitoring bore locations BH004, BH1009, BH1017, BH014, BH021, BH023, BH025 and the registered operational bores for the Base Case and the Sensitivity Cases A, B, C and D are summarised in Table 6.

Observational data and groundwater levels computed by the Groundwater Impact Model for the Base Case are illustrated in Figure 4 and Figure 5 for the monitoring bores in Table 6. Figure 6 illustrates the computed groundwater levels for the registered operational bores (Appendix B) as no observational data is available for those bores. Note that several bores listed fall under the same licence number and have been registered with the same spatial coordinates.

Drawdown contours are shown for the Base Case:

- Figure 7 and Figure 8 show drawdown at beginning of operation in the Hawkesbury Sandstone and Ashfield Shale, respectively,
- Figure 9 and Figure 10 show drawdown in the Hawkesbury Sandstone and Ashfield Shale, respectively, in the long term.

Maximum estimated drawdown occurs in the south-west where the elevations of the tunnel invert levels are at their lowest (i.e. the tunnel is deepest). In the long-term, groundwater drawdown may extend up to 2 km from the tunnel alignment in the area with the lowest invert levels of the twin-tunnels, but typically extend to 0.6 to 1 km.

Figure 11 compares the long term drawdown estimates of

- the numerical Groundwater Impact Model
- the analytic drawdown estimates presented in the EIA document and
- updated analytic drawdown estimates using the final tunnel alignment, calibrated hydraulic parameter and recharge values from the Groundwater Impact Model and the analytic method.

The three drawdown estimates all exhibit consistent behaviour, with drawdown in the south-west extending further than in the north-east. The differences between the estimates are primarily due to

- in the south-west
  - the tunnel alignment below the NWRL tunnels and hence, higher drawdown of the potentiometric head is estimated along the tunnel alignment
  - the spatial extent of drawdown is further increased in the numerical model by geological structures intersecting the tunnel alignment and exhibit a higher hydraulic conductivity compared to the undisturbed Hawkesbury Sandstone. This higher conductivity value has been used for the updated analytical estimate.
- in the north-east, drawdown estimated by the numerical model is exacerbated by the shape of the groundwater table which generally follows topography and decreases away from the tunnel alignment (which follows a ridge line)
- the numerical Groundwater Impact Model utilises more recent data and employs a finer level of detail (both spatially and temporally) in describing the hydrogeological domain (particularly lateral to the twin-tunnels alignment) such as the following which cannot be incorporated fully (or at all) by the analytic estimates:
  - topographic details
  - spatial changes in hydraulic material parameters
  - recharge rates.

Table 6: Estimated Groundwater Drawdown (m) at Registered and Groundwater Monitoring Bores at Commencement of Operations (November 2019) and Long Term

SITE	BASE CASE		CASE A		CASE B		CASE C		CASE D	
	Commence Operations	Long Term	Commence Operations	Long Term	Commence Operations	Long Term	Commence Operations	Long Term	Commence Operations	Long Term
BH025	5.6	7	5.5	6.7	5.1	7	5.6	7	5.5	6.7
BH023	2.9	5.3	2.8	4.8	2.3	5.3	2.9	5.3	2.8	4.8
BH021	0.6	3.3	0.3	2.1	0.4	3.3	0.6	3.3	0.3	2.1
BH014	13.6	14.7	13.4	14.4	13.3	14.7	13.6	14.7	13.3	14.4
BH004	4	11.3	4.9	11.1	3.4	11.3	4	11.2	4.7	10.9
BH1009	28.3	32.9	34.3	35.8	25.2	32.9	28.3	32.9	31.9	34.1
BH1017	30.6	32.7	30.6	32.8	29.5	32.7	30.1	32.3	30.1	32.3
GW028366	34.5	37.4	34.5	37.4	32	37.4	34.4	37.4	34.4	37.4
GW103826	11.2	25.6	11.6	24.9	9.2	25.6	11.2	25.5	11.4	24.5
GW103827	11.2	25.6	11.6	24.9	9.2	25.6	11.2	25.5	11.4	24.5
GW103828	11.2	25.6	11.6	24.9	9.2	25.6	11.2	25.5	11.4	24.5
GW103829	11.2	25.6	11.6	24.9	9.2	25.6	11.2	25.5	11.4	24.5
GW107571	1.6	8	1.7	8.6	1.1	8.1	1.6	7.6	1.6	8.1
GW107088	5.1	5.9	5	5.8	4.8	5.9	5.1	5.9	5	5.8
GW114379	5.2	9.2	5.2	9	4.2	9.2	4.9	9	4.9	8.7
GW114380	5.3	9.1	5.2	8.9	4.3	9.1	4.9	8.8	4.8	8.6
GW114381	5.2	9.2	5.2	9	4.2	9.2	4.9	9	4.9	8.7
GW114382	5.2	9.2	5.2	9	4.2	9.2	4.9	9	4.9	8.7
GW068381	11	18.1	11.1	18.1	9	18.1	11	18	11.1	18
GW103060	12.5	14.6	12.4	14.5	11.7	14.6	12.5	14.6	12.3	14.4

SITE	BASE CASE		CASE A		CASE B		CASE C		CASE D	
	Commence Operations	Long Term	Commence Operations	Long Term	Commence Operations	Long Term	Commence Operations	Long Term	Commence Operations	Long Term
GW100380	12.5	14.6	12.4	14.5	11.7	14.6	12.5	14.6	12.3	14.4
GW114316[A]	1.5	10.2	1.4	10.1	0.9	10.3	1.4	10	1.4	9.9
GW114317[A]	1.5	10.2	1.4	10.1	0.9	10.3	1.4	10	1.4	9.9
GW114314[A]	1.5	10.2	1.4	10.1	0.9	10.3	1.4	10	1.4	9.9
GW114313[A]	1.4	10	1.4	10	0.7	10	1.3	9.8	1.4	9.7
GW114315[A]	1.4	10	1.4	10	0.7	10	1.3	9.8	1.4	9.7
GW114316[B]	1.3	10.4	1.4	10.1	0.8	10.2	1.3	9.8	1.5	10
GW114317[B]	1.3	10.4	1.4	10.1	0.8	10.2	1.3	9.8	1.5	10
GW114314[B]	1.3	10.4	1.4	10.1	0.8	10.2	1.3	9.8	1.5	10
GW114313[B]	1.4	10.4	1.4	10	0.9	10.1	1.3	9.7	1.5	9.9
GW114315[B]	1.4	10.4	1.4	10	0.9	10.1	1.3	9.7	1.5	9.9

[A]assumes bore is screened in Hawkesbury Sandstone; [B]assumes bore is screened in Ashfield Shale

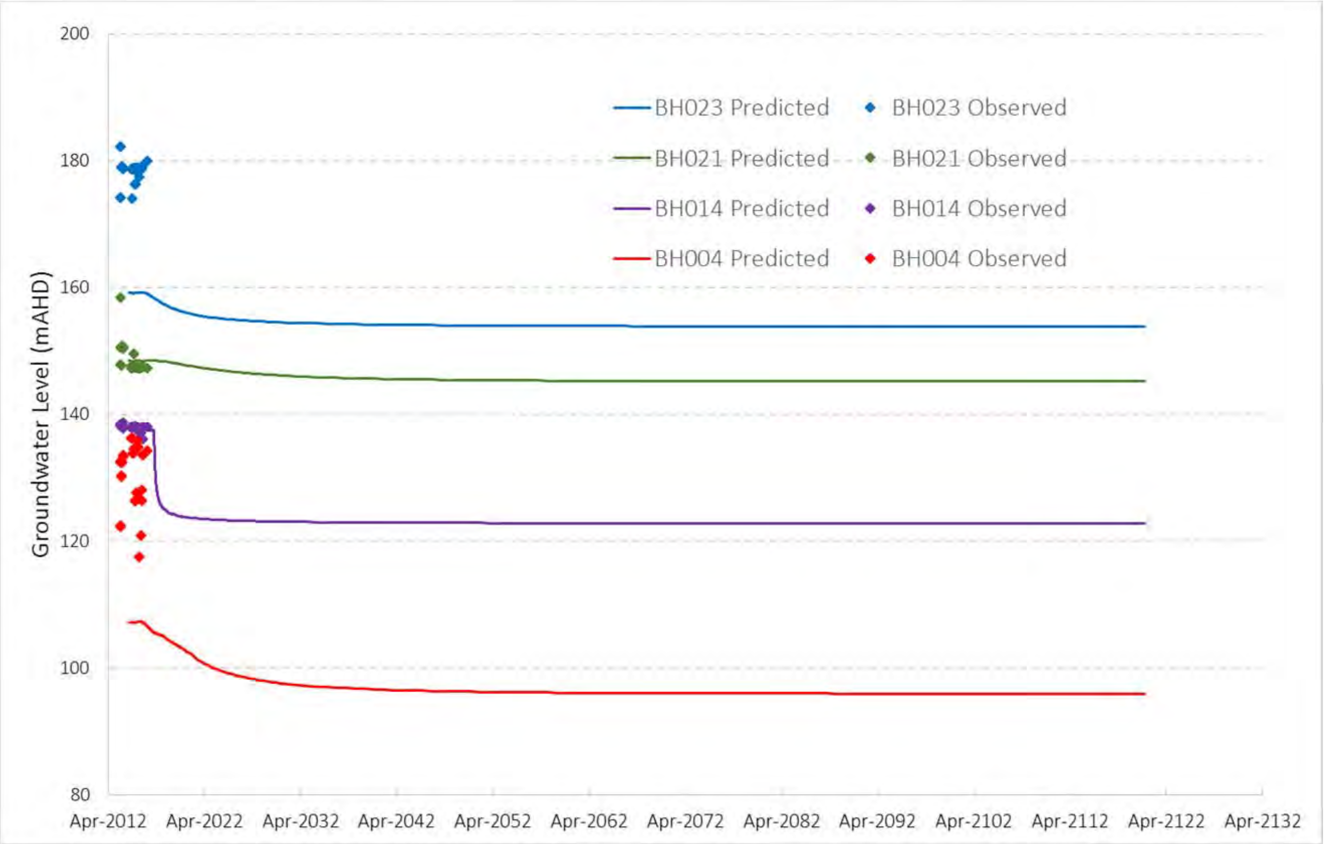


Figure 4: Observed and Computed (Base Case) groundwater levels at monitoring bores BH021, BH023, BH014 and BH004

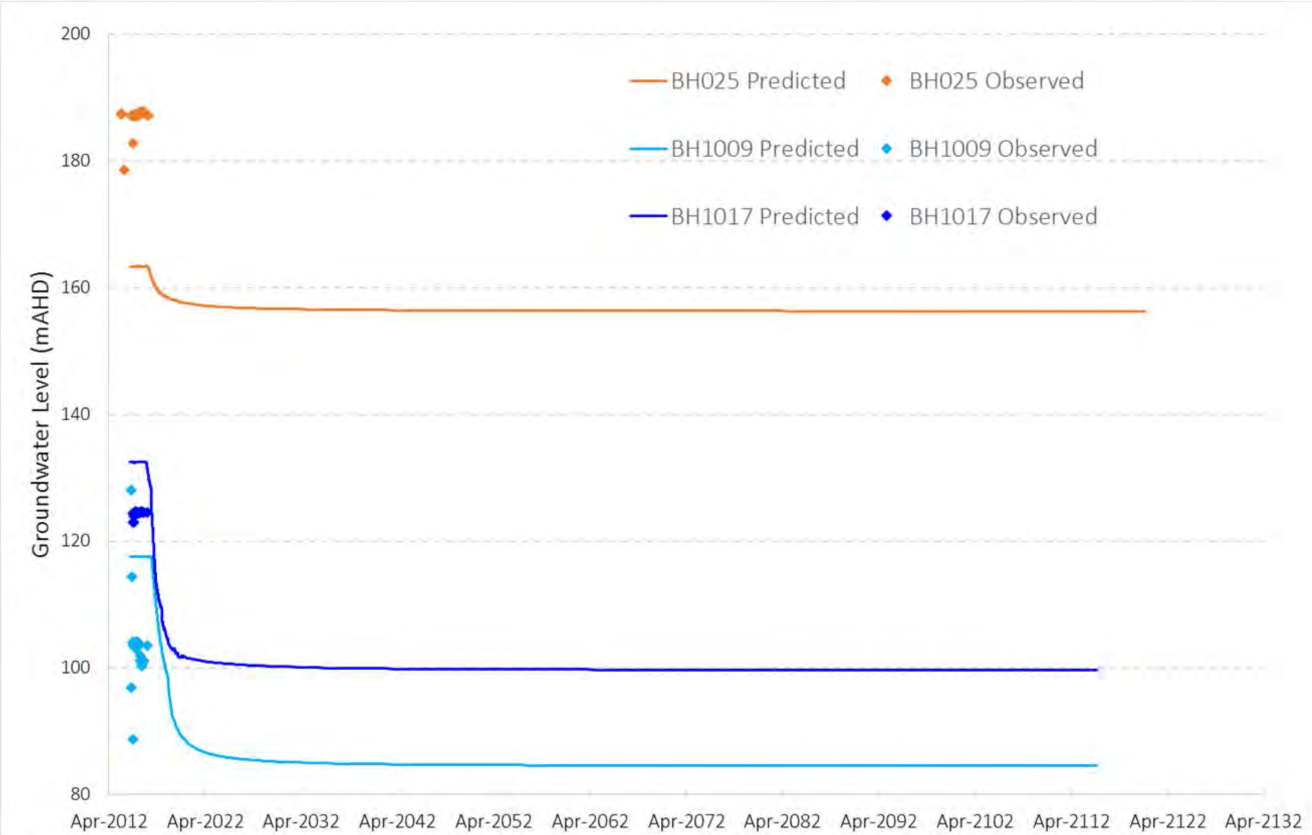


Figure 5: Observed and Computed (Base Case) groundwater levels at monitoring bores BH025, BH1009 and BH1017

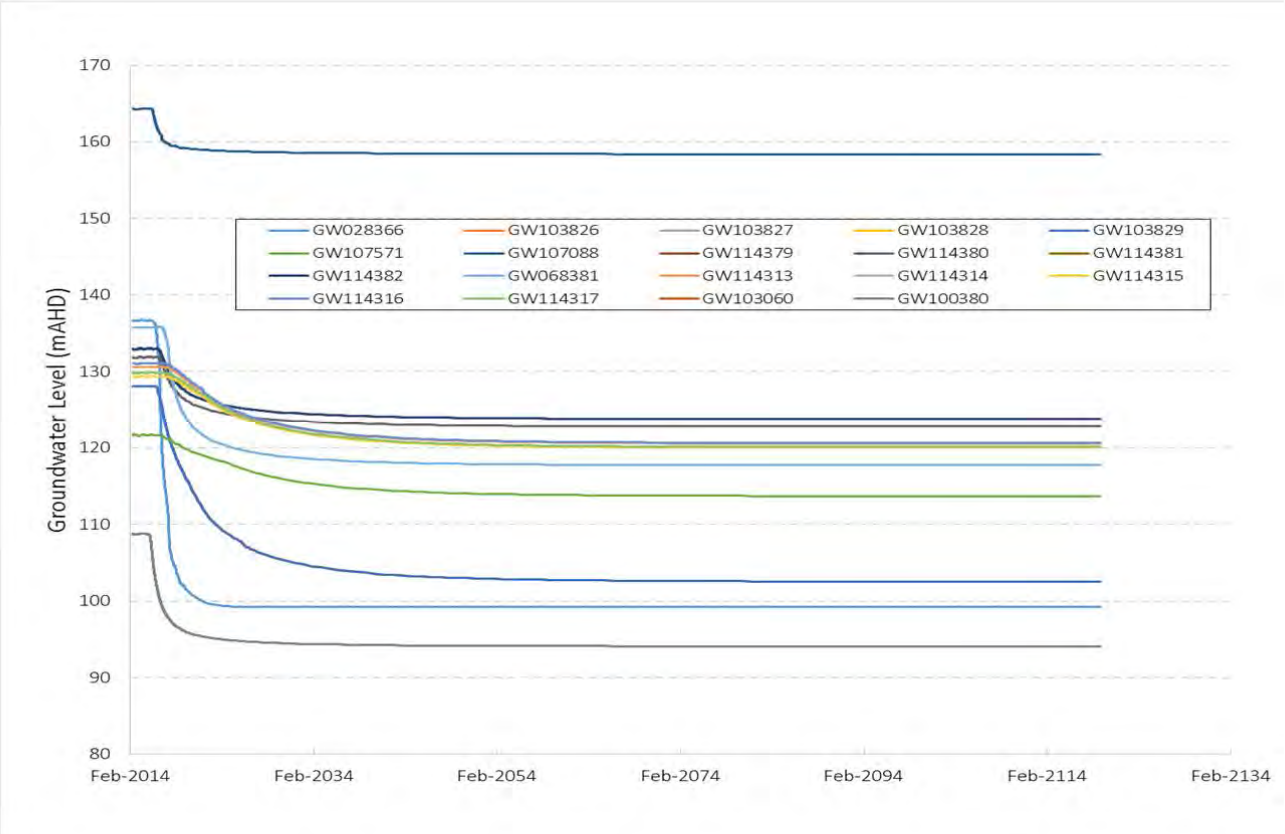
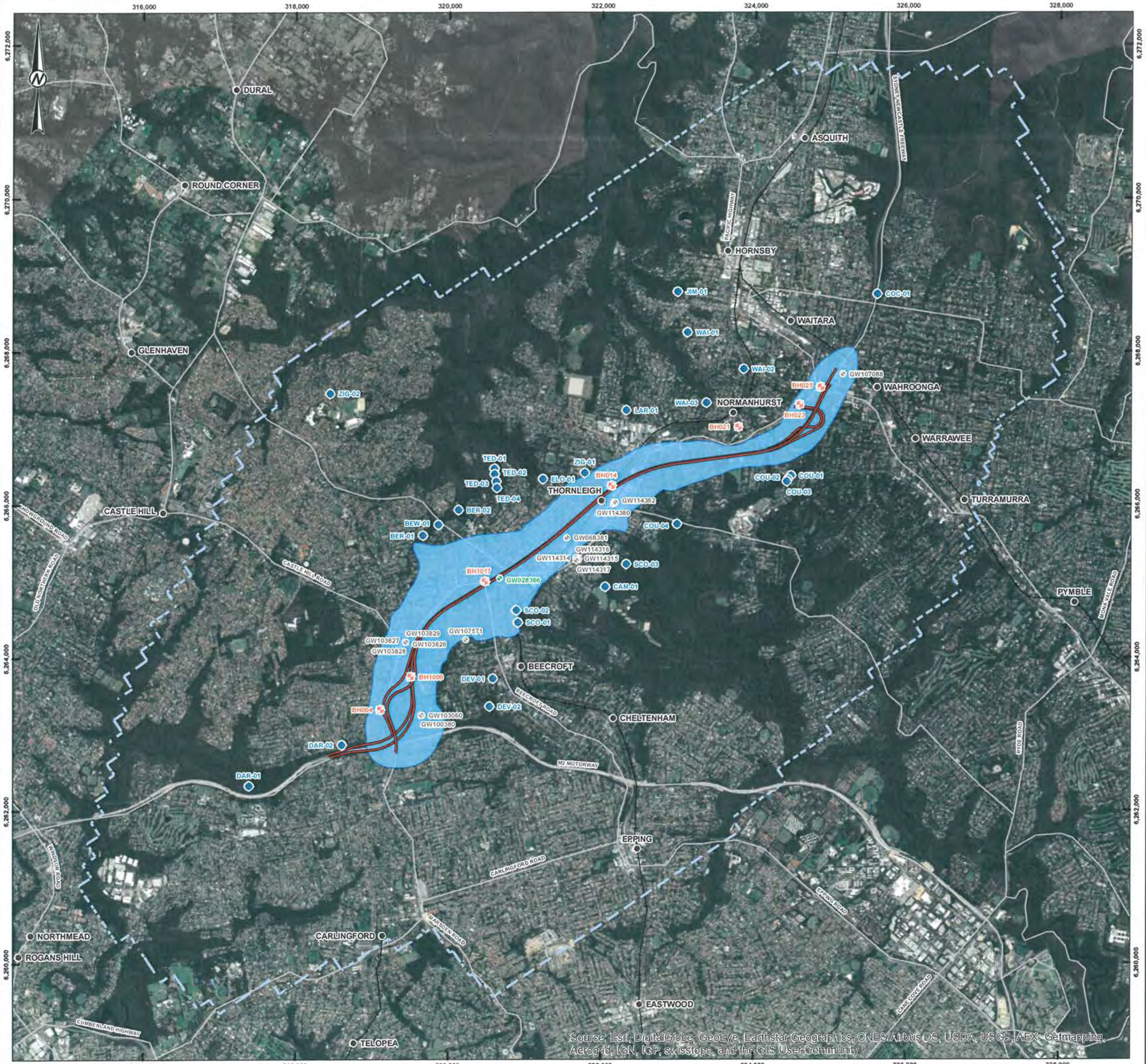


Figure 6: Computed (Base Case) Groundwater Levels at Registered Bores

Figure 7: Computed Groundwater Drawdown in Hawkesbury Sandstone at Commencement of Operations



LOCATION MAP

LEGEND

- Localities

Groundwater Locations

- Springs and GDE Sites
- Monitoring Bore
- Registered Bore
- Registered Bores Within 14m Drawdown Area
- NorthConnex Twin-Tunnel Alignment
- Model Domain Boundary

Transport

- Railways
- Main Roads

Groundwater Impact Zone (area within 2m drawdown contour)

- Numerical Model Estimate

NOTE(S)

Tunnel, Bores and GDE: Provided by LLBJV / Bouygues Construction Australia 2016.

REFERENCE(S)

COPYRIGHT

Localities, Roads and Railways: GeoScience Australia (C) Copyright Commonwealth of Australia (Geoscience Australia) 2006.

0 1 2 Kilometres
1:50,000
PROJECTION: GDA 1994 MGA Zone 56

CLIENT
LLBJV / BOUYGUES CONSTRUCTION AUSTRALIA

PROJECT
NORTH CONNEX TUNNEL

TITLE
COMPUTED GROUNDWATER DRAWDOWN IN HAWKESBURY SANDSTONE AT COMMENCEMENT OF OPERATIONS

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-07-29
PREPARED	DP
DESIGNED	SW
REVIEWED	LMQ
APPROVED	DB

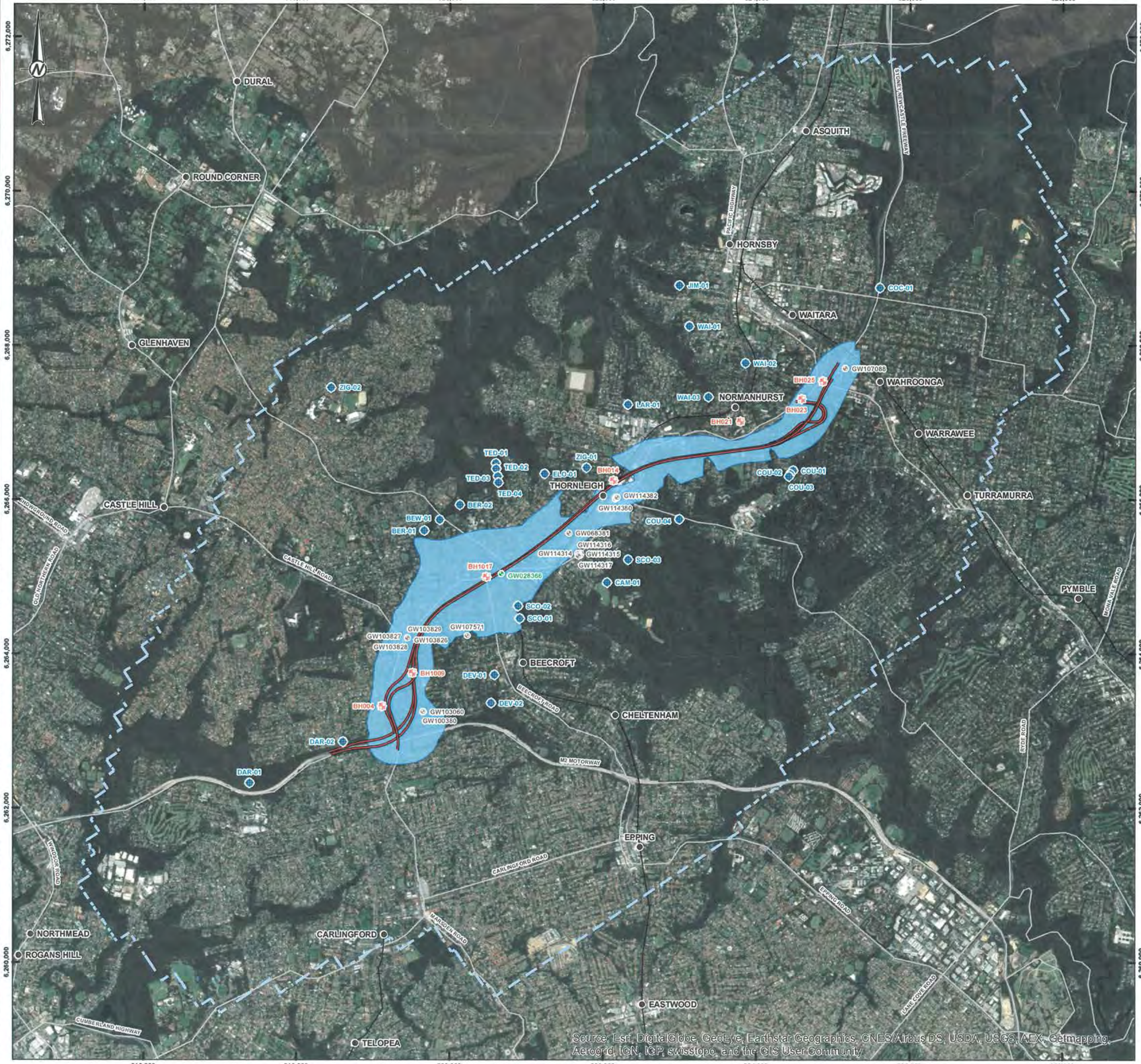
PROJECT NO.	CONTROL	REV.	FIGURE
1563023	001	0	7

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A3

25mm

Path: \\golder.gds\GAP\Brisbane\Jobs\Hyd\2015\Sydney\NConnex Brisbane Working Folder\GIS working\MXD\1536023_001_R_Rev0_GndWater_Predicted_Fig6.mxd

Figure 8: Computed Groundwater Drawdown in Ashfield Shale at Commencement of Operations



LOCATION MAP

LEGEND

- Localities

Groundwater Locations

- Springs and GDE Sites
- Monitoring Bore
- Registered Bore
- Registered Bores Within 14m Drawdown Area
- NorthConnex Twin-Tunnel Alignment
- Model Domain Boundary

Transport

- Railways
- Main Roads

Groundwater Impact Zone (area within 2m drawdown contour)

- Numerical Model Estimate

NOTE(S)

Tunnel, Bores and GDE: Provided by LLBJV / Bouygues Construction Australia 2016.

REFERENCE(S)

COPYRIGHT

Localities, Roads and Railways: GeoScience Australia (C) Copyright Commonwealth of Australia (Geoscience Australia) 2006.

0 1 2 Kilometres

1:50,000

PROJECTION: GDA 1994 MGA Zone 56

CLIENT

LLBJV / BOUYGUES CONSTRUCTION AUSTRALIA

PROJECT

NORTH CONNEX TUNNEL

TITLE

COMPUTED GROUNDWATER DRAWDOWN IN ASHFIELD SHALE AT COMMENCEMENT OF OPERATIONS

CONSULTANT

Golder Associates

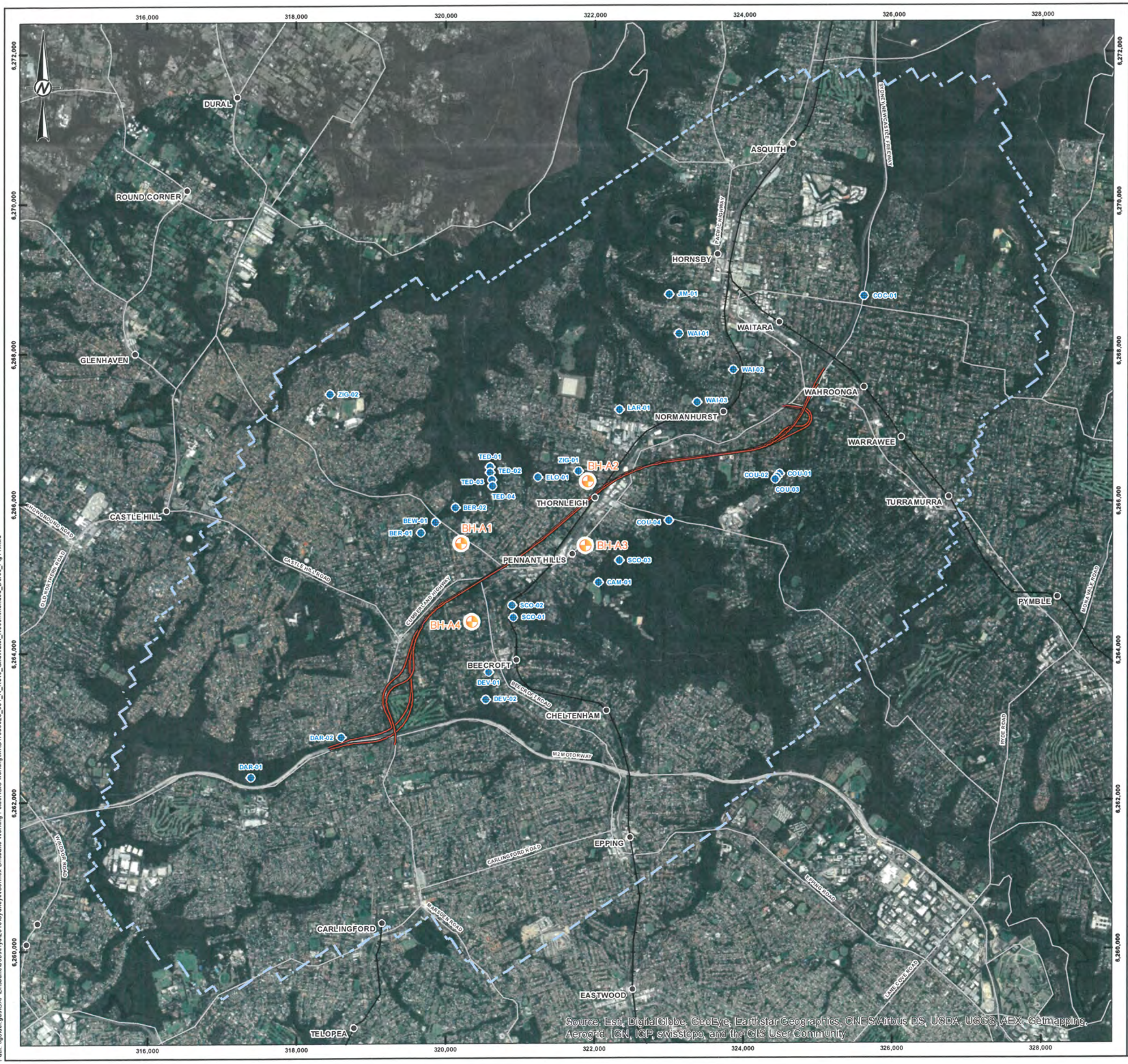
YYYY-MM-DD	2016-07-29
PREPARED	DP
DESIGNED	SW
REVIEWED	LMQ
APPROVED	DB

PROJECT NO.	CONTROL	REV	FIGURE
1563023	001	0	8

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM A3

Path: \\golder.gds\GAP\Brisbane\Jobs\Hyd\2015\Sydney\NConnex Brisbane Working Folder\GIS working\MXD\1536023_001_R_Rev0_GndWater_Predicted_Ashfield_Fig7.mxd

Figure 9: Computed Groundwater Drawdown in Hawkesbury Sandstone in the Long Term



LOCATION MAP

LEGEND

- ● Localities

Groundwater Locations

- Springs and GDE Sites
- Recommended Monitoring Bore Sites
- NorthConnex Twin-Tunnel Alignment
- Model Domain Boundary

Transport

- Railways
- Main Roads

NOTE(S)

Tunnel, Bores and GDE: Provided by LLBJV / Bouygues Construction Australia 2016.

REFERENCE(S)

COPYRIGHT

Localities, Roads and Railways: GeoScience Australia (C) Copyright Commonwealth of Australia (Geoscience Australia) 2006.

0 1 2

1:50,000 Kilometres

PROJECTION: GDA 1994 MGA Zone 56

CLIENT

LLBJV / BOUYGUES CONSTRUCTION AUSTRALIA

PROJECT

NORTH CONNEX TUNNEL

TITLE

SUGGESTED LOCATIONS FOR RECOMMENDED MONITORING BORES

CONSULTANT

Golder Associates

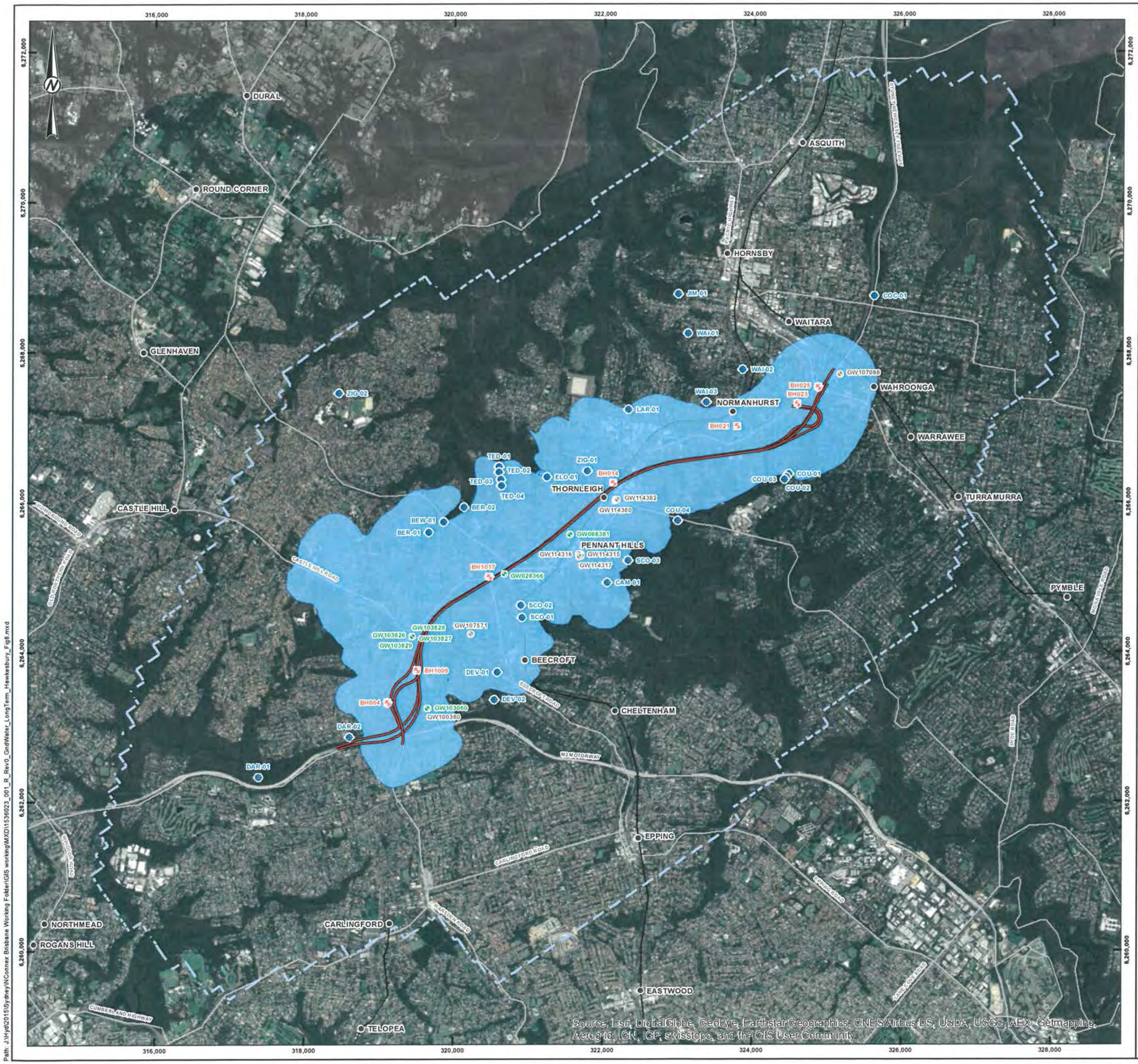
YYYY-MM-DD	2016-07-27
PREPARED	DP
DESIGNED	SW
REVIEWED	LMQ
APPROVED	DB

PROJECT NO.	CONTROL	REV.	FIGURE
1563023	001	0	12

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A1

25mm

Path: \\golder.gds\GAP\Brisbane\Jobs\Hyd\2015\Sydney\NConnex Brisbane Working Folder\GIS working\MXD\1536023_001_R_Rev0_GndWater_Recommended_Bores_Fig11.mxd



LOCATION MAP

LEGEND

- Localities

Groundwater Locations

- Springs and GDE Sites
- Monitoring Bore
- Registered Bore
- Registered Bores Within 14m Drawdown Area
- NorthConnex Twin-Tunnel Alignment
- Model Domain Boundary

Transport

- Railways
- Main Roads

Groundwater Impact Zone (area within 2m drawdown contour)

- Numerical Model Estimate

NOTE(S)
Tunnel, Bores and GDE: Provided by LLBJV / Bouygues Construction Australia 2016.

REFERENCE(S)

COPYRIGHT
Localities, Roads and Railways: GeoScience Australia (C) Copyright Commonwealth of Australia (Geoscience Australia) 2006.

0 1 2
1:50,000 Kilometres
PROJECTION: GDA 1994 MGA Zone 56

CLIENT
LLBJV / BOUYGUES CONSTRUCTION AUSTRALIA

PROJECT
NORTH CONNEX TUNNEL

TITLE
COMPUTED GROUNDWATER DRAWDOWN IN HAWKESBURY SANDSTONE IN THE LONG TERM

CONSULTANT: Golder Associates

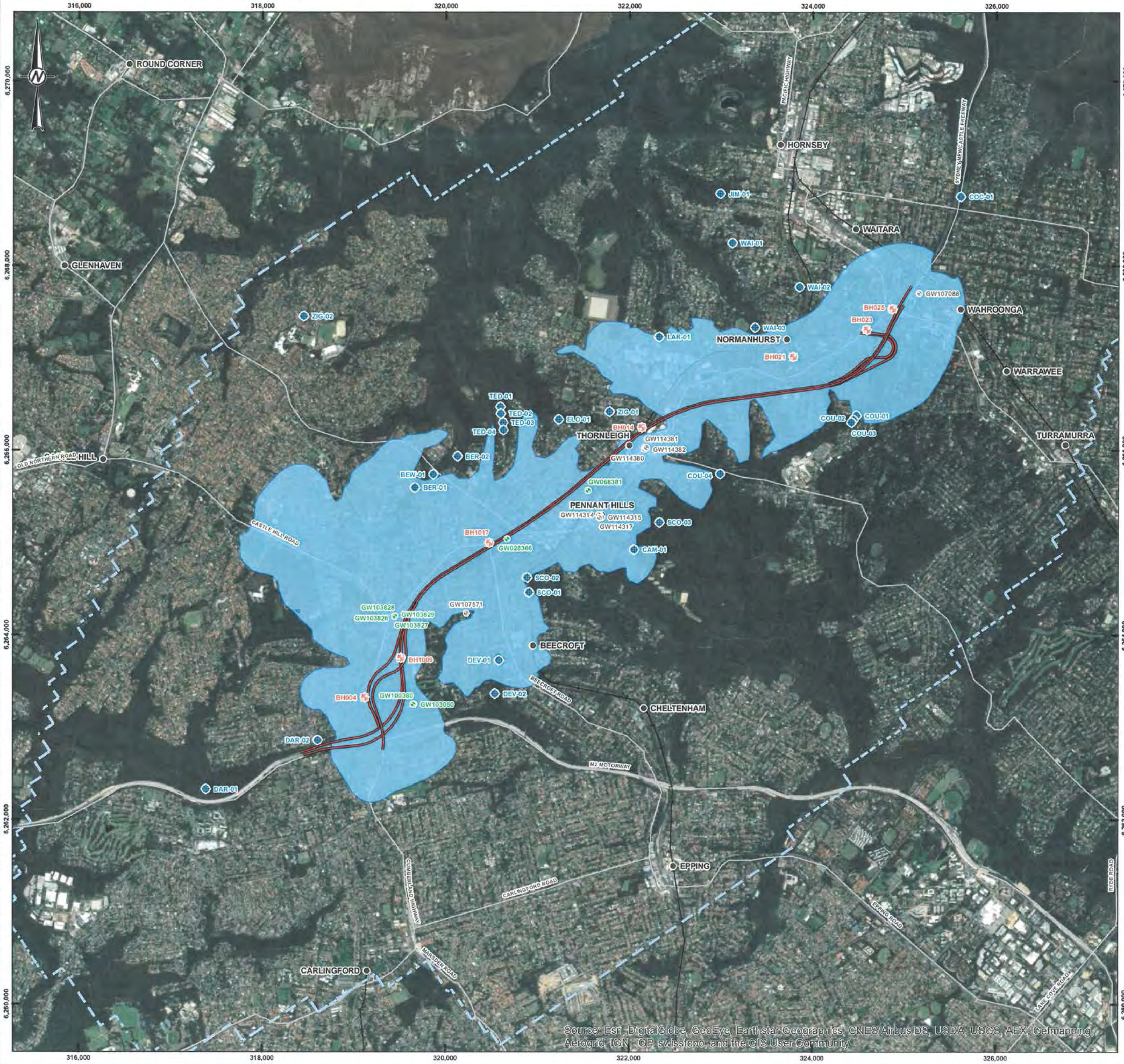
YYYY-MM-DD	2016-07-18
PREPARED	DP
DESIGNED	SW
REVIEWED	LMQ
APPROVED	DB

PROJECT NO.	CONTROL	REV	FIGURE
1563023	001	0	9

Path: J:\Hyd\2015\Sydney\NConnex Brisbane Working Folder\GIS working\MXD\1536023_001_R_Rev0_GndWater_LongTerm_Hawkesbury_Fig8.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A3

Figure 10: Computed Groundwater Drawdown in Ashfield Shale in the Long Term



LOCATION MAP

LEGEND

- Localities

Groundwater Locations

- Springs and GDE Sites
- Monitoring Bore
- Registered Bore
- Registered Bores Within 14m Drawdown Area
- NorthConnex Twin-Tunnel Alignment
- Model Domain Boundary

Transport

- Railways
- Main Roads

Groundwater Impact Zone (area within 2m drawdown contour)

- Numerical Model Estimate

NOTE(S)

Tunnel, Bores and GDE: Provided by LLBJV / Bouygues Construction Australia 2016.

REFERENCE(S)

COPYRIGHT

Localities, Roads and Railways: GeoScience Australia (C) Copyright Commonwealth of Australia (Geoscience Australia) 2006.

0 1 2 Kilometres

1:41,132

PROJECTION: GDA 1994 MGA Zone 56

CLIENT

LLBJV / BOUYGUES CONSTRUCTION AUSTRALIA

PROJECT

NORTH CONNEX TUNNEL

TITLE

COMPUTED GROUNDWATER DRAWDOWN IN ASHFIELD SHALE IN THE LONG TERM

CONSULTANT: Golder Associates

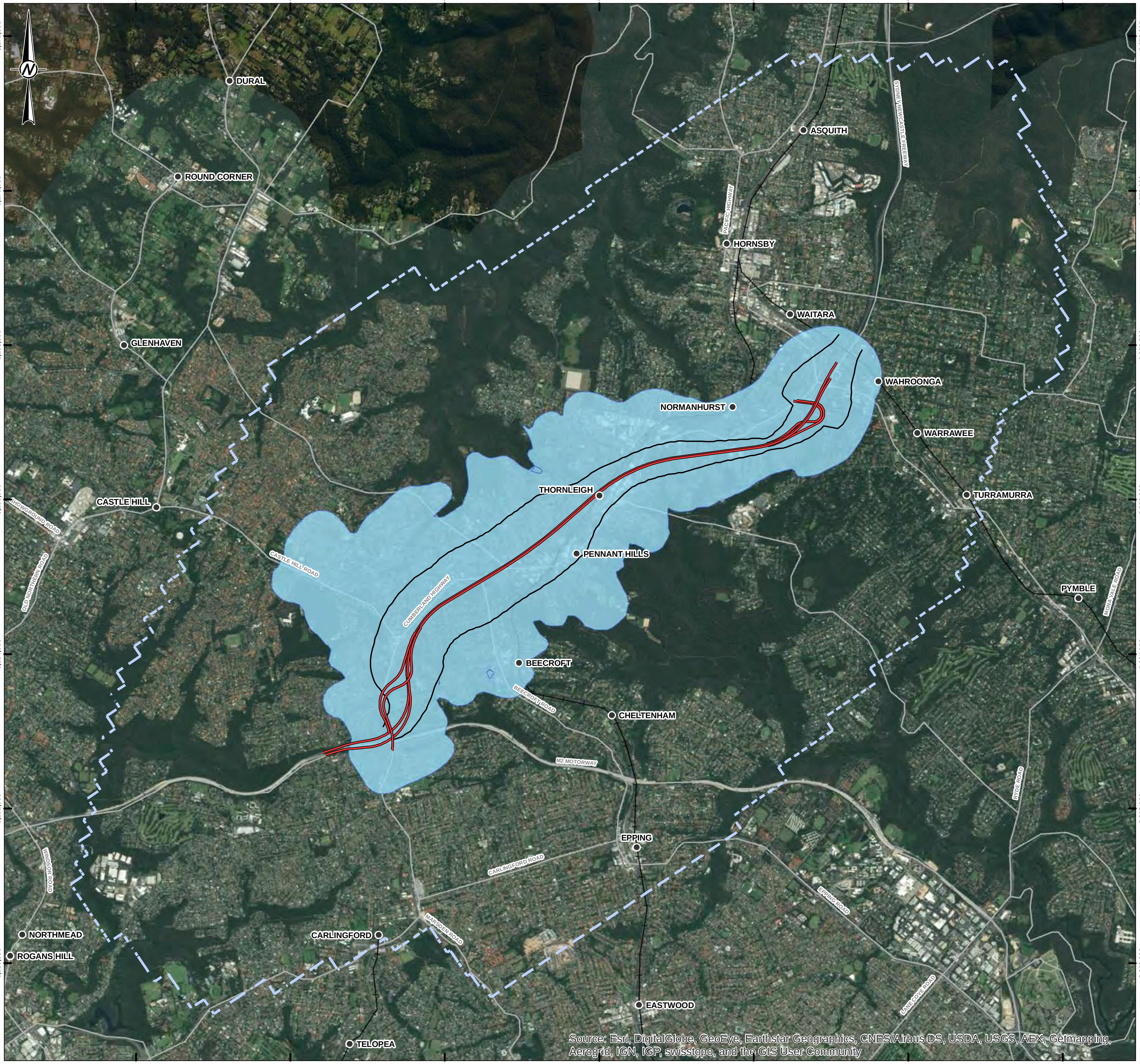
YYYY-MM-DD	2016-07-29
PREPARED	DP
DESIGNED	SW
REVIEWED	LMQ
APPROVED	DB

PROJECT NO.	CONTROL	REV.	FIGURE
1563023	001	0	10

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A3

Path: \\golder.gds\GAP\Brisbane\Jobs\Hyd\2015\Sydney\NConnex Brisbane Working Folder\GIS working\MXD\1563023_001_R_Rev0_GndWater_LongTerm_Ashfield_Fig9.mxd

Figure 11: Comparison of Analytical and Numerical Estimates of Drawdown in the Hawkesbury Sandstone in the Long Term.



LOCATION MAP

LEGEND

- Localities
- NorthConnex Twin-Tunnel Alignment
- Model Domain Boundary

Transport

- Railways
- Main Roads

Groundwater Impact Zone (area within 2m drawdown contour)

- Analytical Drawdown Prediction (NorthConnex M1-M2 Water Quality Monitoring Program, 2015)
- Numerical Model Estimate

NOTE(S)

Tunnel, Bores and GDE: Provided by LLBJV / Bouygues Construction Australia 2016.

REFERENCE(S)

COPYRIGHT

Localities, Roads and Railways: GeoScience Australia (C) Copyright Commonwealth of Australia (Geoscience Australia) 2006.

0 1 2

1:50,000 Kilometres

PROJECTION: GDA 1994 MGA Zone 56

CLIENT

LLBJV / BOUYGUES CONSTRUCTION AUSTRALIA

PROJECT

NORTH CONNEX TUNNEL

TITLE

COMPARISON OF ANALYTICAL AND NUMERICAL ESTIMATES OF DRAWDOWN IN THE HAWKESBURY SANDSTONE IN THE LONG TERM

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-10-10
PREPARED	DP
DESIGNED	SW
REVIEWED	LMQ
APPROVED	DB

PROJECT NO.	CONTROL	REV.	FIGURE
1563023	001	0	11

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: A3
25mm
0

Path: Y:\Gosford_Modelling\Model Re-calibrate July 2015\1536023_001_R_Rev0_Comp_Analytical_Num_Est_Fig11_Oct10.mxd

5.2 Impacts to spring flows

A census undertaken at the sites listed in Table 1 is shown in Appendix A. Observations concerning groundwater can be summarised for the 27 sites as

- No discharge (surface expression of groundwater) was identified or observed at 14 sites
- No discharge rate was recorded for 9 sites, though seepage (slow) had been observed
- A small discharge rate was recorded at 4 sites.

Impacts at these sites at the commencement of operations and in the long term can be summarised as follows:

- At the 14 sites where no discharge was observed, the Groundwater Impact Model estimated no change.
- Zero discharge was computed at the 9 sites where no discharge rates were recorded but wet or moist conditions were observed. However, the Groundwater Impact Model estimated no change from the computed pre-excavation discharge rates at the commencement of operations or in the long term.
- At the 4 sites where small discharge rates had been recorded, the Groundwater Impact Model's computed pre-excavation discharge rates were lower than those observed (a result from the model calibration). No changes from the computed pre-excavation discharge rates were estimated at the commencement of operations or in the long term.

The discharge rates and changes in groundwater levels at the spring sites have been estimated for the Base Case and the four sensitivity cases at the commencement of operations and in the long term and are summarised in Appendix C.

5.3 Aquifer interference

The New South Wales (NSW) Aquifer Interference Policy (released in 2012 by the NSW Office of Water, Department of Primary Industries) applies to all aquifer interference activities both during and after an activity. Aquifer interference includes

- The penetration of an aquifer
- The interference with water in an aquifer
- The taking of water from an aquifer
- The taking of water from an aquifer in the course of carrying out an activity prescribed by the regulations, and
- The disposal of water taken from an aquifer in the course of carrying out an activity prescribed by the regulations.

The policy stipulates that impacts and water taken following the completion of an activity need to be planned for and managed. Minimal impact considerations for aquifer interference activities specify a less than or equal to 10 % cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40 m from any high priority GDE or culturally significant site listed in the schedule of the relevant water sharing plan; and a maximum of a 2 m decline cumulatively at any water supply work.

The NCX tunnel will penetrate both the Ashfield Shale and Hawkesbury Sandstone aquifers and interfere with the water in those aquifers. Table 7 presents the computed interflow of groundwater between the Ashfield Shale and Hawkesbury Sandstone aquifers prior to excavation, at the commencement of operations and in the long term for the Base Case. Long term interflow between the Ashfield Shale and Hawkesbury Sandstone aquifers is estimated to be 94 % of pre-excavation flow rates for Ashfield Shale to Hawkesbury Sandstone flow and to be 99 % of pre-excavation flow rates for Hawkesbury Sandstone to Ashfield Shale flow.

Groundwater will also be taken from the Ashfield Shale and Hawkesbury Sandstone aquifers by drainage into the tunnel. In Table 8, the estimated water take in the long term for the Base Case is 0.2 m^3/d from the Ashfield Shale aquifer and 329 m^3/d from the Hawkesbury Sandstone aquifer.

The model estimates that no water is taken from creeks and streams, this is consistent with observations that the creeks are ephemeral[5].

Table 7: Interflow between Ashfield Shale and Hawkesbury Sandstone Aquifers (m^3/d) computed for the Base Case

	Pre-Tunnel	Commencement of Operations	Long Term
From Ashfield Shale Aquifer to Hawkesbury Sandstone Aquifer	2324	2128 (92%)	2174 (94%)
From Hawkesbury Sandstone Aquifer to Ashfield Shale Aquifer	90	97 (108%)	89 (99%)

Table 8: Computed Incidental Water Take (m^3/d)

	Pre-Tunnel	Commencement of Operations	Long Term
From the Ashfield Aquifer	-	1.1	0.2
From the Hawkesbury Sandstone Aquifer	-	562	329

6.0 CONCLUSIONS

Predictive simulations using the Groundwater Impact Model indicate that the NCX project will induce changes in the groundwater regime as follows:

- Groundwater drawdown may extend up to 2 km, typically in the range 0.6 to 1 km, from the tunnel alignment (in the south-west, adjacent to the deepest sections of the tunnel).
- Spring and GDE sites are estimated to experience little to no change in discharge rates in the long term.
- Interflows between the Ashfield Shale and Hawkesbury Sandstone aquifers change but remain within 6 % of pre-excavation flow rates.

7.0 RECOMMENDATIONS

The Groundwater Impact Model predicts an extent of drawdown that is larger than originally calculated in the EIA document for NorthConnex. The original calculations (2D model) were based on a concept design tunnel alignment and did not account for the drainage effect of higher permeable geological structures intersecting the tunnel alignment. The 3D numerical Groundwater Impact Model utilises more recent data and employs a finer level of detail (both spatially and temporally) in describing the hydrogeological domain (particularly lateral to the twin-tunnels alignment) such as topographic details, spatial changes in hydraulic material parameters and recharge rates.

The extent of drawdown is now estimated to encompass or approach the sites of several springs and GDE's that were formerly outside the computed drawdown zone. To facilitate the early identification of potential impacts to those sites, we recommend the installation (to 10 m below the local groundwater level) of the following monitoring bores

- One monitoring bore (BH-A1) located between the tunnel alignment and sites BER-01, BEW-01 and BER-02,
- One monitoring bore (BH-A2) located between the tunnel alignment and sites TED-01,-02,-03,-04 and ZIG-01,
- One monitoring bore (BH-A3) located between the tunnel alignment and sites CAM-01 and SCO-03,
- One monitoring bore (BH-A4) located between the tunnel alignment and sites DEV-01,-02 and SCO-01.

The groundwater level data recorded at these monitoring bores could assist in determining if any observed trends are related to project activities or other causes (for example, seasonality).

Report Signature Page

GOLDER ASSOCIATES PTY LTD

Scott Weeks
Senior Hydrogeologist

Dr Detlef Bringemeier
Principal Hydrogeologist

SW/DB/sw

A.B.N. 64 006 107 857

Golder, Golder Associates and the GA globe design are trademarks of Golder Associates Corporation.

\\golder.gds\gap\sydney\jobs\geo\2015\1536023_llbjv_ncx cs1_si\correspondence out\1536023-700 groundwater impact modelling rev1.docx

APPENDIX A

Spring and GDE Data

Spring and Groundwater Dependent Ecosystem Data (provided by LLBJV)

Site	Easting	Northing	Spring	GDE	Signs of surface groundwater expression (Nov 2014)	EEC[1]	RARC[2] score	Spring Flow			
								Nov-14	June-15	Sept-15	Oct-15
CAM-01	322056	6264926	NO	YES	None observed. Presence of Blue Gums indicates shallow groundwater level.	Blue Gum High Forest	Not available	None observed	None observed	None observed	None observed
COC-01	325615	6268749	YES	NO	Spring observed in headwaters of Cockle Creek. Flow estimated at 0.2L/S out of deep shale creek bank overlying sandstone. High concentration of iron flocculation in discharge.	No	Very poor	0.2 L/s	0.5 L/s	0.2 L/s	0.6 L/s
COU-01	324482	6266376	YES	YES	Three springs observed flowing out of creek bank in clay soil near geological boundary with sandstone. Heavy weed growth near spring. Iron flocculation observed in spring discharge. Vegetation may be seasonally dependent on groundwater. Springs classified as minor contributors to stream flow.	Sydney Turpentine Ironbark Forest	Average	None recorded	None recorded	"Higher Flow since last monitoring"	<0.1 L/s
COU-01A	324478	6266385	YES	YES	Not Observed	Sydney Turpentine Ironbark Forest	Average	None recorded	None recorded	None recorded	None recorded

Site	Easting	Northing	Spring	GDE	Signs of surface groundwater expression (Nov 2014)	EEC[1]	RARC[2] score	Spring Flow			
								Nov-14	June-15	Sept-15	Oct-15
COU-01B	324458	6266362	YES	YES	Not Observed	Sydney Turpentine Ironbark Forest	Average	None recorded	None recorded	None recorded	None recorded
COU-02	324446	6266331	YES	YES	Three springs observed flowing out of creek bank in clay soil near geological boundary with sandstone. Heavy weed growth near spring. Iron flocculation observed in spring discharge. Vegetation may be seasonally dependent on groundwater. Springs classified as minor contributors to stream flow.	Sydney Turpentine Ironbark Forest	Average	None recorded	None recorded	None recorded	<0.1 L/s
COU-03	324427	6266303	YES	YES	Three springs observed flowing out of creek bank in clay soil near geological boundary with sandstone. Heavy weed growth near spring. Iron flocculation observed in spring discharge. Vegetation may be seasonally dependent on groundwater. Springs classified as minor contributors to stream flow.	Sydney Turpentine Ironbark Forest	Average	None recorded	None recorded	None recorded	<0.1 L/s

Site	Easting	Northing	Spring	GDE	Signs of surface groundwater expression (Nov 2014)	EEC[1]	RARC[2] score	Spring Flow			
								Nov-14	June-15	Sept-15	Oct-15
COU-04	322998	6265748	NO	NO	None identified	Not available	Not available	None identified	None recorded	None recorded	None recorded
DAR-01	317392	6262328	YES	NO	Groundwater seeping slowly out of fracture in sandstone and pooling next to creek.	No	Not available	<0.1 L/s	None recorded	None recorded	None recorded
DAR-02	318609	6262860	NO	NO	None identified	Not available	Not available	None identified	None recorded	None recorded	None recorded
DEV-01	320589	6263727	NO	NO	None observed. Tall vegetation clumped in a depression at the stream headwater indicates that a spring may be present, but not currently flowing.	Blue Gum High Forest	Not available	None observed	None observed	None observed	None observed
DEV-02	320546	6263363	NO	NO	None identified	Not available	Not available	None identified	None recorded	None recorded	None recorded
ELO-01	321240	6266335	NO	NO	Ferric iron staining noted on culvert. Culvert flowing out of inaccessible private property. The presence of upstream spring is likely.	No	Not available	None recorded	None recorded	None recorded	None recorded
JIM-01	322998	6268780	YES	NO	Spring seeping (<0.1 L/sec) from sandstone above creek at the boundary with shale soils.	No	Good	< 0.1 L/s	None recorded	None recorded	None recorded
LAR-01	322330	6267232	NO	NO	None identified	Not available	Not available	None identified	None recorded	None recorded	None recorded

Site	Easting	Northing	Spring	GDE	Signs of surface groundwater expression (Nov 2014)	EEC[1]	RARC[2] score	Spring Flow			
								Nov-14	June-15	Sept-15	Oct-15
SCO-01	320918	6264461	YES	YES	Groundwater seeping from shale soil on creek bank overlying sandstone (<0.1 L/sec).	Sydney Turpentine Ironbark Forest	Excellent	< 0.1 L/s	< 0.1 L/s	< 0.1 L/s	< 0.1 L/s
SCO-02	320896	6264620	YES	YES	Spring observed in grassed area above the headwater of Scout Creek. Water is pooled and seeping slowly up through the shale soil which overlies sandstone.	Blue Gum High Forest	Not available	< 0.1 L/s	< 0.1 L/s	< 0.1 L/s	None recorded
SCO-03	322332	6265221	NO	NO	None identified	Not available	Not available	None identified	None identified	None recorded	<0.1 L/s
SCO-03A	322239	6265329	YES	NO	Not Observed	No	Not available	Not Observed	< 0.1 L/s	None recorded	None recorded
TED-01	320604	6266471	YES	NO	Springs identified in creek bed at shale/sandstone boundary. High concentration of ferric iron settled on creek bed. A weir noted at the creed headwaters is restricting surface flow.	No	Poor	<0.1 L/s	<0.1 L/s	<0.1 L/s	<0.1 L/s
TED-02	320608	6266398	YES	NO	Springs identified in creek bed at shale/sandstone boundary. High concentration of ferric iron settled on creek bed. A weir noted at the creed headwaters is restricting	No	Poor	<0.1 L/s	<0.1 L/s	<0.1 L/s	<0.1 L/s

Site	Easting	Northing	Spring	GDE	Signs of surface groundwater expression (Nov 2014)	EEC[1]	RARC[2] score	Spring Flow			
								Nov-14	June-15	Sept-15	Oct-15
					surface flow.						
TED-02A	320608	6266410	YES	NO	Not observed	No	Poor	Not Observed	<0.1 L/s	<0.1 L/s	<0.1 L/s
TED-02B	320617	6266403	YES	NO	Not Observed	No	Poor	Not Observed	<0.1 L/s	<0.1 L/s	<0.1 L/s
TED-02C	320611	6266389	YES	NO	Not Observed	No	Poor	Not Observed	<0.1 L/s	<0.1 L/s	<0.1 L/s
TED-03	320631	6266301	YES	NO	Springs identified in creek bed at shale/sandstone boundary. High concentration of ferric iron settled on creek bed. A weir noted at the creed headwaters is restricting surface flow.	No	Poor	<0.1 L/s	<0.1 L/s	<0.1 L/s	<0.1 L/s
TED-04	320637	6266220	YES	NO	Springs identified in creek bed at shale/sandstone boundary. High concentration of ferric iron settled on creek bed. A weir noted at the creed headwaters is restricting surface flow.	No	Poor	<0.1 L/s	<0.1 L/s	<0.1 L/s	<0.1 L/s

Site	Easting	Northing	Spring	GDE	Signs of surface groundwater expression (Nov 2014)	EEC[1]	RARC[2] score	Spring Flow			
								Nov-14	June-15	Sept-15	Oct-15
WAI-01	323130	6268249	YES	NO	Spring observed seeping out of sandstone (<0.1L/sec). Ferric iron observed in discharged groundwater.	No	Very poor	<0.1 L/s	None recorded	None recorded	None recorded
WAI-02	323860	6267770	NO	NO	None identified	Not available	Not available	None identified	None recorded	None recorded	None recorded
WAI-03	323377	6267330	NO	NO	None identified. Possible perennial spring location indicated by water in shallow pools.	No	Not available	None identified	None recorded	None recorded	None recorded
BER-01	319669	6265598	NO	NO	None identified	Not available	Not available	None identified	None recorded	None recorded	None recorded
BEW-01	319871	6265739	NO	NO	None identified	Not available	Not available	None identified	None recorded	None recorded	None recorded
BER-02	320134	6265933	NO	NO	None identified	Not available	Not available	None identified	None recorded	None recorded	None recorded
ZIG-01	321788	6266418	NO	NO	None identified	Not available	Not available	None identified	None recorded	None recorded	None recorded
ZIG-02	318456	6267454	YES	YES	Fracture in sandstone. Presence of iron flocculation in discharge.	Blue Gum High Forest	Not available	None recorded	None recorded	None recorded	None recorded

[1]Endangered Ecological Community; [2]Rapid Appraisal of Riparian Condition

APPENDIX B

Groundwater Data Update

Registered Water Bores

Works Number	License Number	Easting	Northing	Depth below ground surface (m)	Water Level Data	Screen Formation	Comments	Represented in Impact Model
GW028366	10BL021374	320677	6265040	4.2	Not available	Not available	No screen interval available	Yes, assumes screens are at bottom of the hole
GW103826	10BL156658	319450	6264204	4.5	Not available	Alluvium / regolith	No screen interval available	Yes
GW103827	10BL156658	319450	6264204	4.9	Not available	Alluvium / regolith	No screen interval available	Yes
GW103828	10BL156658	319450	6264204	5.7	Not available	Alluvium / regolith	No screen interval available	Yes
GW103829	10BL156658	319450	6264204	4	Not available	Alluvium / regolith	No screen interval available	Yes
GW107571	10BL160936	320233	6264235	45.35	Not available	Not available	No screen interval available	Yes, assumes screens are at bottom of the hole
GW107088	10BL164779	325163	6267703	162	Not available	Sandstone	No screen interval available	Yes
GW114313	10BL604936	321691	6265293	Not available	Not available	Not available	No depth, screen interval available	Yes, two cases assume screens are in Hawkesbury Sandstone or Ashfield Shale
GW114314	10BL604936	321687	6265282	Not available	Not available	Not available	No depth, screen interval available	Yes, two cases assume screens are in Hawkesbury Sandstone or Ashfield Shale
GW114315	10BL604936	321701	6265274	Not available	Not available	Not available	No depth, screen interval available	Yes, two cases assume screens are in Hawkesbury Sandstone or Ashfield Shale
GW114316	10BL604936	321670	6265299	Not available	Not available	Not available	No depth, screen interval available	Yes, two cases assume screens are in Hawkesbury Sandstone or Ashfield Shale
GW114317	10BL604936	321682	6265268	Not available	Not available	Not available	No depth, screen interval available	Yes, two cases assume screens are in Hawkesbury Sandstone or Ashfield Shale

Works Number	License Number	Easting	Northing	Depth below ground surface (m)	Water Level Data	Screen Formation	Comments	Represented in Impact Model
GW114379	10BL604932	322164	6266016	8	Not available	Not available	No screen interval available	Yes, assumes screens are at bottom of the hole
GW114380	10BL604932	322165	6266011	8	Not available	Not available	No screen interval available	Yes, assumes screens are at bottom of the hole
GW114381	10BL604932	322174	6266030	8	Not available	Not available	No screen interval available	Yes, assumes screens are at bottom of the hole
GW114382	10BL604932	322190	6266029	7	Not available	Not available	No screen interval available	Yes, assumes screens are at bottom of the hole
GW068381	50BL141112	321559	6265567	34	Not available	Sandstone	No screen interval available	Yes
GW103060	10BL159553	319661	6263248	27	Not available	Sandstone	No screen interval available	Yes
GW100380	10BL142460	319651	6263248	180	Not available	Sandstone	No screen interval available	Yes

APPENDIX C

Computed Spring and GDE Discharge Rates

Computed Spring and GDE Discharge Rates (L/s)

SITE	Observational Discharge Data	Base Case		Case A		Case B		Case C		Case D	
		Commence Operations	Long Term	Commence Operations	Long Term	Commence Operations	Long Term	Commence Operations	Long Term	Commence Operations	Long Term
CAM-01	0	0	0	0	0	0	0	0	0	0	0
COC-01	0.2	0	0	0	0	0	0	0	0	0	0
COU-01	None recorded Assume <0.1	0	0	0	0	0	0	0	0	0	0
COU-02	None recorded Assume <0.1	0	0	0	0	0	0	0	0	0	0
COU-03	None recorded Assume <0.1	0	0	0	0	0	0	0	0	0	0
COU-04	0	0	0	0	0	0	0	0	0	0	0
DAR-01	None recorded Assume <0.1	0	0	0	0	0	0	0	0	0	0
DAR-02	0	0	0	0	0	0	0	0	0	0	0
DEV-01	0	0	0	0	0	0	0	0	0	0	0
DEV-02	0	0	0	0	0	0	0	0	0	0	0
ELO-01	0	0	0	0	0	0	0	0	0	0	0
JIM-01	<0.1	0	0	0	0	0	0	0	0	0	0
SCO-01	<0.1	0	0	0	0	0	0	0	0	0	0
SCO-02	None recorded Assume <0.1	0	0	0	0	0	0	0	0	0	0
SCO-03	0	0	0	0	0	0	0	0	0	0	0

SITE	Observational Discharge Data	Base Case		Case A		Case B		Case C		Case D	
		Commence Operations	Long Term	Commence Operations	Long Term	Commence Operations	Long Term	Commence Operations	Long Term	Commence Operations	Long Term
TED-01	None recorded Assume <0.1	0	0	0	0	0	0	0	0	0	0
TED-02	None recorded Assume <0.1	0	0	0	0	0	0	0	0	0	0
TED-03	None recorded Assume <0.1	0	0	0	0	0	0	0	0	0	0
TED-04	None recorded Assume <0.1	0	0	0	0	0	0	0	0	0	0
WAI-01	<0.1	0	0	0	0	0	0	0	0	0	0
WAI-02	0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
WAI-03	0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
BER-01	0	0	0	0	0	0	0	0	0	0	0
BEW-01	0	0	0	0	0	0	0	0	0	0	0
BER-02	0	0	0	0	0	0	0	0	0	0	0
ZIG-01	0	0	0	0	0	0	0	0	0	0	0
LAR-01	0	0	0	0	0	0	0	0	0	0	0

APPENDIX D

Computed Groundwater Drawdown at Spring and GDE Sites

Computed Groundwater Drawdown (m) at Spring and GDE sites

SITE	Base Case		Case A		Case B		Case C		Case D	
	Commence Operations	Long Term	Commence Operations	Long Term	Commence Operations	Long Term	Commence Operations	Long Term	Commence Operations	Long Term
CAM-01	0.5	3.9	0.0	4.0	0.1	3.8	0.1	3.6	0.3	3.6
COC-01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COU-01	0.0	1.6	0.3	1.6	0.2	1.7	0.3	1.7	0.1	1.6
COU-02	0.1	1.3	0.2	1.3	0.1	1.4	0.2	1.4	0.1	1.3
COU-03	0.0	1.0	0.1	1.1	0.2	1.2	0.2	1.2	0.1	1.2
COU-04	0.0	1.0	0.0	0.9	0.0	0.8	0.4	0.8	0.4	1.1
DAR-01	0.0	0.1	0.0	0.9	0.0	0.1	0.0	0.0	0.0	0.1
DAR-02	0.2	0.6	0.1	0.4	0.0	0.4	0.1	0.5	0.1	0.4
DEV-01	0.0	0.1	0.0	1.0	1.2	1.4	0.0	0.1	0.8	0.9
DEV-02	0.0	0.8	0.5	1.1	0.0	0.7	0.0	0.8	0.0	0.6
ELO-01	0.5	1.4	0.7	1.7	0.6	2.1	0.1	0.4	0.2	0.5
JIM-01	0.0	0.6	0.0	0.0	0.0	0.5	0.3	0.4	0.0	0.2
SCO-01	1.3	6.4	1.3	3.0	0.4	6.1	1.5	6.1	1.5	6.1
SCO-02	3.0	11.0	3.2	15.0	1.6	10.8	2.3	10.1	2.3	10.4
SCO-03	2.5	2.8	2.8	3.0	0.6	0.5	0.0	0.3	0.0	0.0
TED-01	0.8	3.2	0.4	2.8	0.0	2.7	0.0	2.7	0.1	2.9
TED-02	0.0	3.4	0.0	3.5	0.0	3.3	0.0	3.2	0.2	3.3
TED-03	0.4	4.7	0.2	3.9	0.0	4.2	0.0	4.1	0.0	4.2
TED-04	0.4	4.7	0.0	4.7	0.2	4.9	0.0	4.4	0.0	4.6
WAI-01	0.0	0.2	0.0	0.0	0.5	0.6	0.0	0.9	0.0	0.0
WAI-02	2.5	2.9	1.0	1.0	0.0	1.0	1.9	1.8	0.0	0.0
WAI-03	2.2	2.0	1.0	1.0	0.0	1.4	0.0	0.0	0.0	0.1
BER-01	1.2	7.8	1.2	8.1	0.8	7.9	1.0	7.4	1.0	7.5
BEW-01	0.3	2.0	0.2	2.0	0.2	2.1	0.2	1.7	0.3	1.9

SITE	Base Case		Case A		Case B		Case C		Case D	
	Commence Operations	Long Term	Commence Operations	Long Term	Commence Operations	Long Term	Commence Operations	Long Term	Commence Operations	Long Term
BER-02	0.0	1.0	0.0	1.0	0.0	0.8	0.3	1.1	0.0	0.9
ZIG-01	1.7	6.3	1.5	6.0	1.2	6.3	1.1	5.8	1.3	5.7
LAR-01	0.4	2.3	0.0	1.8	0.0	2.5	0.3	2.3	0.0	1.9

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

For more information, visit golder.com

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 44 1628 851851
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Pty Ltd
124 Pacific Highway
St. Leonards, New South Wales 2065
Australia
T: +61 2 9478 3900

Golder Associates

“This page has been intentionally left blank”