

**GAWLER EAST RESIDENTIAL
STORMWATER MANAGEMENT STRATEGY**

Prepared for
DELFIN LEND LEASE

By



OCTOBER 2008

JOB NO: C070975

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ISSUE REGISTER					
Rev	Date	Issue	Originator	Approved	Authorised
A	01.02.08	Revisions made as per Delfin feedback	GL	DB	DB
B	30.09.08	Issued for Development Plan Amendment	GL	DB	DB
C	3.10.08	Issued for Development Plan Amendment	GL	DB	DB



1. INTRODUCTION

1.1 Report Purpose

Wallbridge and Gilbert have been engaged by Delfin Lend Lease to review and develop a stormwater management strategy for the future development area that could accommodate up to approximately 4500 at Gawler East and Gawler South East. The area lies within the City of Gawler. This work builds on the previous preliminary studies that provided a brief insight to into stormwater management of the site.

This report summarises the investigation into developing potential opportunities for managing stormwater quantity, quality and reuse in support of a Development Plan Planning (DPA) report to rezone the land enabling development to proceed. This study will contribute to developing an agreed stormwater master plan for any future residential development.

The scope of work included a desk top investigation into the management of surface water and ground water with the aim of developing a strategy incorporating water sensitive urban design concepts for future development. The key goals being to, reduce the flooding impacts downstream as a result of increasing stormwater runoff, maximise retention of water on site for reuse, as well as incorporating treatment systems that will minimise the risk of potential adverse impacts on receiving environments, being local natural watercourses and the South Para River. This study included the assessment of:

- On site detention, treatment and retention (including providing a rainwater tank for each allotment)
- Treatment of runoff through a combination of:
 - Vegetated swales along major drainage paths
 - watercourse restoration
 - wetlands
 - Bioretention swales
- Aquifer storage and recovery (ASR)

All systems are based on pre-conceptual design and consider the treatment train methodology.

Further work will be required to develop an agreed stormwater master plan for the development site area including a cost estimate for those works.

This study focuses on the area bounded by (refer Figure 1):

- Potts Road, Eckermann Avenue and South Para River to the south
- Rural areas to the east
- Calton and Balmoral Roads to the north
- Gawler Town adjoins to the west





Figure 1: *Gawler East Development Area*

2. STUDY OBJECTIVES

The DPA will aim to rezone the site such residential development can occur. The development site will occur in an area where there has been no previous water quality and quantity monitoring. In such a situation numerical modelling techniques are required to estimate the volume and quality of stormwater runoff that will be generated by the new development as well as estimating what occurs in the pre-development situation. Modelling of both quantity and quality of stormwater runoff is discussed in further detail in section 4 of this report.

This section aims to set the parameters for both policy objectives and key performance targets for any proposed development on the subject land. The view taken in this investigation is to apply and adopt as much as practicable the *Water Sensitive Urban Design* philosophy.

Water sensitive urban design (WSUD) is defined as the integration of urban planning and development with the management, protection and conservation of water within the consideration of the total urban water cycle. It provides sustainable stormwater management outcomes by combining the normal hydraulic design criteria with ecological, biological, economic, social and aesthetic considerations. It applies to the urban water cycle and designing it to be more sustainable by limiting the negative impacts associated with urban development on the pre-existing environment.

Water sensitive urban design can encompass improvement at all levels, such as regional catchment, down to the single dwelling level. WSUD seeks to provide a more sustainable approach to the management of the urban water cycle. In this context the stormwater strategy for the development seeks opportunities to facilitate the following outcomes:

- More efficient use of both conventional water supplies and locally generated urban water resources.
- Reduced changes of the hydrological regime through reduced stormwater discharge by employing the *at source control* philosophy to stormwater management.
- Reducing downstream urban flooding impacts.
- Improved quality of stormwater.
- Improved landscapes, recreation linkages and amenity.
- Improved ecological and habitat outcomes.

These are achieved by adopting the methodologies as follows:

- Detain or slow the conveyance of stormwater through the system.
- Harvest and use stormwater as an alternative source of water to reduce the reliance of potable water at all scales.
- Use vegetation and landscaping to filter stormwater.
- Water efficient landscaping.
- Protection of the water related environments and their associated values.
- Protection and enhancement of recreational, social, and cultural values.
- Local treatment and reuse of wastewater as applied for fit for purpose uses.

An important characteristic considered in the stormwater management strategy is the provision within the urban environment of *habitat corridors and linkages* to enhance the natural environment. Strategic planning of the urban area should allow for this consideration due to the pressures placed on the natural environment as a consequence of urban development and loss of habitat. The preservation of existing watercourse and other drainage corridors is a key outcome of the strategy outlined in this report.

Guiding Policy Considerations

These policy considerations are based on incorporating three key criteria for managing stormwater, these are:

- stormwater quality,
- stormwater quantity, and
- stormwater reuse.

In summary these policies are;

Policy 1 – Manage the environmental impact of stormwater as a conveyor of pollution.

Stormwater quality varies depending on its source, flow pattern and frequency of flow. Roof water will be of considerably better quality than road water and its potential use needs to give recognition to its origin. This policy is structured on the basis that roof water collected for storage by households will be suitable for appropriate use in accordance with guidelines produced by the Department of Health and SA Water.

Negative environmental and aesthetic impacts arise from stormwater runoff such as sediment accumulation, turbidity, nutrient enrichment, gross pollutants, heavy metals, oils and grease and high runoff rates.

By facilitating improvements in stormwater quality, this will assist in achieving other objectives not just limited to reuse, but also including improved urban amenity, and enhanced ecological, habitat outcomes for downstream environments.

Policy 2 - Manage stormwater as part of the urban water cycle, environment and with consideration to watercourses and floodplain ecosystems where feasible.

Considers the integration of the urban water cycle, which includes water supply, stormwater and wastewater streams. This integration aims to create a *closed water system* as a means of leading to the environmental sustainability of the urban catchment. Closed water systems seek to use and reuse water and minimise the net loss. This is achieved by minimising the importation of potable water (conventional water supply) while making other locally derived water available for non-potable uses. One of these alternative methods to service urban areas is to use locally generated stormwater and wastewater.

The importance of this is achieved by the application of water sensitive planning and management principles, namely:

- incorporating water resources issues very early in the land use planning process
- managing stormwater at the catchment or sub-catchment level
- wherever possible, using natural contours to incorporate and enhance functions and characteristics of the natural stormwater system and associated ecosystems
- maximising local on-site storage and stormwater reuse, using natural flow paths; and
- using carefully selected species of vegetation in stormwater management to promote filtering and slowing runoff to maximise settling of particulate-bound pollutants, and infiltration.

Aim to facilitate stormwater management as part of the urban environment via vegetated swales, filter strips, revegetated/ restored watercourses, extended detention basins and constructed wetlands.

WSUD source control includes water conservation and stormwater retention strategies employed at the urban allotment or sub catchment level. In addition it provides sustainable stormwater management where by the hydraulic design criteria are combined with ecological, biological, economic, social and aesthetic considerations.

Policy 3 - Manage the impacts of increased stormwater runoff

Through urbanisation of the area, more stormwater runoff will be generated which then flow through other areas, increasing the risk of flooding, while causing a deterioration of water quality.

The stormwater management systems must be designed to perform their traditional function of ensuring minimal risk of flooding, and damage to public and private property with the added requirement for protecting receiving ecosystems. The strategy will have due regard for maintaining a stormwater regime that minimises the downstream impacts associated with increased runoff from its developed area.

The stormwater management strategy for the site adopts the multi-objective approach to stormwater management, resulting in an integration of all three policies. The rationale for this lies in the fact that many management measures such as wetlands, which are designed for water quality treatment, amenity, ecological and habitat values, also have inherent flood retardation benefits. Flood prevention and public safety remain as fundamental objectives for the planning and design.

2.1 Key Performance Objectives

A significant component of the strategy involves setting clear objectives for the management of stormwater quality and quantity.

Stormwater Quantity and Management of Peak Runoff

A key requirement for any new development is the management of peak flows to ensure that flooding is not exacerbated by the development. The Town of Gawler generally adopts the standard of ensuring the downstream post development 100 – year average recurrence interval (ARI) peak flows are no greater than the:

- Pre-development 5 year ARI flow or
- Capacity of the downstream drainage infrastructure

Stormwater Quality

Stormwater quality objectives that have been adopted for this development are measured on the basis of annual loads of pollutants. Two performance standards are proposed to ensure the best outcome is achieved for the post development case.

1. Adopting the Victorian pollutant removal standards which uses the best environmental practice approach, which have been summarised in the CSIRO publication “Urban Stormwater, Best Practice Environmental Management Guidelines” These guidelines are summarised and presented below.

CSIRO guideline reduction parameters

• Total phosphorous reduction	=	45%
• Total nitrogen reduction	=	45%
• Suspended solids reduction	=	80%
• Gross pollutants removal	=	70%

2. South Australian EPA water quality policy, EPP Water Quality (2003) defines the guidelines for *fresh water environments*. The listed pollutant concentrations will be used as the limiting targets. These are based on their general water quality criteria in table 1 EPP (2003) and presented below.

• EPP Water Quality Criteria		
• Total phosphorous	=	0.5 mg/L
• Total nitrogen	=	5 mg/L
• Suspended sediment	=	20 mg/L
• Gross pollutants	=	Not specified (Adopt 100% removal)

The water quality criteria is based on schedule 2, table 1 of the EPP 2003. Given that the natural watercourses would be considered to be a fresh water environment, the water quality criterion has been selected on that basis.



Stormwater treated to achieve the Victorian standards is expected to be suitable for ASR and other reuse applications such as irrigation of open spaces. Whilst other pollutant loads are not considered here due to the limitations of the modelling software, it is assumed that other pollutants would be effectively removed and or treated. The rationale is based on the premise that very fine pollutants are attached to other particulate pollutants such as phosphorous (TP) and suspended solids (SS). Therefore while targeting TP and SS, it is reasonable to expect that many more pollutants are in fact being removed, trapped and or treated.

The Victorian standards are recognized guidelines that are certain to exceed the standards defined by South Australian EPA water quality policy, EPP Water Quality (2003) outlined in item 2. Therefore the CSIRO pollution reduction guidelines will be used as a guide to size treatment measures. In any case the conceptual design of the treatment measures aims to ensure that treated stormwater released into downstream watercourse is at least in accordance with the standards as defined by the South Australian EPA water quality policy, EPP Water Quality (2003).

Stormwater Retention and Reuse

There are no specific targets specified for stormwater reuse (e.g. minimum quantity or percentage reduction on potable use). However this report evaluates the quantity of treated stormwater that can be harvested in storages that can become available for reuse applications.

Stormwater harvesting and reuse within the single allotment will be analysed to assess the potential savings on potable water consumption which can be achieved by providing alternative roof runoff water for specific uses. Roof stormwater runoff is considered relatively clean and only requiring minimal treatment that could be supplied directly to service an allotment. The application of roof runoff water can be applied to domestic uses including:

- Toilet flushing
- Laundry
- Garden irrigation and other outdoor uses.

Integrating Stormwater Management with the Landscape

Important objectives of the stormwater system is to minimise the land take required for stormwater treatment and retardation while using these elements as features in the landscape and part of community open space. This is considered within the limitations of the site's physical characteristics and seeking opportunities to achieve multi-objective outcomes.

3. CATCHMENT DESCRIPTION

3.1 Study Area

The site is located within the City of Gawler, and lies to the east of the main township, as shown in Figure 1. The site includes several significant watercourses including the South Para River.

A cadastral and topographic map of 1:5,000 with 2 m contours for the region was obtained from Mapland to assess the catchments throughout the site area.

Existing land use information was derived from site observations and inspection of aerial photography. The catchment areas generally comprises of cleared rural areas used predominantly for grazing and agriculture and a disused quarry. Numerous deep and shallow valleys intersect the site as well as major infrastructure including an above-ground 600 diameter trunk water main, and major overhead electricity lines.

A breakdown of the main sub-areas for the site has been provided in appendix A. These sub-areas are divided according to their catchments within the site. Section 3.3 provides a general description of each sub- area.

3.2 Existing Stormwater Infrastructure

Given the rural nature of the locality, the site is not serviced by existing stormwater infrastructure. Several minor and major watercourses and valleys traverse the site. Generally, a majority of the site will eventually drain into the South Para River. However, smaller catchments have been identified which will drain through to existing adjacent residential areas via flow paths.

3.3 Catchments

A brief description of the sub-area have been made and summarised in Table 1 on the following page. Table 1 is referenced to the catchment plan in Appendix B.



Table 1: *Sub-area summary*

Sub-Area Reference Number	Area (Ha)	Description
1	26.4	Gawler East. Gently sloping area with slopes averaging 3% to 7%. Area drains to Calton Road via a shallow wide valley and enters a dam on north side of the road. Trunk water main bisects the land.
2	169.8	Gawler East. Small portion of land drains to Calton Road. Major watercourse intersects and drains the area eventually merging with South Para River. Numerous small valleys drain into watercourse. Land slope varies approximately from 5 - 11% on the upper slopes, to 15 - 20% within the lower valley areas near the watercourse. Existing quarry located with northern portion of land. Trunk water main and overhead cables bisect the land.
3	17.2	Gawler East. Characteristics are identical to sub-catchment 2. However, the total area drains into South Para River.
4	8.0	Gawler East. Sub catchment is located adjacent to existing residential area and drains via a valley that enters South Para River. Land slope varies approximately from 5 - 11% on the upper slopes, to 15 - 20% within the lower valley areas.
5	32.1	Gawler South East. An existing rural land division catchment that is located to and drain directly into South Para River via steep valleys. Land slope varies approximately from 8 - 11% on the upper slopes, to 15 - 30% within the lower valley areas.
6	58.5	Gawler South East. An existing rural land division catchment that drains via two branching watercourses. These drain directly into the South Para River. Land slope varies approximately from 5 - 11% on the upper slopes, to 15 - 20% within some lower valley areas.
7	43.1	Gawler South East. An existing rural land division catchment that drains via two branching watercourses, which drain into existing residential areas to the west. Land slope varies approximately from 5 - 11% on the upper slopes, to 15 - 20% within some lower valley areas.
8	16.9	Gawler South East. An existing rural land division catchment that drains towards Potts Road.. Land slope varies and is approximately 5 - 16%.

4. PROPOSED STORMWATER MANAGEMENT MEASURES

With the objectives for the strategy defined in section 2, the planning for them into a future development requires careful consideration and understanding of the limitations on various management measures. WSUD solutions do not necessarily come in a standardised form, that is, they don't necessarily fit into every site or urban development. Each case requires a solution that fits in to work in with the site's physical constraints, characteristics and indeed includes seeking opportunities.

The strategy adopts the treatment train approach which involves the selection and sequential ordering of stormwater management measures to achieve optimal pollutant removal. Different measures use different processes to remove pollutants, depending on the size range of the pollutant types. In order to achieve the pollutant treatment targets for environmental considerations and reuse applications, a range of management measures will be required, and the selection and order in which they are constructed form critical considerations.

The following stormwater management measures are selected to form a suite of techniques that will be modelled to assess their performance against the objectives defined in section 2.

The following stormwater best management practices (BMPs) have been selected which can be integrated into any future planned development of the site. These have been considered within the limitations imposed due to the site's physical characteristics, and indeed to also seek opportunities that achieve multi-objectives. The BMPs include:

- Allotment rainwater tanks – a source control measure that will collect and harvest roof runoff for domestic non potable uses. May contribute to reduced allotment flow discharges for events up to the 3 month to 1 year ARI storm event.
- Major flood retarding basins also incorporating wetlands – are a means of temporary slowing flood flow by incorporating controlled outlets to regulate flows. A series of ponds and reed beds could be incorporated into the design to treat stormwater flows for the frequent events up to the 1 year ARI storm event. Retention storage could be accommodated subject to further assessment (i.e. not within the scope of this study).
- Localised retarding basins and ponds – small wet detention ponds located along drainage flow paths within valleys which contribute to a major watercourse. These could be designed to improve flow regime through the valleys to slow and reduce erosion potential within the floor of the drainage flow paths.
- Biofiltration and vegetated swales - a source control measure that will collect and treat locally generated stormwater runoff from roads. Can be used as a means of providing a visual feature along roadways and reserves as well as retarding flows. However its applications are limited within steep sites.
- Gross pollutant traps and trash racks – to intercept and capture larger particles, rubbish and other debris.

4.1 Stormwater Modelling Approaches

This section summarises the water quality and quantity simulation carried out for this study.

Water Quantity

Section 4.2 makes a conceptual assessment of the site's hydrology to determine the flood retardation requirements. An excel spreadsheet adopting the Rational Method has been used to carry out the hydrological analysis of pre and post development scenarios.

Detention storage requirements are determined by utilising an excel spreadsheet which is configured to suit the pre-developed flow rate from each sub-area.

Water Quality

Section 4.3 simulates the water quality management outcomes of the proposed strategy.

The modelling uses the MUSIC software package. MUSIC is the Model for Urban Stormwater Improvement Conceptualisation, developed by the CRC for Catchment Hydrology in Victoria. MUSIC provides the ability to simulate both quantity and quality of runoff from catchments ranging from a single house block and urban areas up to many square kilometres, and the effect of a wide range of treatment facilities on the quantity and quality of runoff downstream. MUSIC predicts the performance of the stormwater quality management systems.

By simulating the performance of stormwater quality improvement measures, MUSIC determines if the proposed systems can meet the specified water quality objectives. MUSIC will simulate the performance of a group of stormwater management measures, configured in series or in parallel to form a treatment train. MUSIC adopts the continuous modelling simulation approach, which is recommended in water quality modelling. Hence it can be used to assess the cumulative pollutant loads on the ecosystem.

4.2 Water Quantity Assessment

Adopting the stormwater quantity management parameters outlined in section 2, the pre and post development scenarios have been assessed on a conceptual basis. Preliminary sizes for flood detention basins have been determined to limit the outflow rate equivalent to a 5 year ARI pre-developed flow rate.

The basins will need to be modelled in more detail during subsequent phases of design. The assessment carried out for the purposes of this study, are provided as a guide to inform the stormwater management strategy for future development of the site.

A location plan highlighting the basins and their storage requirements is provided in Appendix A as part of the stormwater management strategy. These are also summarised in section 5. Hydrological input and output files are provided in Appendix C.

4.3 Water Quality Modelling

This simulation is based on using first order calculations based on simplistic application to assess the size of various treatment systems. The exact sizing of the treatment systems will require more rigorous calculations to attain the size and specific design configurations. For the purposes of this report, indicative plan area sizing is provided and summarised within the stormwater management strategy in Appendix A.

The catchment characteristics and parameters have been entered into the MUSIC model as shown in Figure 2. The MUSIC model is run for 1 year, which is based on an average year of rainfall with larger storms imbedded. The results and outcomes are presented in this section.

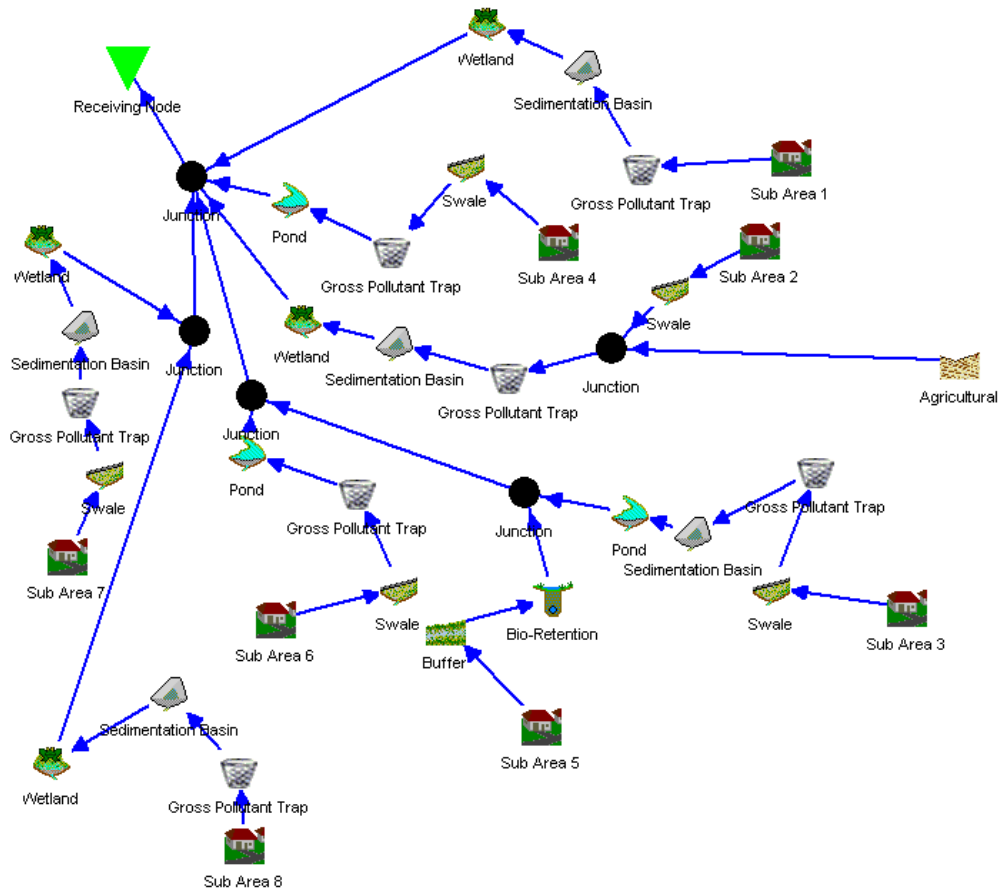


Figure 2: MUSIC water quality model

Water Quality Simulation Results

The results presented in this section demonstrate water quality compliance in accordance with the target values specified in section 2. These are assessed against the Victorian CSIRO targets and the EPP Water Quality (2003) criteria for *fresh water environments*.

The results are presented in Table 2 and 3 with a comparison to the target values.

Table 2: *Water Quality Results compared to EPP Water Quality parameters*

Pollutant Type		TP	TN	TSS	Gross Pollutants
Target value mg/L		0.5	5	20	Not specified
Sub-Area Reference Number	1	0.02	0.31	2.41	0
	2	0.01	0.01	0.05	0
	3	0.01	0.01	0.11	0
	4	0.02	0.26	2.95	0
	5	0.01	0.10	0.50	0.01
	6	0.03	0.36	3.66	0
	7	0.02	0.38	2.25	0
	8	0.02	0.02	1.97	0

Table 3: *Water Quality Results compared to Victorian CSIRO parameters*

Pollutant Type		TP	TN	TSS	Gross Pollutants
Target percentage reduction		45%	45%	80%	70%
Sub-Area Reference Number	1	97.8	89.4	75.9	100
	2	100	99.9	99.9	100
	3	99.8	99.3	98.5	100
	4	97.1	99.8	99.3	98.5
	5	96.5	86.8	77.4	100
	6	94.0	80.7	62.4	100
	7	97.8	89.1	76.0	100
	8	97.7	89.1	73.6	100

The resultant pollutant concentrations attained from the simulations revealed that each fall within the average (mean) limits set by the EPA in South Australia and those set by the Victorian CSIRO. The stormwater management strategy comprising of the site treatment systems will be satisfactory in terms of meeting the required limits of pollutant concentrations.

4.5 Stormwater Harvesting

Roof Water Harvesting

An objective of the strategy was to harvest and reuse stormwater within the development site so that the demand on the conventional mains supply (potable water) is reduced. Water recycling on a household basis can provide the potential to harvest stormwater and store it in household rainwater tanks. Whilst no specific targets have been established, the aim is to provide means by which alternative supplies can be sourced by utilising stormwater for non potable uses. In addition, by utilising rainwater tanks will assist in protecting the ecology of the watercourse by reducing allotment discharges.

Collection of rainwater for the minimum applications such as for toilet flushing and laundry uses guarantees that the roof water will be reused without reliance on the owner to use the collected rainwater. This also ensures that there is tank storage becomes available for a majority of the annual rainfall events, ensuring that stormwater outflows from allotments are reduced for the regular rainfall events.

As part of the development, owners could be encouraged to adopt other voluntary household water reuse measures as part of a development maintaining an environmentally sensitive image. Such additional water reuse applications could include connection to the hot water service and garden irrigation systems. Strict adherence to SA Water and Department of Health guidelines will need to be monitored.

The State's minimum size requirement for rainwater tanks is 1 kL. This strategy adopts a more environmental approach to domestic harvesting and proposes a 2 kL tank as a minimum for smaller courtyard allotments. Larger tanks are proposed where lot size allows.

A simulation of tank performance and the savings achieved was modelled to assess the potential savings in potable water for various tank sizes. Rainfall data is based on 10 years of continuous recordings from the Adelaide Airport weather station (1987 -1996). Typical house water consumption rates have been adopted from *WSUD: Basic Procedures for "source control" of stormwater, A hand book for Australian Practice 2005. (University of South Australia)*.

The criterion for tank sizing is proposed and is presented in Table 4 as well as the results of the simulations.

Table 4: Proposed minimum rainwater tank sizing for lot area

Maximum Allotment Area (m ²)		400	600	800
Minimum tank size (kL)		2	3	5
Simulation results (Annual Averages)	Demand Met by Mains Water (kL)	66	59	52
	Demand Met by Rain Water (kL)	53	60	67
	Number days full demand met by rain tank	139	164	188
	Reduction in Overflow to Street (measured as a Proportion of Runoff from Effective Roof Area) (%)	69	78	87
	Roof Runoff from connected roof Area (kL)	78	78	78
	Overflow to Street (kL)	25	18	11
	Demand Met by RAINWATER as Proportion of Required Annual Demand for Specified Use (%)	45	51	56

The results highlight that there is a significant amount of roof runoff water held within the tank that is available for all in-house and outdoor uses. Reductions and savings in potable water use can be achieved by implementing rainwater tanks.

Aquifer storage and Recovery (ASR)

A previous investigation (Australian Groundwater technologies (AGT), 2005) for a development area west of Main North Road (West of Para Fault line) revealed that the geology of that site was suitable for an ASR scheme. The study however also suggested that an ASR scheme east of Main North Road (East of Para Fault line) may not be considered feasible. This site lies to the east of the fault line and therefore further investigations would be required to ascertain whether ASR is suitable. Advice from AGT revealed that the geology of the site may be highly variable and further investigations would be necessary.

At this stage ASR is not given further consideration within the confines of the development. However, alternatives to establish an ASR scheme downstream of the site on the Gawler plains will be explored in collaboration with the Gawler Council. Opportunities to inject and extract / reuse water can provide a means by which infrastructure associated with ASR is consolidated at the one locality west of Main North Road. This study has not explored this option but highlights that this option will need to be considered if ASR is pursued for the final scheme.

Subject to more vigorous assessment, the wetlands basins may be able to accommodate additional storage from which water may be drawn for reuse applications such as irrigating local reserves. The development could potentially harvest an annual average volume in the range of 100 to 300 ML.



5. SUMMARY OF PROPOSED STORMWATER MANAGEMENT MEASURES

The strategy uses stormwater BMPs for the management of quantity, quality and reuse. This has been based on a desktop review of the site and includes preliminary modelling to assess the size and performance of the various measures in meeting the performance objectives outlined in section 2.

The proposed management measures for each sub area are presented in Appendix A and summarised in Table 5.

Table 5: *Stormwater management summary*

Sub-Area Reference Number	Treatment Measures	Sub-Area Detention storage requirement (ML)	Comments
1	<ul style="list-style-type: none"> Wetland 	9	Wetland to treat and detain stormwater and release flows at a controlled rate
2	<ul style="list-style-type: none"> Linear Wetlands and Detention storages Watercourse restoration and revegetation Wet detention ponds in series located within valleys / major flow paths 	55	Linear wetland system along watercourse also incorporating detention storage. Detention ponds required in series through valley lines to control outflows and provide source control.
3	<ul style="list-style-type: none"> Wet detention ponds in series Watercourse restoration and revegetation 	4.2	Wet detention ponds to treat and detain stormwater and release flows at a controlled rate. Revegetate watercourse and provide erosion control measures.
4	<ul style="list-style-type: none"> Wet detention ponds in series Watercourse restoration and revegetation 	2.4	Wet detention ponds to treat and detain stormwater and release flows at a controlled rate. Revegetate watercourse and provide erosion control measures.
5	<ul style="list-style-type: none"> Bioretention swales with linear spreader 	(6.5)	Bioretention swale sited along a level contour to treat and detain the 3 month ARI flow and release at a controlled rate. Detention is not achievable due to physical constraints.
6	<ul style="list-style-type: none"> 2 x Wetlands Watercourse restoration and revegetation 	18.7	Wetland to treat and detain stormwater and release flows at a controlled rate. Revegetate watercourse and provide erosion control measures.
7	<ul style="list-style-type: none"> Wetlands Watercourse restoration and revegetation 	11.9	Wetland to treat and detain stormwater and release flows at a controlled rate. Revegetate watercourse and provide erosion control measures.
8	<ul style="list-style-type: none"> 2 x Wetland 	5.7	Wetlands to treat and detain stormwater and release flows at a controlled rate, transfer overflows to wetland in area 7.

(6.5) denotes that detention basin cannot be located within sub area due to physical constraints.



6. SUMMARY

This study develops the stormwater management strategy for a parcel of land located to the east of the Gawler Township which could accommodate up to approximately 4500 homes. The strategy adopts stormwater best management practices to manage the quantity, quality and reuse applications based on an urban development scenario.

This report applies the multi-objective approach to stormwater management and adopts key policy criteria to minimise its environmental impact. The policies are based on best management practices for urban stormwater management. The stormwater management strategy considers the characteristics, constraints and opportunities within the site as much as possible. The strategy includes:

- Several constructed wetland systems comprising flood detention storages to treat and manage quality and quantity of stormwater
- Rehabilitated watercourses to improve ecology, biodiversity and provide opportunities for passive recreation
- Wet detention ponds to manage quality and quantity of stormwater with major flow paths
- Revegetated major flow paths to create urban linkages for flora and fauna, convey stormwater in a sustainable manner, integrate stormwater and landscape, improve amenity, and improve water quality
- Rainwater tank harvesting for individual allotments to reduce potable water demand and stormwater runoff from minor rainfall events (3 month to 1 year events)
- Bioretention swales to treat the regular (3 month ARI) stormwater flows.
- Gross pollutant traps and trash racks
- The preservation of existing watercourse and other drainage corridors

The development could potentially generate an annual average volume in the range of 100 to 300 ML for reuse applications. Reductions in potable water supply for toilet and laundry uses of approximately 50% could be achieved by adopting larger rainwater tank requirements for individual allotments,

The stormwater management strategy is attached to this report in Appendix A. It highlights the stormwater management measures that collectively form the strategy. These are based on conceptual design and will require further analysis in order to provide detail that is sufficient for costing.

