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PROPOSAL:

Cooks River Improvement Strategy

Sydney Water

May 2014

Document history

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Contents

1 Introduction

Sydney Water is proposing to facilitate the development of The Cooks River Water Quality Improvement Strategy in partnership with councils, communities and agencies.

The aim of the project is to consolidate and prioritise the past, present and future activities and initiatives that have been developed to protect and improve the quality of the Cooks River and estuaries. The project will seek to capture hot spots and other landuse activities having adverse impacts that have not been identified through existing programs.

The outcome of the project will be a Water Quality Improvement Program to improve the water quality of the River to meet agreed Environmental Values. The process of developing the Program will improve Sydney Water's relationships with catchment stakeholders and the local community by embedding their values and needs.

The project will be delivered in two phases:

- Phase 1: benchmarking the catchment's history, context, conditions, and activities of stakeholders. This phase of the project will involve:
    - 2-3 stakeholder engagement workshops with key catchment stakeholders.
    - Up to 10 stakeholder meetings to engage the stakeholders and ensure buy-in to the process.
    - Development of a Physical profile of the catchment which will identify catchment and river health values, existing programs and projects.
    - Phase 1 Interim Report (September 2014) stakeholder approved.
- Phase 2 will build on phase 1 and develop a consolidated Water Quality Improvement Program. This strategy document will compile, integrate and communicate the existing and collated information on waterway health, community concerns, catchment and waterway action plans.
    - Effectively drawing on existing and proposed information from media, government relations, monitoring programs, CMA and local government catchment action plans and Sydney Water programs.
    - Workshopping and negotiating with councils, communities and agencies on WQ targets to meet environmental and community values.
    - Establishing acceptable and approved River Water Quality Targets that meet Environmental and Community Values.

This proposal is for Phase 1 works.

Alluvium has specialist skills across the spectrum of sustainable urban water management from policy and planning through to design and implementation. We specialise work in urban water management and adopt and implement the latest advances and techniques. We have significant experience in the concept and detailed design of stormwater treatment, flooding and stormwater harvesting systems, as well as construction documentation, construction supervision and maintenance planning. Our skills and expertise are underpinned by a strong philosophical and practical regard for the environment.

Alluvium places a strong emphasis on a trans-disciplinary approach to provide for softer and greener solutions which are less engineered and which require attention to the details of design. WSUD by its very nature requires this softer engineering approach and Alluvium's expertise lies in our ability to span the divide between traditional civil engineers, urban designers and landscape architects.

This project will be delivered by Alexa McAuley and David Knights of Alluvium with support from staff from Alluvium. Alluvium has undertaken a range of projects in the Cooks River Valley and other projects relevant to the project as outlined in the table.

A Selection of Relevant Skills and Experience of Alluvium's Project Team

Skill areas	Recent Experience	Key Personnel
Working In the Cooks River Catchment	• Secondment to Marrickville Council to undertake various projects including preparing subcatchment management plans for catchments draining to the Cooks River • Secondment to the Cooks River Sustainability Initiative to provide technical leadership for development of subcatchment management plans with partner councils • Various stormwater quality improvement projects (including investigations and design) with Cooks River Councils including Marrickville, Canterbury, Rockdale, Strathfield, Bankstown, Hurstville • Training and capacity building exercises with Cooks River Councils, including MUSIC modelling, hydraulic conductivity testing and training for DA staff • Technical support to PhD candidate Lois Oulton undertaking monitoring of stormwater treatment systems within Cooks River catchments	David Knights Alexa McAuley Anna Thompson Andrew McMillan
Stakeholder engagement	• Leading cross-council technical workshops for CRSI councils • Leading interdisciplinary project workshops for stormwater quality improvement projects • Facilitating subcatchment planning workshops for Marrickville Council and other CRSI councils	David Knights Alexa McAuley Richard McManus
Strategic policy development	• Development of a Water Sensitive Urban Design Strategy for Darwin Harbour • Review of Landcom's WSUD policy • Development of stream health flow objectives for Melbourne Water • Development of WSUD Planning Controls for various councils • Review of water conservation targets for Landcom	David Knights Alexa McAuley Richard McManus

2 Project appreciation

A series of issues have been identified by the project team, which should be addressed to allow for the successful implementation of the project. Our appreciation of these issues is outlined in the following sections.

2.1 Established Networks

The Cooks River councils have been working together for a significant period to improve stormwater quality management in the Cooks River catchment:

- In 1997 a working party consisting of Marrickville Council, Strathfield Council, Canterbury City Council, the Cooks River Catchment Management Committee (CRCMC), the Environment Protection Authority (EPA), Greening Australia and the Department of Land and Water Conservation (DLWC) commissioned and published the ***Cooks River Foreshores Strategic Plan***

- Following the completion of this Plan, the **Cooks River Foreshores Working Group (CRFWG)** was formed. The group played a significant role in increasing communication between member councils and state government agencies. Over 12 years it grew from a membership of four councils to eight councils and inspired increased community action and financial investment from state agencies.

- **OurRiver** (the Cooks River Sustainability Initiative) was an initiative of the CRFWG which ran from 2007-2011. The project trialled an innovative planning model which was undertaken in six subcatchments across eight local government areas and aimed to improve council capacity for Sustainable Urban Water Management (SUWM), increase community capacity and ownership, and to improve the health of the Cooks River. The sub-catchment plans included concept designs for 100 stormwater treatment systems. 10 systems were constructed using funding from the program, and the partner councils are continuing to construct the other systems using other funding sources.

- The **Cooks River Alliance (CRA)** was established in 2011 with the signing of a Memorandum of Understanding (MoU) by the eight founding member councils: Ashfield, Bankstown, Canterbury, City of Sydney, Hurstville, Marrickville, Rockdale and Strathfield. The CRA's current programs include:
    - A council capacity building program for water management and other catchment issues
    - A catchment-wide monitoring program
    - Development of an Information Portal to Manage Information about the Cooks River Catchment
    - Implementation of sub-catchment management plans actions and other priority works
    - Development of a Communications Strategy
    - Development of a climate Change Resilience Program

While the Cooks River councils will welcome leadership and support from Sydney Water, this needs to be provided with due respect for the work already undertaken and currently underway. Through past and current programs, the Cooks River councils have developed:

- Established formal and informal networks

- A good understanding of the Cooks River catchment and the challenges to improving the health of the Cooks River

- Organisational capacity to improve stormwater management in the Cooks River catchment

- Extensive community engagement and strong community support for council programs

Sydney Water needs to find ways to build on these successes, to support existing programs and complement them with related activities.

2.2 Need for Co-ordination

Improving the health of the Cooks River catchment and the River itself is a significant challenge, as there are many sources of pollutants, many land managers in the catchment and the catchment is highly urbanised. All of the stakeholders recognise this challenge and the need for co-ordination, however there are many ways in which Sydney Water could facilitate a co-ordinated approach.

Some of the co-ordination tools and activities which we believe would be useful components of this project are:

- Developing conceptual maps of:
    - Cooks River stakeholders and their relationships
    - Catchment management data and activities (to avoid overlaps and help identify gaps)
- Establishing a stakeholder engagement framework, including:
    - Communication protocols
    - Establishing protocols/agreements for data and information sharing
- Clarifying roles and responsibilities of key stakeholders including Sydney Water

The workshops and other stakeholder engagement activities proposed as part of the project will be a key tool to understand the existing situation, establish open stakeholder communications and develop a framework for ongoing collaboration.

2.3 Role of Sydney Water

Acknowledging the existing networks and activities underway in the Cooks River catchment, there are also some significant gaps and some clear roles which Sydney Water could take:

- There is significant community interest in improving river health, including increasing recreational use of the River, and it is understood that reducing wastewater overflows is likely to be a key factor in meeting recreational water quality objectives. Therefore Sydney Water can play a key role in this area – understanding wastewater overflows and potential methods to reduce them.
- There are no State Government partners in the CRA and Sydney Water can potentially help provide a link between Cooks River Councils and State Government agencies
- Target-setting is potentially an area where the Cooks River Councils will welcome leadership, as it does not appear to be part of the CRA's (or any other agencies') current activities

This project will help define a role for Sydney Water within the Cooks River catchment, and to establish its relationship with other stakeholders.

2.4 End Product

This project will deliver the following outputs:

- Stakeholder engagement framework
- Clear picture of current governance arrangements, catchment management activities and achievements so far
- Database (including GIS database) of key catchment information
- Identification of gaps which need to be addressed
- Physical profile of the Cooks River catchment
- Information on environmental/catchment and community values
- Stakeholder support for the program/process

This project is Phase 1 of a two-stage project. Phase 2 will deliver a consolidated Water Quality Improvement Program, including acceptable and approved River Water Quality Targets that meet Environmental and Community Values.

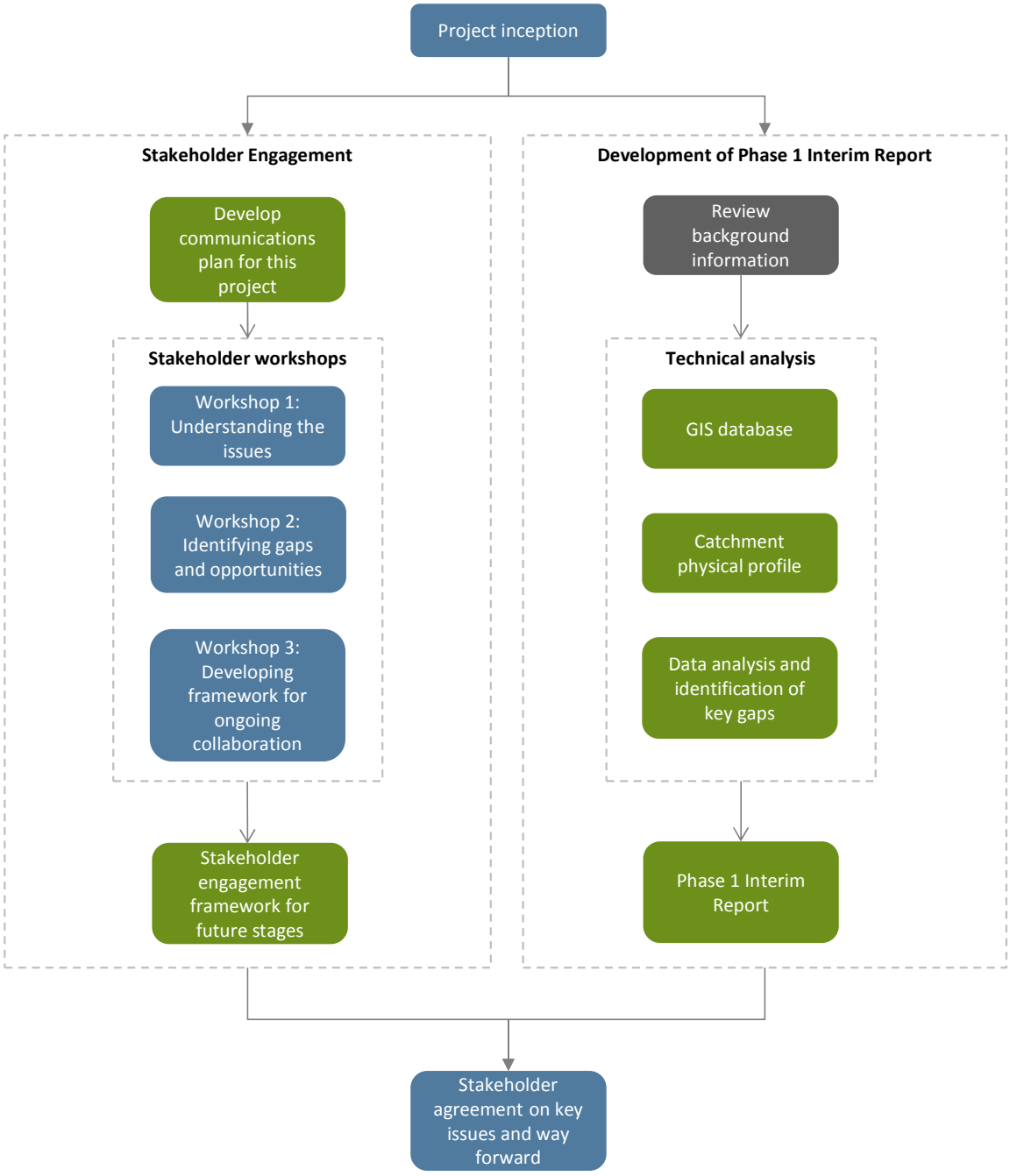
3 Methodology

Our proposed method is based on our experience of developing catchment management policy and strategic programs, and our conversation with Sydney Water in April 2014. Figure 1 below outlines our proposed tasks for the project.

The project includes two parallel streams:

1. stakeholder engagement and
2. desktop research and analysis to develop the Phase 1 Interim Report.

Each of these streams will contribute to the other and they will run simultaneously.



Engagement with Sydney Water through the project will include:

- A project inception meeting
- The three stakeholder workshops
- Meetings with key staff during the project
- A final presentation

3.1 Stage 1 – Project inception

We will kick off the project with a meeting with Sydney Water to discuss the proposed approach and timeline. At this meeting we can also discuss:

- Overall project objectives
- Methodology and key deliverables
- Proposed content of the stakeholder engagement workshops, GIS database and report
- Preferred approach for progress reports and invoicing
- Communications protocol for the project
- Approximate timing for key engagement activities and milestones
- Preferred format of deliverables

Outputs:

- Inception meeting with Sydney Water

3.2 Stage 2 – Stakeholder engagement

Stakeholder engagement will include the following components:

- Development of a stakeholder engagement strategy
- Three stakeholder engagement workshops
- Meetings on more specific issues

3.2.1 Task 2.1 – Stakeholder engagement strategy

A stakeholder engagement strategy will be developed, to serve both this project itself as well as future stakeholder engagement within the Cooks River catchment. This document will therefore evolve throughout the project as more information is gathered and our understanding of the stakeholders improves.

The strategy will include:

- Identification of stakeholders in the Cooks River catchment, including state and local government, community and other groups
- Broad description of roles and responsibilities in relation to the River
- Concept map of stakeholder relationships
- Concept map of stakeholder activities

- Information on data maintained by different stakeholders, any existing data sharing arrangements, proposed new protocols/agreements for data and information sharing

- Definition of Sydney Water's role within the Cooks River catchment

- Scope and content of stakeholder engagement activities associated with this project

- Recommendations on future stakeholder engagement activities

- Communication protocols

3.2.2 Task 2.2 – Stakeholder engagement workshops

As part of this project we are proposing to hold three major stakeholder workshops with broad participation. The scope for each of these is broadly expected to include:

- Workshop 1: identifying the issues:
    - Understand existing stakeholders and activities in the Cooks River catchment
    - Identify key players, roles, lines of communication
    - Identify key current activities relating to catchment management, water quality, River health
- Workshop 2: Identifying gaps and opportunities
    - Identify potential gaps in current activities and opportunities for improvement (particularly where Sydney Water can contribute)
    - Ask stakeholders what they expect or want of Sydney Water
    - Start to define Sydney Water's role
- Workshop 3: Developing framework for ongoing collaboration
    - Refine understanding of Sydney Water's role
    - Start to define key activities which will be led by Sydney Water in the future
    - Agree on communication and information sharing arrangements

3.2.3 Task 2.3 – Stakeholder meetings

In addition to the large stakeholder workshops, we have also allowed for up to ten (10) smaller meetings with individual stakeholders to facilitate communication and commitment to the project. These may include meetings with the following groups:

- The Cooks River Alliance – to understand their current and planned activities in more detail

- Different sections of Sydney Water to understand organisational objectives, specific capabilities, technical information, etc (e.g. to discuss sewer overflow modelling and analysis)

- State government agencies such as the Metropolitan Water Directorate and (former) Sydney Metropolitan Catchment Management Authority, who may have a role in setting broad policy direction or providing funding and support in some form

- Community groups such as the Cooks River Alliance

- Individual Councils (as required)

Outputs:

- Stakeholder engagement strategy document
- Stakeholder engagement workshops (3 No)
- Stakeholder meetings (10 No)

3.3 Stage 3 – Review and compilation of background information

This task will include the following components:

- Spatial (GIS) information
- Technical (e.g. water quality, flow data, etc) information
- Previous studies and reports

A key part of this task will be to bring together information held by different organisations (e.g. councils' stormwater data and Sydney Water's sewer data) in order to analyse it in new ways.

3.3.1 Task 3.1 – GIS database

We will set up a GIS database for the whole Cooks River catchment, including layers such as:

- Land use
- Stormwater drainage system and subcatchments
- Sewer network and overflow points
- Water quality monitoring sites
- Potential hotspots (e.g. former landfills)
- Historical layers (e.g. old creeklines)

This will allow us to undertake the analysis proposed in the following tasks (physical profile).

3.3.2 Task 3.2 – Technical information

Based on our previous work in the Cooks River catchment, we already have a good understanding of stormwater data and will be able to compile information on stormwater flows and pollutant loads for the purposes of this project.

One of the key things we will need to add to this is data on wastewater overflows. This will include:

- GIS data on overflow locations and quantities
- Review of SCAMPS to understand modelling and analysis
- Review of any other field investigations which have been undertaken (e.g. smoke tests)
- Meeting with Sydney Water technical staff to understand issues, previous analysis, etc.

We will compile water quality monitoring information which is available in the catchment, including information from both Sydney Water and councils. Note that one of the CRA's current programs is a catchment-wide monitoring program, therefore we will discuss this task with them to ensure no doubling up of efforts.

We will compile available information on hydrodynamics of the Cooks River, including tidal regime, tide levels, mixing, flushing. We will talk to the modellers at OEH who recently undertook modelling of Botany Bay, in order to understand how far their modelling extended up the Cooks River and what they can tell us regarding freshwater/saltwater exchange in the River. We will search other reports for similar information and review information such as water quality data for clues as to the salinity profile.

Sediment quality is potentially a key issue in the Cooks River, which impacts on water quality within the River. Pollutants can interact with sediments in complex ways, being released and reabsorbed under different conditions (e.g. dependent on temperature, salinity, velocity, etc). We will review available data on sediment quality for clues as to the processes at work in the Cooks River.

3.3.3 Task 3.3 – Previous studies and reports

Further to the specific technical issues listed above, we will compile broad background information, including the issues listed in Sydney Water's brief:

- Historical context
- Topography and drainage
- Flooding
- Climate
- Geology and soils
- Flora and fauna
- Community
- Ecological, social and economic values
- Previous programs to reduce pollution

3.3.4 Task 3.1 – Gap analysis

A key part of this task will be to identify gaps in data and knowledge about processes within the Cooks River, particularly those processes which impact on water quality and pollutant movement through the system. This may point to the need for further monitoring and analysis, and a preliminary scope of work can be developed as part of this project.

Outputs:

- GIS database for the Cooks River catchment
- Compilation of background data and information from previous studies and reports
- Gap analysis

3.4 Stage 4 – Developing a physical profile

The Phase 1 Interim Report will include a "physical profile" of the Cooks River catchment, including the background information compiled above, as well as the following catchment analysis which we will undertake as part of this project:

- Impervious area and estimated stormwater flows on a subcatchment basis
- Pollutant loads from both stormwater and sewer sources (subcatchment basis)
- Identification of hot spots/ high-risk subcatchments for wastewater overflows/stormwater pollution
- Wet weather and dry weather flow and pollutant movement patterns

Outputs:

- Physical profile of the Cooks River catchment, including details such as flows and pollutant loads, identification of hotspots and pollutant movement patterns in the system

3.5 Stage 5 – Reporting

This task will include preparation of the Phase 1 Interim Report. The Phase 1 Interim Report will compile, integrate and communicate the existing and collated information on waterway health, community concerns, catchment and waterway action plans. It will include the following components:

- Background information
- Summary of environmental/catchment and community values
- Physical profile, including results of catchment analysis
- Identification of issues – (where is more work required to support values?)
- Gap analysis and identification of additional data and analysis required
- Recommendations and a road map for Phase 2

The reporting undertaken for Phase 1 will make recommendations for Phase 2 of the project. The outcome of Phase 2 will be the consolidated Water Quality Improvement Program. The WQIP will;

- Effectively draw on existing and proposed information from media, government relations, monitoring programs, CMA and local government catchment action plans and Sydney Water programs (this will be drawn from the outputs of Phase 1).
- Workshop and negotiate with councils, communities and agencies on WQ targets to meet environmental and community values.
- Establishing acceptable and approved River Water Quality Targets that meet Environmental and Community Values.

Outputs:

- Phase 1 Interim Report (draft and final), including summary of environmental/catchment and community values, physical profile, identification of issues and gap analysis
- Road map for Phase 2

4 Project Team

Richard McManus will be the project manager for the project. He has extensive experience in developing and design water cycle management strategies. Richard will be assisted by Alexa McAuley, David Knights and Andrew McMillan. Detailed CVs are included in Appendix A.

Richard McManus
Masters of Engineering Science, University of New South Wales, 1998
Bachelor of Arts (Hons) (Env Science), Sydney University, 1993

Richard is the NSW Regional Manager of Alluvium, with twenty years experience in Urban Water Management. Richard has particular expertise in integrated strategic management of water resources, strategic policy and planning, integration and implementation of stormwater management best practice, evaluation, and project coordination and management. This expertise extends to working with local councils, state and federal government, industry and community groups, and is coupled with an extensive understanding of stormwater and waterways management complemented with significant skills in conducting interviews and workshops. Richard has authored or co-authored over 30 policy and conference papers and been responsible for setting stormwater management policy on a state and local government level.

David Knights
Bachelor of Engineering (Environmental) (Honours), University of New South Wales
Bachelor of Arts, University of New South Wales

David is an environmental engineer with more than 15 years' experience in sustainable water management. He has been developing WSUD Strategies and Integrated Water Cycle Management Strategies for various clients throughout Australia and internationally.

He has been involved in all levels of Integrated Water Cycle Management from concept design to construction and from stormwater treatment and reuse to wastewater treatment and reuse. David designed the stormwater treatment and reuse scheme for Eastern Avenue at Sydney University which recently won an SIA award for excellence in stormwater initiatives.

Alexa McAuley
Bachelor of Engineering (Environmental) (Honours), University of New South Wales
Masters of Environmental Management, University of New South Wales

Alexa is an environmental engineer with ten years' experience in the urban water sector. Alexa's skills range from policy and guideline development and strategic planning to concept and detailed design. She has prepared water sensitive urban design and water cycle management strategies, as well as policy documents, guidelines and design tools. Alexa has completed a wide range of concept and detailed designs for greenfield and retrofit projects including wetlands, bioretention systems, swales and stormwater harvesting and reuse systems. Alexa has also worked in stormwater and floodplain management, undertaking Stormwater Management Strategies, Catchment Management Plans, Flood and Floodplain Risk Management Studies.

Andrew McMillan
Bachelor of Engineering (Environmental) (Honours), University of Technology Sydney
Bachelor of Business, University of Technology Sydney
Masters of Environmental Management, University of New South Wales

Andrew is a professional civil and environmental engineer with nine years' experience in urban water management. Andrew has undertaken projects on hydrologic catchment analysis and flood assessment, drainage design and water harvesting/recycling and reuse. He has worked through project phases including feasibility studies, concept design and risk assessment, to the preparation of development application documentation and detailed designs for construction. Andrew has a strong focus on design for sustainable development whilst ensuring projects are practical for the whole life cycle.

Andrew has recently developed the detailed designed the $2M Hurstville Golf Course stormwater wetlands, bioretention system and stormwater reuse scheme. He has also provided construction management of the project to install a good project outcome. The scheme is currently under construction and was award $1M in funding from the Federal Government. The project will save more than 30 ML/yr of mains water.

Anna Thompson
Bachelor of Science (Honours) Physical Geography . First Class Honours University of Sydney.

Anna is an environmental scientist who has been working in Water Sensitive Urban Design since finishing her degree in 2010. Anna's work at university gave her theoretical knowledge and practical experience in wetland and bioretention system monitoring and sampling as well as water quality testing and analysis. She also developed a well rounded understanding of environmental systems and natural resources management in an Australian and international context.

Since beginning work in sustainable urban water management in 2011, Anna has been involved in a range of projects through which she has developed skills and experience in strategic catchment and waterway management plans, bank restoration, as well as design of stormwater harvesting and stormwater improvement systems. In particular, Anna has focussed on developing her engineering design skills through concept and detailed design projects of wetlands and bioretention systems in urban street and park environments. Anna has a sound working knowledge of modelling tools including MUSIC, DRAINS, and HEC-RAS as well as in geographic analysis and design tools including Map Info, ESRI-Arc GIS, 12D and AutoCad.

5 Budget and deliverables

We have outlined tasks and hours to each task for the project based on the brief and discussion with Sydney Water. The fee for phase 1 of the project as shown in the following table is $79,000 (ex GST).

5.1 Schedule of rates

Team member	Hourly charge rate (excl. GST)	Company
Richard McManus	$250	Alluvium
David Knights	$250	Alluvium
Alexa McAuley	$220	Alluvium
Andrew McMillan	$170	Alluvium
Anna Thompson	$140	Alluvium

The above rates will apply for items of the request for proposal, as well as any other advice required by the project beyond the information provided in this Proposal.

5.2 Fee Schedule

	Task	Richard McManus	David Knights	Alexa McAuley	Andrew McMillan	Total
		250	250	220	170	
1.0	Inception Meeting	4		4		$ 1,880.00
2.0	**Stakeholder engagement**					
2.1	Develop stakeholder engagement strategy	12	4	12		$ 6,640.00
2.2	Stakeholder engagement workshops (3) (inc. prep)	24		24		$ 11,280.00
2.3	Stakeholder meetings (up to 10)	30		12		$ 10,140.00
3.0	**Desktop research and analysis**					
3.1	Review and compilation of background information	4	8	24	64	$ 19,160.00
4.0	Develop physical profile		8	24	40	$ 14,080.00
5.0	Reporting	8	8	16	40	$ 14,320.00
	Disbursements					$ 1,500.00
	Total (ex GST)					**$ 79,000.00**
	GST					$ 7,900.00
	Total (inc GST)					$ 86,900.00

5.3 Timeline

The proposed timeline for the project is outlined in the following table, which shows the work occurring from June to September 2014.

	Task	2-Jun	9-Jun	16-Jun	23-Jun	30-Jun	7-Jul	14-Jul	21-Jul	28-Jul	4-Aug	11-Aug	18-Aug	25-Aug	1-Sep	8-Sep	15-Sep	22-Sep
1.0	Inception Meeting																	
2.0	**Stakeholder engagement**																	
2.1	Develop stakeholder engagement strategy																	
2.2	Stakeholder engagement workshops (3) (inc. prep)																	
2.3	Stakeholder meetings (up to 10)																	
3.0	**Desktop research and analysis**																	
3.1	Review and compilation of background information																	
4.0	Develop physical profile																	
5.0	Reporting																	

6 Project experience

A selection of projects recently completed by Alluvium (previously Equatica) in the Cooks River Catchment demonstrates our diverse experience in providing sustainable water management services in this area.

Cooks River Sustainability Initiative
Marrickville Council, 2008-09

Equatica provided specialist knowledge on subcatchment planning to the Cooks River Sustainability Initiative for more than a year. David Knights was located at CRSI's office part time, where he oversaw the development of six subcatchment management plans for Cooks River subcatchments in different local government areas. His role included project planning, technical guidance and review, including directing, managing and mentoring staff to complete the six subcatchment plans. David also helped the CRSI team build capacity amongst affiliated councils and to run community visioning and planning sessions.

Tennyson Street Subcatchment Management Plan
Marrickville Council, 2008

Equatica completed a Subcatchment Management Plan for the Tennyson Street subcatchment in Marrickville LGA. The project involved workshops with community members and other stakeholders to develop a vision and guiding principles for WSUD in the subcatchment, and then development of WSUD options which will reduce water demands, improve stormwater quality and enhance public open space within the subcatchment.

Stormwater harvesting feasibility assessments - Airey Park and Hudson Park
Strathfield Council, 2009

Equatica completed stormwater harvesting feasibility assessments for two major parks in Strathfield Council. This involved assessment of irrigation demands for each park, as well as stormwater harvesting, storage and treatment options. Both of the parks are located along the Saleyard Creek stormwater channel, but also have other sources of stormwater available from local catchments. The feasibility assessment looked at the various sources of stormwater available, and compared each option in terms of estimated costs and expected reliability of supply. Water balance modelling was used to assess supply reliability for different irrigation demand scenarios.

Drew Street Raingardens
Advice during concept design, detailed design and construction Strathfield Council and the Cooks River Sustainability Initiative, 2010

Equatica provided design advice and technical assistance to Strathfield Council engineers to develop detailed designs for two 75 square metre raingardens in Drew Street, Greenacre. The treatment systems are located in a wide road median on a quiet residential street. The systems treat runoff from the local houses and roads. These were the first raingardens constructed by Council's crew and hands-on advice was provided by Equatica during the construction process. The system was planted out by the local residents. Over 30 community members turned out to participate in the planting day.

Wallace Street Raingarden
Concept and detailed design
Marrickville Council, 2009

Equatica developed designs for a small raingarden in Marrickville South. The raingarden treats a residential catchment consisting of single dwellings and road runoff. The system is located at the end of a steep street. A key design challenge at the site was designing the raingarden to work in a relatively constrained space with moderate gradients.

Bundara Reserve rain garden
Concept, detailed design and construction advice Hurstville Council and the Cooks River Sustainability Initiative, 2010

Equatica developed the concept designs, detailed designs and also provided construction advice for a raingarden treating runoff from a local residential catchment draining to Upper Wolli Creek in the Cooks River catchment. The treatment system is a "second generation" bioretention system including a saturated zone with a carbon source. A key component of the design was to retain excavated material on site and revegetate the mounds with native grasses and shrubs. The community was supportive of this concept as it also assisted in screening the residential area from the adjacent industrial area.

Thornley Street bioretention system
Concept and detailed design
Marrickville Council, 2009

Equatica developed concept and detailed designs for a bioretention system at Thornley Street in Marrickville South. Detailed designs were completed in collaboration with Martin Pell from Sprout. At this site, stormwater cascades down a rocky channel through a small bushland reserve, and used to spill onto a grassy area at the base of the channel. Equatica designed a stilling basin, bioretention system and high flow bypass channel, which were constructed in 2010.

Federation Road bioretention system
Concept and detailed design
Marrickville Council, 2009

Equatica developed concept and detailed designs for a bioretention system at Federation Road in Newtown. Detailed designs were completed in collaboration with Martin Pell from Sprout. Levels were a key constraint at this site, which slopes significantly. With high pedestrian traffic it was important to avoid any large level changes at the edges of the system. This was the first bioretention system which Marrickville Council constructed in-house, therefore a simple design was developed, which was straightforward to implement.

Chain of Ponds Reserve - Bioretention Swale
Concept and detailed design advice
Strathfield Council, 2009

Strathfield Council is in the process of upgrading the Chain of Ponds Reserve. As part of this upgrade a bioretention swale to treat local stormwater runoff was included in the plans for the site. Equatica worked closely with Council's landscape architect and drainage engineer to develop the designs and also review the detailed designs.

Yarrowee Wetland and Stream Restoration Works
Concept design, detailed design and documentation
Strathfield Council and Sydney Metro CMA, 2009

This project will restore a small tributary of the Cooks River, where the existing channel is significantly degraded. Equatica developed concept and detailed designs for a constructed wetland, with a dual habitat and stormwater treatment function. The wetland will treat stormwater from two local residential catchments, and also control alligator weed in the drainage channel.

7 Company information

In November 2013, Equatica merged with Alluvium to form a company that brings together Equatica's strength in urban water management and Alluviums strength in catchment and waterway science.

Alluvium was founded in 2006 to provide advice to government and private organisations on sustainable solutions to issues facing the management of our water resources, rivers and catchments.

We believe the application of creative thinking, robust science and practical engineering can effectively address the complex and interrelated threats to our natural environment.

Our relationships with our clients and stakeholders are founded on honesty and openness, and we believe communication, dialogue and knowledge sharing is the foundation of the successful partnerships we have forged since our formation.

We actively cultivate a culture of personal responsibility for client relationships and communication with all our staff. Collaboration with other specialist firms is central to our approach. We are experts in our field, but we do not pretend to be experts in all fields; instead we have strong trusting relationships with other specialists, including research bodies and niche consulting firms.

The science, policy and application of water resource and river management is evolving at a rapid rate to address the critical issues facing Australia's natural environment. We stay at the leading edge of this field by investing in internal research capability and closely aligning ourselves with leading researchers in our field.

We operate across Australia from our offices in Melbourne, Sydney, Brisbane, Townsville and Canberra.

Business name:	Alluvium
Contact person:	Richard McManus
Details: Street address:	Suite 6, Level 1, 2-12 Foveaux St Surry Hills NSW 2010
Postal address:	PO Box 847 Strawberry Hills NSW 2012
Phone:	8094 9703
E-mail:	richard.mcmanus@alluvium.com.au
ABN	45 653 522 596
Staff in Sydney	6
Staff in Alluvium	45

7.1 Referees

Sydney Park Stormwater Harvesting and Reuse Scheme Stage 1 and Stage 2
Our fees were approximately $150,000 for concept and detailed design and $40,000 for construction supervision.
Damon La'Rance
Project Manager, Open Space
City Of Sydney
Phone: 9246 7767
Email: dlarance@cityofsydney.nsw.gov.au

Concept and Detailed Designs: for Mason Park, Airey Park and Hudson Park Stormwater Harvesting and Reuse Projects;
Various budgets up to $40,000 for each project
Jon Stiebel (formerly Strathfield Council's Manager Sustainability; now at Leichhardt Council)
Phone: 9367 9222
Email: jons@lmc.nsw.gov.au

7.2 Insurance

A summary of our insurance details are provided below.

Insurer	Policy No	Details	Amount Insured	Dates
QBE Insurance (Australia) Ltd	42A415719BPK	Business Pack Insurance	Public Liability - $20,000,000	24/07/2013 to 24/07/2014
Dual Australia Pty Ltd	P-PI/0/29588/12/D-3 BRIC Ref 267880/14	Breach of Professional duty as Environmental Consultants.	Total sum insured - $10,000,000 Excess: $10,000	16/10/2013 to 16/10/2014
QBE Workers Compensation Ltd	WGB131223327122	Workers Compensation Insurance		30/06/14

8 Quality Assurance

We have provided details of our quality assurance system, OH&S policy and insurance details in this section. Any additional information on these areas can be provided, if required.

8.1 Quality management system

Our Quality Management System (QMS) is built around ISO 9001-2000 (currently being updated to ISO 9001-2008) and customised to fit a medium sized consulting business. The QMS is intended to provide the optimum mix of quality assurance without overburdening the business with unnecessary levels of bureaucracy (that are inevitably passed on to the client). We have developed a number of bespoke quality assurance tools to ensure our work is always at the required standard. For this study we will apply the following (in addition to our stand QMS procedures:

- **Technical Review –** We will provide technical review of the project deliverables during the project and before the release of any reports. Technical review will be undertaken by an appropriately qualified, senior member of staff.
- **Modelling/analysis review –** in addition to a review of any written reports, we will review any models or other analysis products developed in this study. The review will be undertaken by an appropriately qualified, senior member of staff.
- **Document Control –** All reports, discussion papers, and memos are stored on the Alluvium server and backed up daily.
- **Client sign off points –** There are a number of meetings in the project schedule that provide the opportunity for Council review and sign off on progress, prior to further project activity. These hold points help to ensure that the product is kept on track, client fully informed and there is shared responsibility to a successful project outcome.
- **Active client communications** –we will establish an agreed communications protocol between James Fitzgerald and the nominated Council manager at the inception meeting.

8.2 OH&S

Alluvium recognises its responsibility under the Occupational Health and Safety (Commonwealth Employment) Act 1991 (the OH&S Act) and state based legislation. We have developed a specific OH&S policy that provides the framework to providing a healthy and safe workplace and to eliminate conditions and incidents that could result in personal injury or ill health. We have separate policies for field- and office-based activities.

The policy has been developed over a period of time in consultation with our staff, and has been signed off by the Alluvium Board. A copy of the policy is available to Council on request.

The Alluvium Quality Management System has been developed to meet the requirements of AS/NZS ISO 9001:2008 Quality management systems – requirements (the Standard). The information contained in the Quality Management Manual provides an overview of the Quality Management system.

Appendix A – CVs

Richard McManus

Education and training:

BA Env Sc (Hons)
Sydney University 1993

M Engineering Science (Environmental Hydrology)
University of New South Wales, 1998

Professional memberships:

President Stormwater NSW

Richard has particular expertise in integrated strategic management of water resources, strategic policy and planning, integration and implementation of stormwater management best practice, evaluation, and project coordination and management. This expertise extends to working with local councils, state and federal government, industry and community groups, and is coupled with an extensive understanding of stormwater and waterways management complemented with significant skills in conducting interviews and workshops. Richard has authored or co-authored over 30 policy and conference papers and been responsible for setting stormwater management policy on a state and local government level.

Key skill areas:

- Integrated water management
- WSUD Policy and training
- WSUD strategy and planning
- Social research and program evaluation

WSUD POLICY, CAPACITY BUILDING AND TRAINING

- WSUD LEP and DCP provisions:
  - Penrith Council WSUD DCP provision and guideline (2013).
  - Hornsby Council WSUD DCP provision and guideline (2011 and 2013).
  - Marrickville Council WSUD DCP Provisions (2011).
  - Wollongong Council review of WSUD controls (2011).
  - Strathfield Council provisions, guidelines and training (2010-11).
  - WSUD LEP and DCP Template for councils in NSW, Botany Bay Coastal Catchment Initiative / Sydney Metropolitan CMA (2008).
  - City of Ryde provisions, guidelines and training (2008)
  - Blacktown Council provisions, guidelines and training (2008) *Winner NSW SIA Awards Excellence in Research, Innovation, Policy and Education 2010.*
  - Fairfield Council provisions, guidelines and training (2007).
- WSUD Guidelines:
  - Introductory fact sheet and presentation for the WSUD in Sydney Program.
  - Sydney Metro CMA WSUD Interim Reference Guideline – Concept Design
  - Sydney Metro CMA WSUD Interim Reference Guideline – Construction & Establishment for Swales, Bioretention Systems & Wetlands
  - Sydney Metro CMA WSUD Incentives Paper
- WSUD Training
  - Introduction to WSUD
  - WSUD Conceptual Design
  - WSUD for Planners and DA Assessment Officers

- Water Cycle Management Strategies
    - Hornsby Council review of Catchment Planning Program.
    - City of Ryde Water Quality Strategic overview and catchment plan.
    - Integrated Water Cycle Management Framework for Warringah Council.
    - Total Water Cycle Management Strategy for the City of Sydney to direct water conservation, stormwater harvesting and treatment in the City.
    - Strategic Review of Woollahra Council's Environmental Works Program.
    - Evaluation of Stormwater Management Practices in Sydney's Drinking Water Catchments for the Sydney Catchment Authority.

WSUD STRATEGY AND PLANNING

- Review of Sydney Water Stormwater Charge for Low Impact Discount (2013).
- UrbanGrowth NSW (nee Landcom) WSUD Sustainability Reporting 2005 - 2013.
- Stockland WSUD indicators and case studies (2012).
- WSUD Strategy and Case Studies for Landcom 2009.
- Review of Landcom Water Conservation Targets 2009.
- WSUD input into Street Design Guidelines:
    - Parramatta Council (2010),
    - City of Sydney (2010) and
    - Landcom (2006).
- Technical Review of the Environmental Trust Grants 2008-2010.
- Review and Evaluation Water Sensitive Urban Design in the Sydney Metropolitan Region for the WSUD in Sydney Program.
- Barriers and Opportunities to WSUD Adoption in the Botany Bay Catchment prepared for the Botany Bay Coastal Catchments Initiative.
- Development of corporate reporting indicators to benchmark the capacity of local government to implement sustainable urban water practices in Melbourne.
- State Environment Protection Policy (Waters of Victoria) Implementation Project" for EPA Victoria and the Municipal Association of Victoria.
- Project manager for over 200 NSW Government Stormwater Trust Grants.

WSUD STRATEGIES

- Stormwater Harvesting
    - Hurstville Stormwater Harvesting Feasibility Study: Hurstville Golf Course
    - Feasibility Study Report for Sustainable Water Management in the Duck River Catchment – Bankstown, Ashfield and Parramatta Councils.
    - Review of the Hyde, Cook and Phillip Parks Water Reuse Feasibility Study for the City of Sydney: Technical review.
- Development of Water Sensitive Urban Design (WSUD) Strategies
    - Royal Botanic Gardens and the Domain Sydney (for Cox Richardson)
    - Hyde Park (for Clouston)
    - for Landcom residential developments in Greater Sydney including Royal Newcastle Hospital, Mt Annan, UWS Campbelltown, Spring Farm, Warnervale Town Centre.
    - Green Square Town Centre.
    - Sydney University.

WSUD CONCEPTS

- North Sydney Council Berry Creek Catchment
- Auburn, Parramatta and Bankstown Councils in the Duck River Catchment.
- Sydney Fish Market (Government Architects Office).
- MacCabe Park Wollongong (Government Architects Office).
- Redleaf Masterplan (Woollahra Council)
- City Farm (City of Sydney)
- Wiley Park (Canterbury)

Alexa McAuley

Education and training:
Masters in Environmental Management, University of New South Wales, Sydney 2010

Bachelor of Engineering - Environmental (Honours Class 1 and the University Medal) University of New South Wales, Sydney 2001

Industry affiliations:
Australian Water Association
Stormwater NSW

Alexa is an environmental engineer with more than ten years experience in the urban water sector. After starting her career in stormwater drainage and floodplain management, Alexa has been working in sustainable urban water management, specialising in water sensitive urban design since 2006.

Alexa's skills range from policy and strategic planning to concept and detailed design. Alexa has delivered numerous water sensitive urban design and water cycle management strategies, policy documents, guidelines and design tools, as well as a large number of concept and detailed designs for greenfield and retrofit projects including wetlands, waterway restoration, bioretention systems, swales and stormwater harvesting and reuse systems.

Alexa is passionate about improving the health of urban streams and protecting bushland from stormwater runoff. When she's not at her desk, she can often be found in the bush, and was the world rogaining champion in 2010.

Key skill areas:

- Water Sensitive Urban Design
- Sustainable urban water management
- Stormwater quality and treatment
- Stormwater harvesting and reuse
- Catchment management
- MUSIC modelling
- Hydraulics
- Concept and detailed design
- Integration of sustainable water management with landscape and engineering design
- Development of policy and guidelines for WSUD/sustainable water management

Relevant projects:

Project	Description	Role	Client	Year
Maluga ponds water quality improvement project	Design of major restoration works to Maluga Ponds to improve water quality in the ponds as well as enhancing their role as a stormwater treatment system and improving safety, amenity and habitat values. The design includes a recirculating bioretention system.	Project Manager & Design Engineer	Bankstown City Council	2012
Gordon Creek, Lovers Jump Creek and Ku-ring-gai Creek catchment management plans	Development of catchment management plans for three urbanised catchments in northern Sydney. These projects followed an innovative approach which explored how Council could encourage improved water management outcomes on private land, recognising that there are limited opportunities to improve stormwater quality on public land in these catchments.	Project Manager & Engineer	Ku-ring-gai Council	2011-2012

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Project	Description	Role	Client	Year
Bungarribee Creek catchment plan	Development of a catchment management plan for Bungarribee Creek – an urbanised catchment in western Sydney with ongoing development pressure.	Project Manager	Blacktown City Council	2012
Lake Gillawarna water quality improvement project	Design of major restoration works to Lake Gillawarna (southern pond) to improve water quality in the lake as well as enhancing its role as a stormwater treatment system and improving safety, amenity and habitat values. The resident ibis population was a key consideration as the site is a key refuge breeding site for the species.	Project Manager and Design Engineer	Bankstown City Council	2011-2012
Marrickville Council Engineering placement	Part-time placement at Marrickville Council to work within the Water and Catchments team to deliver Subcatchment Plans, concept designs for stormwater harvesting and reuse, stormwater treatment systems, and input to WSUD policy.	Planning and Design Engineer	Marrickville Council	2011
Standard Drawings for streetscape stormwater treatment systems	Development of a set of standard drawings for streetscape stormwater treatment systems including various rain garden configurations.	Project Manager & Design Engineer	Sydney Metropolitan Catchment Management Authority	2010
Callan Park Integrated Water Cycle Management Strategy	Development of an IWCM strategy as part of the 2010 Callan Park Master Plan, including water conservation, stormwater treatment, harvesting and reuse and wastewater recycling. A goal of the Masterplan is for the site to provide a net positive impact on the water cycle, and the IWCM strategy outlines how this can be achieved.	Planning & Design Engineer	With McGregor Coxall for Leichhardt Council	2010
Parramatta Public domain guidelines – WSUD information	Development of guidelines for incorporating WSUD into public domain projects in Parramatta LGA, including a set of typical design drawings for common streetscape WSUD elements suitable for the Parramatta LGA	Planning & Design Engineer	with McGregor Coxall for Parramatta City Council	2010
Bundara Reserve Bioretention System	Concept, detailed designs, documentation and construction advice for a bioretention system in Bundara Reserve, Beverly Hills. This was the first bioretention system installed in Hurstville LGA.	Project Manager & Design Engineer	Hurstville City Council	2010
Echo Point Stormwater Harvesting and Reuse Scheme	Concept, detailed designs, documentation and construction advice for a stormwater harvesting scheme at Echo Point. Stormwater is treated on site and used to flush toilets at the busy facility. The scheme forms part of a "Green Precinct" at Katoomba.	Project Manager & Design Engineer	Blue Mountains City Council	2009-2010
WSUD Designs for Johnston Subdivision, Palmerston NT	Concept, detailed designs and documentation for more than ten stormwater treatment systems for the subdivision, including wetlands and bioretention systems which were designed specifically for the wet-dry tropical climate.	Project Manager & Design Engineer	NT Department of Planning and Infrastructure	2009
Bioretention system designs for Chatswood Mall	Concept, detailed designs, documentation and construction advice for bioretention systems incorporated into the re-design of Chatswood Mall.	Design Engineer	Willoughby City Council	2009
WSUD Implementation Strategy for Darwin Harbour	Development of policy, planning framework and guidelines for WSUD for protection of water quality in Darwin Harbour, in the wet/dry tropics	Planning Engineer	NT Department of Planning and Infrastructure	2006-2009

David Knights

Education and training:
Bachelor of Environmental Engineers (Hons 1)

UNSW, Sydney, 2000

Bachelor of Arts (History)
UNSW, Sydney, 2000

Industry affiliations:
Stormwater NSW

David is an environmental engineer with extensive experience in strategic planning, sustainable urban water management, integrated water cycle management and green infrastructure. He has a passion for the environment and sustainability. For the last fifteen years he has been developing Integrated Water Cycle Management Strategies and Water Sensitive Urban Design Strategies for various clients both internationally and throughout Australia. He has been involved in all levels of sustainable water management from concept design to construction and from wastewater treatment and reuse to stormwater treatment and reuse.

David has been at the forefront of leading innovative designs including stormwater treatment harvesting and reuse projects, greywater wetlands, green wall treatment systems and a green roof stormwater treatment system. He has a keen interest in design and his projects have won awards for engineering, landscape architecture and planning.

Key skill areas:

- Engineering design
- Strategic catchment management
- Training and knowledge sharing
- Water quality and hydraulic modelling
- Stormwater treatment and reuse
- Wastewater treatment and reuse
- Waterway restoration
- Construction supervision

Relevant projects:

Project	Description	Role	Client	Year
Sydney Park Stormwater Harvesting	Civil, stormwater and hydraulic concept and detail design for a $10M stormwater treatment, habitat improvement and reuse scheme and park upgrade	Project manager/Design Engineer	City of Sydney	2011-2014
Georges River Bank Restoration works, Picnic Point	Soft engineering concept and detail designs for bank protection and restoration works at Picnic Point on the Georges River and associated landscaping and boardwalks	Project manager/Design Engineer	Bankstown City Council	2013-2014
Wangal Park Re-development	Development of a services masterplan, concept design and detailed design including all civil, stormwater, detailed landscaping plans and hydraulic design for a development of a new park on a former landfill	Project manager/Design Engineer	Burwood Council	2012-2014

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Project	Description	Role	Client	Year
Blacktown Showground Reuse scheme	Stormwater and hydraulic concept and detail design for a $15M stormwater treatment and reuse scheme and park upgrade	Project manager/Design Engineer	Blacktown City Council	2011-2013
Kilgariff Development, Northern Territory	Development of a integrated water cycle management strategy including infiltration, wastewater reuse and green infrastructure, Kilgariff, Alice Springs	Project Manager	Department of Planning and Infrastructure	2011-2012
Hurstville Golf Course	Civil, stormwater and hydraulic concept and detail design for a $2M stormwater treatment and reuse scheme with an open storage dam and golf course irrigation upgrade	Project manager/Design Engineer	Hurstville City Council	2011-2013
Discovery Point	WSUD Strategy, DA Reports and Detailed Designs for Discovery Point Development at Wolli Creek	Project Manager	Australand	2012-current
Western Sydney Parklands – Lizard Log	Stormwater, wastewater and hydraulic concept and detail design for a $15M stormwater and greywater treatment and reuse scheme and park upgrade and habitat enhancements	Project manager/Design Engineer	Western Sydney Parklands Trust	2009-2011
Northshore Hamilton	Development of a WSUD strategy for the Public Domain for the Northshore Hamilton a large brownfield re-development on the Brisbane River, north of Brisbane CBD	Project Manager	ULDA	2013
Katoomba Cultural and Civic Centre	Stormwater and hydraulic concept and detail design for a $17M stormwater green roof treatment and reuse scheme	Project manager/Design Engineer	Blue Mountains City Council	2009-2010
Yarrowee Wetland	Civil, stormwater and hydraulic designs for the development of a stormwater treatment and habitat wetland	Project Manager/Design engineer	Strathfield City Council	2009-2010
Training and capacity building	Training in water quality modelling, stormwater treatment and reuse design, construction and operation and maintenance	Presenter	Various Clients	2008-current
Bondi Beach Stormwater Harvesting Project	Development of a stormwater harvesting project saving 100 ML/yr of potable. The treated water is used for irrigation and toilet flushing at Bondi Beach. A Hydrocon infiltration treatment system was also constructed as part of the harvesting scheme.	Project Manager/Design engineer	Waverley Council	2011-2012
WSUD Implementation Strategy for Darwin Harbour	Development of policy, planning framework and guidelines for WSUD for protection of water quality in Darwin Harbour, in the wet-dry tropics	Project Manager, Planning Engineer	Department of Planning and Infrastructure	2006-2009
Stormwater Harvesting Strategic Assessment	Development of a strategic assessment for 7 playing fields and Dee Why Town Centre redevelopment in the Warringah LGA. The study recommended aquifer storage and reuse projects, underground storage and reuse projects and landfill remediation projects in a wide ranging and comprehensive strategic assessment of options	Project Manager, Planning Engineer	Warringah Council	2012-2013

Andrew McMillan

Education and training:
Bachelor of Engineering – Civil & Environmental (Honours Class 1), Bachelor of Business, University of Technology, Sydney, 2006

Masters in Environmental Management, University of New South Wales, 2015 (expected)

Industry affiliations:
Australian Water Association
Engineers Australia
Stormwater NSW

Andrew is a civil and environmental engineer with more than eight years experience in the urban water sector. His experience in concept and detailed design of stormwater treatment and recycling systems is underpinned by a strong understanding of hydrology, hydraulics and modelling skills.

Andrew's work spans hard urban areas and streetscapes through to natural environments and he has worked on the design of bioretention and wetland stormwater treatment systems, harvesting systems, wetland and waterway restoration, water quality monitoring and analysis, and catchment analysis and strategic planning.

Andrew is a volunteer with Engineers Without Borders Australia and is completing a Masters in Environmental Management at UNSW where he is refining his sustainability credentials and gaining further knowledge of environmental issues and management approaches.

Key skill areas:

- Water Sensitive Urban Design
- Sustainable urban water management
- Stormwater quality and treatment
- Stormwater harvesting and reuse
- Catchment management
- MUSIC modelling
- Hydraulics
- Concept and detailed design
- Construction supervision
- Water quality monitoring and analysis
- Development of policy and guidelines for WSUD/sustainable water management

Relevant projects:

Project	Description	Role	Client	Year
Sydney Olympic Park Bennelong Pond and Parkway	Design for restoration of Bennelong Pond within Bicentennial Park. Concept and detailed design of bioretnetion swales to treat runoff from the Parkview Precinct development.	Engineer	Sydney Olympic Park Authority	2014
Dubbo JJC stormwater harvesting	Concept and detailed design of a rural stormwater project for irrigation of a sports field.	Engineer	Department of Attorney General & Justice	2014
Cranebrook wetlands	Concept and detailed design for restoration of a regionally significant wetland, and a large bioretention system.	Engineer	Penrith Council	2014
Discovery Point WSUD strategy and detailed designs	Development of WSUD strategy for Discovery Point. Concept designs for more than eight stormwater treatment systems for the site, including bioretention raingardens which were designed specifically for the constrained urban setting.	Engineer	Australand	2012-2014

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Project	Description	Role	Client	Year
Wangal Park wetlands	Concept and detailed design of treatment wetlands and a stormwater harvesting scheme for a new park on the site of an old landfill.	Engineer	Burwood City Council	2013
Hurstville Golf Course stormwater harvesting	Concept, detailed designs, documentation and construction advice for a stormwater harvesting scheme at Hurstville Golf Course. Stormwater is treated on site and used to irrigate the golf course.	Engineer	Hurstville City Council	2012-2013
Jim Ring Reserve stormwater harvesting	Detailed design of stormwater harvesting system with offtake from the pond in Maluga Passive Park	Engineer	Bankstown City Council	2013
Maluga ponds water quality improvement project	Design of major restoration works to Maluga Ponds to improve water quality in the ponds as well as enhancing their role as a stormwater treatment system and improving safety, amenity and habitat values. The design includes a recirculating bioretention system.	Engineer	Bankstown City Council	2012-2013
Marrickville Golf Course bioretention	Feasibility assessment and concept design and documentation for a bioretention stormwater treatment system located on the golf course	Engineer	Marrickville Council	2012
Rockdale water quality monitoring and assessment	Monthly water quality monitoring of 17 creek sites for one year in Rockdale, with analysis of data and development of urban stream water quality benchmarks.	Engineer	The City of Rockdale	2012-2013
Bondi beach stormwater harvesting	Detailed design of a stormwater harvesting project saving 1000 ML/yr for irrigation and toilet flushing at Bondi Beach.	Engineer	Waverley Council	2012
Hornsby Heights wastewater recycling scheme	Feasibility assessment and concept design of a recycled water scheme to supply water for irrigation from the Hornsby Heights STP.	Engineer	Hornsby Council	2012
Gordon Creek, Lovers Jump Creek and Ku-ring-gai Creek catchment management plans	Development of catchment management plans for three urbanised catchments in northern Sydney. These projects followed an innovative approach which explored how Council could encourage improved water management outcomes on private land, recognising that there are limited opportunities to improve stormwater quality on public land in these catchments.	Engineer	Ku-ring-gai Council	2011-2012
Lake Gillawarna water quality improvement project	Design of major restoration works to Lake Gillawarna (southern pond) to improve water quality in the lake as well as enhancing its role as a stormwater treatment system and improving safety, amenity and habitat values. The resident ibis population was a key consideration as the site is a key refuge breeding site for the species.	Engineer	Bankstown City Council	2011-2012