URBAN LAND DEVELOPMENT AUTHORITY

PROPOSED RESIDENTIAL DEVELOPMENT
BELYANDO ESTATE – PHASE 1
MORANBAH

PRELIMINARY STORMWATER QUALITY MANAGEMENT PLAN

Report No: IRC001/R02
REV: A
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UDP Consulting Engineers

Dalgety Place
84 Denham Street
Townsville Qld 4810

PO Box 1110
Townsville Qld 4810

Ph: 07 4772 0666
Fax: 07 4772 0566
Email: main@udpconsulting.com.au
Web: www.udpconsulting.com.au

Urban Development
Design Infrastructure
Project Management

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REPORT AUTHORISATION					
Revision		**Rev. Date**		**Report Details**	
A		7 November 2012		For Approval	
Prepared By		**Reviewed By**		**Authorised By**	
Malcolm Briody		Shane Martin		Patrick Brady	

1 INTRODUCTION

1.1 Background

This report assesses the impacts on the stormwater quality for the proposed first 193 lots (Phase 1) forming the Belyando Estate, a new residential development located just south of Moranbah. The proposed development is approximately 23 Ha in area and is located on an existing parcel of land described as Lot 29 on SP218555 and is generally bound by Grosvenor Creek to the northeast, a 3500 man mining camp (the MAC camp) to the southeast and future residential development to the west.

Further development to the south and southwest of the site is constrained by a Dust Exclusion Area.

The subject land is situated adjacent to the Grosvenor Creek flood plain and consists of relatively flat terrain sloping gently towards Grosvenor Creek.

The proposed layout plan for Phase 1 of the Belyando Estate is included in Appendix A.

1.2 Study Objectives

The objectives of this study were to:

- Prepare an SQMP incorporating principles of Water Sensitive Urban Design (WSUD) applicable for the catchment / climate;
- Develop water quality models to assess the performance of the proposed stormwater controls and quantify the water quality benefits.

1.3 Scope of Works

The scope of works for this study included:

- Review of surface water, engineering and meteorological reports and data for the area;
- Site assessment and available literature to establish the key hydrological and environmental aspects of the site;
- Establishment of appropriate water quality objectives (WQOs) for the receiving waters (Grosvenor Creek);
- Development of a MUSIC water quality model to quantify long term baseline and future pollutant loads discharged from the local catchment; and
- Assessment of the proposed stormwater controls in terms of reducing the long-term pollutant loads discharged to the receiving waters and achieving the policy outcomes prescribed in SPP 4/10 Healthy Waters.

1.4 Available Data

1.4.1 Topographical Data

Design contours for the subject site were obtained from a detailed survey established over the site by Landmark Consulting, Consulting Surveyors. These contours were used to define sub-catchments within the site. A preliminary catchment plan is shown in Appendix A.

1.4.2 Proposed Land Use Data

Land use data was obtained from aerial photography and cadastral information in order to establish land uses for the baseline water quality modelling.

1.4.3 Historical Rainfall Data

Long-term rainfall data was obtained from the Moranbah Waste Treatment Plant pluviometer (station 034038) at a six (6) minute data interval for the years 1996 – 2006 in order to establish a representative ten (10) year period of rainfall data for use in the MUSIC water quality model. This data range was selected as it was the most complete data set available for the region.

Monthly Areal Potential Evapotranspiration (PET) data was estimated based on the PET maps obtained from the Bureau of Meteorology website (sourced from Climate Atlas of Australia) and is shown in the table below:

Table 1: Moranbah Monthly Areal Potential Evapotranspiration

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Mean PET (mm)	174	158	169	126	84	75	76	102	128	174	185	191

1.4.4 Relevant Planning Controls

The *Environmental Protection (Water) Policy 2009* (EPP Water) seeks to protect and/or enhance the suitability of Queensland's waters for various environmental values. This policy guides the selection of indicators that will protect the environmental values of any water resource.

The State Planning Policy 4/10 Healthy Waters (December 2010) is intended to ensure that development is planned, designed, constructed and operated to manage stormwater in ways that help protect the water environmental values specified in the EP Water Policy.

Indicators for environmental values are the properties of the water that can be measured. The *Australian Water Quality Guidelines* (ANZECC 2000) and *Queensland Water Quality Guidelines* (QWQG, EPA 2006) prescribe properties that protect specific environmental values.

2 SITE ASSESSMENT

2.1 Catchment Description

The catchment for Phase 1 of the Belyando Estate Residential Development is essentially the stage boundaries of the development site. The topography of the existing catchment allows for any clean runoff entering the development site to be temporarily diverted prior to future development.

2.2 Water Quality Objectives

To establish Water Quality Objectives (WQOs), guideline values have historically been taken from either the *Australian Water Quality Guidelines* (ANZECC 2000) or the *Queensland Water Quality Guidelines* (QWQG – EPA, 2006) based upon the environmental values identified for a particular site. These guideline values are typically intended as long-term background concentrations for the sensitive receiving waters downstream of a site.

However with the implementation of the State Planning Policy 4/10 Healthy Waters, it is now recognised that achieving long term pollutant load reduction targets incorporating 'best practice management' is an acceptable and appropriate means of managing urban stormwater quality.

As such, it is proposed to evaluate the impact of the proposed development in terms of long-term average annual pollutant loadings for a traditional residential site. This will be accomplished by:

- Establishing long-term baseline pollutant loads from a MUSIC model of the current land uses in the catchment;
- Modifying the baseline MUSIC model to incorporate the effects of the development due to changes in land use for the proposed development; and
- Examining the relative increase / decrease in long-term pollutant loads to the sensitive receiving waters.

The major pollutants associated with the proposed development are total suspended solids (TSS), total nitrogen (TN), total phosphorus (TP) and gross pollutants (GP).

Isaac Regional Council (in accordance with the *Urban Stormwater Quality Planning Guidelines*, 2010) requires the following reductions in long-term pollutant loadings being generated from the developed site:

- Total Suspended Solids: 75%;
- Total Phosphorus: 60%;
- Total Nitrogen: 35%; and
- Gross Pollutants: 90%.

3 STORMWATER MANAGEMENT PLAN

3.1 Proposed Concept

A conceptual layout plan of the proposed stormwater treatment train is shown in Appendix B.

The proposed concept has the following general features:

- Vegetated buffer located behind the kerb within the road reserve;
- Vegetated drainage swales; and
- A bio-retention system.

The individual elements listed above are discussed in detail in the following.

3.2 Vegetated Buffers

As the development urbanises, the road footpaths will form a vegetated buffer for runoff from the allotments prior to entry into the stormwater drainage system. It is noted that effects of the buffer strip on pollutant loadings has been incorporated into the pollutant parameters for the road reserve source node.

3.3 Vegetated Swale

A Vegetated drainage swale that runs along the north-western boundary of the site will be utilised to convey runoff being discharged from the site to the proposed end-of-line bio-retention system. The swale has been assumed to be a regular trapezoidal grassed open drain with a base gradient of 0.5%, a base width of to 2m, maximum flow depth of 0.5m and a maximum flow width of 8m. The actual characteristics of the swale drain will be confirmed as part of the detailed design stage of the development.

The flat gradient of the drain will allow for significant removal of sediments by filtration through the vegetated surface for all storm flow events.

3.4 Bio-retention basin

A bio-retention basin is considered necessary at the downstream end of the stormwater drainage system to treat the stormwater runoff to the minimum level required prior to being discharged to the receiving waters. The actual area and location of the bio-retention basin will be confirmed as part of the detailed design stage of the development. Table 1 shows the initial sizing of the bio-retention system as modelled in MUSIC.

Table 1: Proposed Bio-retention System Details

Contributing Catchment	Catchment Area	Filter area (m^2)	Extended Detention Depth (m)	Filter Depth (m)	Transitional layer (m)	Drainage layer (m)
A, B	23.1 Ha	1,000	0.3	0.8	0.1	0.3

4 WATER QUALITY MODELLING

4.1 MUSIC Modelling

MUSIC is a water quality modelling system developed by the Cooperative Research Centre for Catchment Hydrology (CRCCH). MUSIC can simulate runoff quantity and quality, for catchments ranging in scale from a single residential lot to several square kilometres. MUSIC is widely used to quantify water quality impacts of proposed developments on receiving waters, and is well suited to assessing the effectiveness of the proposed stormwater controls for the proposed development.

The latest version of MUSIC (v5.1.16) was used to analyse the proposed developments stormwater controls.

4.2 Input Data

The following data was used as input for the MUSIC models:

- Long-term rainfall data was obtained for the the Moranbah Waste Treatment Plant pluviometer (station 034038) at a six (6) minute data interval for the years 1996 – 2006; and
- Monthly aerial potential evapotranspiration data for the Moranbah region based on the Mean PET maps obtained from the BOM website (sourced form Climate Atlas of Australia).

4.2.1 Land Uses

For the purposes of MUSIC modelling, areas within the proposed development were divided into the following land uses:

- Urban Residential:
  - Roof (100% Impervious);
  - Road Reserve (50% Impervious); and
  - Remainder (ground, 5% Impervious).

The following table shows the proposed development sites' catchment characteristics based on the above land uses.

Table 2: Catchment Characteristics

Land Use	Catchment Area (ha)		Total Catchment Area (ha)	Impervious Area (ha)		Total Impervious Area (ha)	% Impervious
	A	B		A	B		
Roof to System	2.83	2.09	4.92	2.83	2.09	4.92	100
Road Reserve	5.2	3.83	9.03	2.60	1.92	4.52	50
Remainder	5.27	3.88	9.15	0.26	0.19	0.46	5
Total	**13.3**	**9.8**	**23.1**	**5.69**	**4.20**	**9.89**	**43**

As there are no locally established pollutant export parameters, generic pollutant export parameters for the identified land uses have been adopted from the Music Modelling Guidelines (Water by Design, Version 1, 2010).

The adopted pollutant export parameters shown in the table below allow for the relative change in pollutant loadings due to urban development to be evaluated and the impacts of the proposed stormwater treatment measures to be assessed.

Table 3: Adopted Pollutant Export Parameters

Land Use	Flow type	Total Suspended Solids (Lot_{10}mg/L)		Total Phosphorus (Lot_{10}mg/L)		Total Nitrogen (Lot_{10}mg/L)	
		Mean	Std. dev	Mean	Std. dev	Mean	Std. dev
Urban Roof	Base flow	N/A	N/A	N/A	N/A	N/A	N/A
	Storm flow	1.30	0.39	-0.89	0.31	0.26	0.23
Urban Road	Base flow	1.00	0.34	-0.97	0.31	0.20	0.20
	Storm flow	2.43	0.39	-0.30	0.31	0.26	0.23
Urban Ground	Base flow	1.00	0.34	-0.97	0.31	0.20	0.20
	Storm flow	2.18	0.39	-0.47	0.31	0.26	0.23

4.3 Modelling Methodology

Two scenarios were examined using MUSIC:

- A developed case scenario, representing the proposed Phase 1 of the Belyando Estate development; and
- A developed case scenario, representing the proposed Phase 1 of the Belyando Estate development with the proposed stormwater treatment controls.

4.4 Model Setup

4.4.1 Developed Case – no treatment

The MUSIC model was set up as follows:

- The sub-catchments were split into seperate source nodes based on the land uses;
- Appropriate pollutant generation rates were assigned to each land use; and
- Each source node was connected via a drainage link with appropriate hydrologic routing times.

4.4.2 Developed Case – with treatment

The MUSIC model was amended to include the proposed stormwater treatment measures.

The modifications to the model included:

- Inclusion of swale nodes to selected catchments; and
- Addition of a bio-retention node for all relevant catchments.

4.5 Pollutant Load Assessment

Comparisons of the mean pollutant loads for the modelled scenarios are shown in the below table. Overall pollutant loads have been reported at the downstream extent of the model.

Table 4: Summary of MUSIC Model Pollutant Loads

Pollutant	Developed Case	Developed Case with Treatment		Isaac Regional Council Pollutant Reduction Targets
	Annual Load	Annual Load and Percentage Reduction		
Total Suspended Solids (kg/yr)	10,200	1,170	88.6%	**89%**
Total Phosphorus (kg/yr)	17.8	6.23	65.0%	**65%**
Total Nitrogen (kg/yr)	93	53.2	42.8%	**43%**
Gross Pollutants (kg/yr)	1,300	0	100%	**90%**

The model results indicate that for the developed case with stormwater controls:

- Overall Total Suspended Solids loads are decreased by approximately 89%;
- Total Phosphorus loads are decreased by approximately 65%;
- Total Nitrogen loads are decreased by approximately 43%; and
- All Gross Pollutant loads are removed (a decrease of 100%).

This indicates the proposed stormwater controls can significantly reduce total pollutant loads discharged to the receiving waters, and will satisfy the minimum pollutant reduction targets required by Isaac Regional Council.

5 SUMMARY AND CONCLUSIONS

This study has assessed the impact on water quality being from the proposed development site known as Phase 1 of Belyando Estate located to the south of Moranbah. A preliminary SQMP has been prepared to support a development application.

A conceptual layout of a stormwater treatment train incorporating the principles of WSUD was prepared. The main features of the layout were:

- Vegetated buffer located behind the kerbs within the road reserves;
- Vegetated drainage swales; and
- A bio-retention system.

These measures have been designed to integrate into the existing drainage of the site, and will offer increased visual amenity, as well as minimal maintenance requirements.

MUSIC water quality modelling was undertaken to establish developed case pollutant loads, and to evaluate the performance of the proposed treatment train. The proposed treatment measures will reduce pollutant loads, in accordance with Isaac Regional Council requirements, to an ecologically sensitive level that will ensure that the proposed development will protect and sustain the downstream values of the receiving waters.

6 REFERENCES

ANZECC (2000), *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*;

Brisbane City Council (2000), *Guideline on Identifying and Applying Water Quality Guidelines in Brisbane City, Version 1;*

Mackay Regional Council (September 2008), *MUSIC Guidelines Version 1.1;*

Water by Design (2010), *MUSIC Modelling Guidelines Version 1;*

Cooperative Research Centre for Catchment Hydrology (1997), *Urban Stormwater Pollution: Industry Report*;

Cooperative Research Centre for Catchment Hydrology (2005), *MUSIC User Guide;*

The State of Queensland, Department of Environment and Resource Management (2010),*Urban Stormwater Quality Planning Guidelines;*

The State of Queensland, Environmental Protection Agency (2006), *Queensland Water Quality Guidelines*;

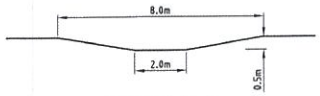
Thuringowa City Council (2005), *City of Thuringowa Planning Scheme*;

Walker, T.A., Cooperative Research Centre for Catchment Hydrology (1999), Removal of suspended solids and associated pollutants by a CDS gross pollutant trap.

APPENDIX A
PROJECT DRAWINGS

LEGEND

- BIO-RETENTION BASIN
- DENOTES CATCHMENT NAME
- (A) CATCHMENT BOUNDARY
- PROPOSED OVERLAND FLOW PATH
- PROPOSED DRAINAGE SWALE
- 227.0 EXISTING CONTOUR
- PRELIMINARY STORMWATER DRAINAGE LAYOUT



SECTION A-A
NTS

STORMWATER QUALITY CATCHMENT PLAN
SCALE 1:1500

0 30.0 60.0 90.0m
SCALE 1:1500

PRELIMINARY ISSUE NOT FOR CONSTRUCTION

REV.	DATE	REVISIONS
1		PRELIMINARY ISSUE

JAS-ANZ ISO 9001

REAL PROPERTY DESCRIPTION:

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DESIGNED:	
CHECKED:	
PROJECT MANAGER: S.MARTIN	PROJECT DIRECTOR: P.BRADY RPEQ 7112

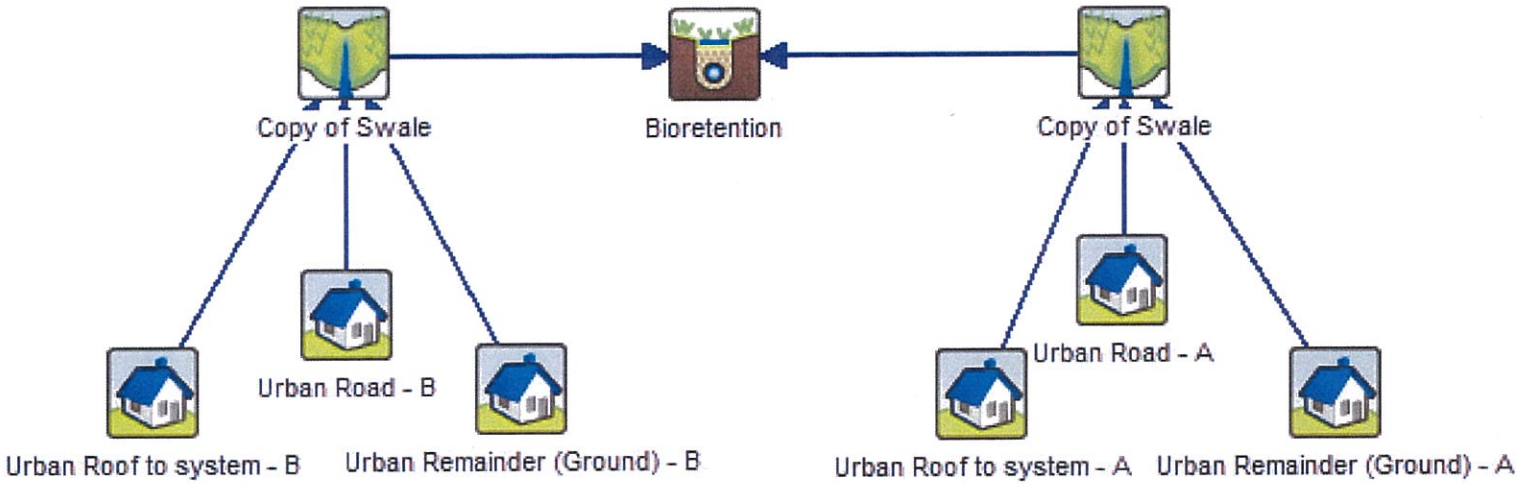
UDP Consulting Engineers
Urban Development Design Infrastructure Project Management
Level 1, 62 Walker Street
TOWNSVILLE QLD 4810
PO BOX 1110
TOWNSVILLE QLD 4810
Phone: (07) 4772 0666
Fax: (07) 4772 0566
Email: main@udpconsulting.com.au
Web: www.udpconsulting.com.au

URBAN LAND DEVELOPMENT AUTHORITY

BELYANDO ESTATE, MORANBAH
MASTERPLANNING - STAGES 1-4
PRELIMINARY STORMWATER QUALITY MANAGEMENT PLAN

DRAWING SIZE	SCALE	DRAWING No.	REV
A1	AS SHOWN	IRC001/SK11	1
	XREF: IRC001-XR-SK		

APPENDIX B
CONCEPTUAL TREATMENT TRAIN AND WATER QUALITY MODELLING RESULTS


Copy of Swale
Bioretention
Copy of Swale
Urban Road - B
Urban Road - A
Urban Roof to system - B
Urban Remainder (Ground) - B
Urban Roof to system - A
Urban Remainder (Ground) - A

Bioretention

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Treatment Train Effectiveness

	Flow (ML/yr)	Peak Flow (m3/yr)	TSS (kg/yr)	TP (kg/yr)	TN (kg/yr)	Gross Pollutants (kg/yr)
Sources	44.1	1.30	10.2E3	17.8	93.0	1.30E3
Residual Load	42.4	4.16	1.17E3	6.23	53.2	0.00
% Reduction	4.0	-221.1	88.6	65.0	42.8	100.0