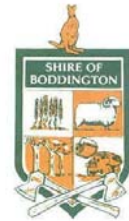


Shire of Boddington Floodplain Management Study



FLOODPLAIN MANAGEMENT STRATEGY

The Boddington Shire Council endorsed the *Shire of Boddington Floodplain Management Study* at its meeting on 11 August 2009



Shire of Boddington Floodplain Management Study

FLOODPLAIN MANAGEMENT STRATEGY

The Boddington Shire Council endorsed the *Shire of Boddington Floodplain Management Study* at its meeting on 11 August 2009

Sinclair Knight Merz
ABN 37 001 024 095
32 Cordelia Street
South Brisbane QLD 4101 Australia
PO Box 3848
South Brisbane QLD 4101 Australia
Tel: +61 7 3026 7100
Fax: +61 7 3026 7306
Web: www.skmconsulting.com

COPYRIGHT: The concepts and information contained in this document are the property of Sinclair Knight Merz Pty Ltd. Use or copying of this document in whole or in part without the written permission of Sinclair Knight Merz constitutes an infringement of copyright.



Executive Summary

Sinclair Knight Merz (SKM) was commissioned by the Shire of Boddington to develop a Floodplain Management Strategy (FMS) for an area of the Shire of Boddington, including the Hotham, Bannister and Crossman Rivers. The Boddington Shire Council endorsed the Shire of Boddington Floodplain Management Study at its meeting on 11 August 2009.

The FMS was based on detailed hydrologic and hydraulic modelling of the study area. The rivers in the study area have well defined channels and a large proportion of the flow remains in the river channel in significant flows. However, there are a number of breakouts on to the floodplain which were activated in a 100 year average recurrence interval (ARI) flood event. Widespread flooding was predicted at the confluences of the rivers and at the sharp bends in the Hotham River at the downstream end of the study area.

The FMS was derived using risk based floodplain management principles as set out in documents such as *Floodplain Management in Australia – Best Practice Principles and Guidelines* (SCARM73, CSIRO, 2000). This included a flood hazard assessment. The existing flood hazard mapping was transposed onto the Shire of Boddington Local Planning Strategy and this highlights that provisions should be made in future Structure Planning for floodplain management. A floodplain development encroachment analysis was also undertaken to assess the impacts of possible filling of areas of the floodplain.

Utilising the results of the hydraulic modelling, options for minimising flood risk and mitigating impacts were discussed including; land use planning, development and building controls, flood warning and flood emergency response planning. The outcomes and recommendations include:

- 1) 100 year ARI floodplain mapping is used for land use planning and for proposed development and building controls;
- 2) the following floodplain development strategy is endorsed by Council:
 - proposed development (ie filling, building, etc) that is located within the flood fringe is considered acceptable with respect to major flooding. However, a minimum habitable floor level of 0.50 m above the adjacent 100 year ARI flood level is recommended to ensure adequate flood protection; and
 - proposed development (ie filling, building, etc) that is located within the floodway and is considered obstructive to major flows is not acceptable as it would increase flood levels upstream. No new buildings are acceptable in the floodway.
- 3) a suitable flood warning network is established with ongoing river flow monitoring to be continued;



- 4) flood emergency response planning is undertaken to provide an evacuation strategy for residents in the event of major river flooding; and
- 5) assessment of proposed development is undertaken on a regional scale rather than in an isolated approach



Glossary

Term	Definition
Average Recurrence Interval (ARI)	The average or expected value of the period between exceedance of a given rainfall intensity or peak discharge. ARI is another way of expressing the likelihood of occurrence of a flood event.
Catchment	The land area draining to a specific location.
Encroachment	Filling in an area of the floodplain affecting flooding.
Ephemeral	A waterway that does not continuously flow, ie, is dry at sometimes during the year.
Flood	The temporary inundation of land by water that has overtopped the natural or artificial banks of the watercourse.
Floodplain	Area of land adjacent to a creek, river, lake, dam or artificial channel which is subject to flooding.
Floodway	The area of the floodplain where significant flow or storage of water occurs during a flood event. Proposed development within a floodway that is considered obstructive to major flooding is not acceptable as it will increase flood levels upstream. No new buildings are acceptable within the floodway.
Flood Fringe	The area of the floodplain where proposed development is acceptable with regard to major flooding subject to certain building controls. Relevant approval is required.
Flood Hazard	Potential loss of life, injury or economic loss caused by flood events.
Freeboard	The height above a defined flood level, typically used to provide a factor of safety in the setting of floor levels.
Hydraulic	Term given to the study of water flow in waterways; in particular, the evaluation of flow parameters such as water level and velocity.



Term	Definition
Hydrology (hydrologic)	Term given to the study of the rainfall and runoff process; in particular, the evaluation of peak flows, flow volumes and the derivation of hydrographs for a range of floods.
Peak Discharge	The maximum flow rate during or following a rainfall event.



Contents

1.	Background	1
1.1	Study Objectives	1
1.2	Study Area	1
2.	Physical Setting	4
2.1	Waterway Description	5
2.1.1	Hotham River	5
2.1.2	Crossman River	6
2.1.3	Bannister River	7
2.2	Climate	7
3.	Flooding Characteristics	10
3.1	History of Flooding	10
3.2	History of Floodplain Development	15
3.3	Institutional Framework	15
3.4	Catchment Response to Rainfall	15
3.4.1	Hydraulic Model Calibration	16
3.4.2	Design Rainfall and Flow Estimation	16
3.4.3	Design Flood Inundation	16
4.	Flood Hazard Assessment and Floodplain Management Measures	18
4.1	Objectives for Floodplain Management	19
4.2	Development of Floodplain Management Options	19
4.3	Assessment of Existing Flood Hazard	21
4.4	Review of the Shire of Boddington Planning Scheme	22
4.5	Floodplain Development Encroachment Analysis	22
4.6	Community Consultation	24
5.	Proposed Floodplain Management Plan	25
5.1	Non-Structural Flood Mitigation Measures	25
5.1.1	Land Use Planning	25
5.1.2	Development and Building Controls	26
5.1.3	Flood Warning/Forecasting	26
5.1.4	Flood Emergency Response Planning	27
5.1.5	Floodplain Development Design and Review Process	27
6.	References	28
	Appendix A Existing Flood Hazard Mapping	29
	Appendix B Designated Floodway and Levels – 100 Year ARI Flood Mapping Series	32



Appendix C	Responses to Community Submissions	33
Appendix D	Flood Affected Areas Summary	34
Appendix E	DoW Recommendations	35



Figures

■	Figure 1-1	Locality Plan	2
■	Figure 1-2	Shire of Boddington Planning Scheme No. 2	3
■	Figure 2-1	Boddington Weir	4
■	Figure 2-2	Pool in Hotham River	5
■	Figure 2-3	Typical Vegetation of the Hotham River	6
■	Figure 2-4	Typical Vegetation of the Crossman River	7
■	Figure 2-5	Average Rainfall and Daily Evaporation by Month	8
■	Figure 2-6	Average Number of Rain Days by Month	8
■	Figure 2-7	Average Daytime Maximum Temperature by Month	9
■	Figure 3-1	Camballing Bridge 1939 Flood	10
■	Figure 3-2	Flooding in Boddington (Date Unknown)	11
■	Figure 3-3	Bannister-Marradong Road Bridge 1955 Flood	12
■	Figure 3-4	1955 Flood Mark	13
■	Figure 3-5	Anecdotal Flood Information	14
■	Figure 4-1	SCARM73 Flood Hazard Categories	20
■	Figure 4-2	Department of Water Recommended Floodplain Development Strategy	21
■	Figure 4-3	100 Year ARI Existing Conditions Hazard Mapping with Planning Scheme	23
■	Figure A-16	100 Year ARI Existing Conditions Hazard Mapping	30
■	Figure A-26	100 Year ARI Existing Conditions Hazard Mapping with Planning Scheme	31

Tables

■	Table 3-1	Summary of Design Flood Peak Discharges in the Study Area	16
■	Table 4-1	Summary of Available Floodplain Management Measures	18
■	Table 4-2	SCARM73 Hazard Category Descriptions and Appropriate Land Uses	20



Document history and status

Revision	Date issued	Reviewed by	Approved by	Date approved	Revision type
A	22/09/2008	A. Howard	A. Howard	18/09/2008	DRAFT – For Client Review
0	23/10/2008	A. Howard	A. Howard	23/10/2008	Final
1	27/04/2009	A. Howard	A. Howard	27/04/2009	Final
2	03/07/2009	A. Howard	A. Howard	03/07/2009	Final
Final Endorsed by Client	11/08/2009	A. Howard	A. Howard	11/08/2009	Final Endorsed by Client

Distribution of copies

Revision	Copy no	Quantity	Issued to
A		Electronic (.PDF)	Mary-ann Coppolina (DoW)
		Electronic (.PDF)	Steve Thompson (Shire of Boddington)
0		Electronic (.PDF)	Mary-ann Coppolina (DoW)
		Electronic (.PDF)	Steve Thompson (Shire of Boddington)
		5 Hard Copies	Steve Thompson (Shire of Boddington)
1		Electronic (.PDF)	Simon Rodgers (DoW)
		1 Hard Copy	Steve Thompson (Shire of Boddington)
Final Endorsed by Client		Electronic (.PDF)	Steve Thompson (Shire of Boddington)
		5 Hard Copies	Steve Thompson (Shire of Boddington)
		Electronic (.PDF)	Simon Rodgers (DoW)

Printed:	18 November 2009
Last saved:	18 November 2009 08:09 AM
File name:	I:\QENV\Projects\QE09456\Reports\FMS\Final\Final Endorsed by Client\091108_Boddington_FMS_Final.docx
Author:	Sarah Gosling
Project manager:	Sarah Gosling
Name of organisation:	Shire of Boddington
Name of project:	Boddington Floodplain Management Study
Name of document:	Floodplain Management Strategy
Document version:	Final – Final Endorsed by Client
Project number:	QE09456



1. Background

Sinclair Knight Merz (SKM) was commissioned by the Shire of Boddington to develop a Floodplain Management Strategy (FMS) for an area focussing on the town of Boddington and Ranford, including the Hotham, Bannister and Crossman Rivers. This strategy was based on detailed hydrologic and hydraulic modelling of the study area.

1.1 Study Objectives

The Standing Committee on Agriculture and Resource Management Report 73 (SCARM73), “Floodplain Management in Australia, Best Practice Principles and Guidelines” (CSIRO, 2000) set out the following principal objectives for floodplain management:

- 1) limit to acceptable levels the effect of flooding on the well-being, health and safety of flood-prone individuals and communities;
- 2) limit to acceptable levels the damage caused by flooding to private and public property;
- 3) ensure that the natural function of the floodplain, to convey and store floodwater during a flood, is preserved and where necessary enhanced, along with any flood-dependent ecosystems;
- 4) encourage the planning and use of floodplains as a valuable and sustainable resource capable of multiple, but compatible, land uses of benefit to the community.

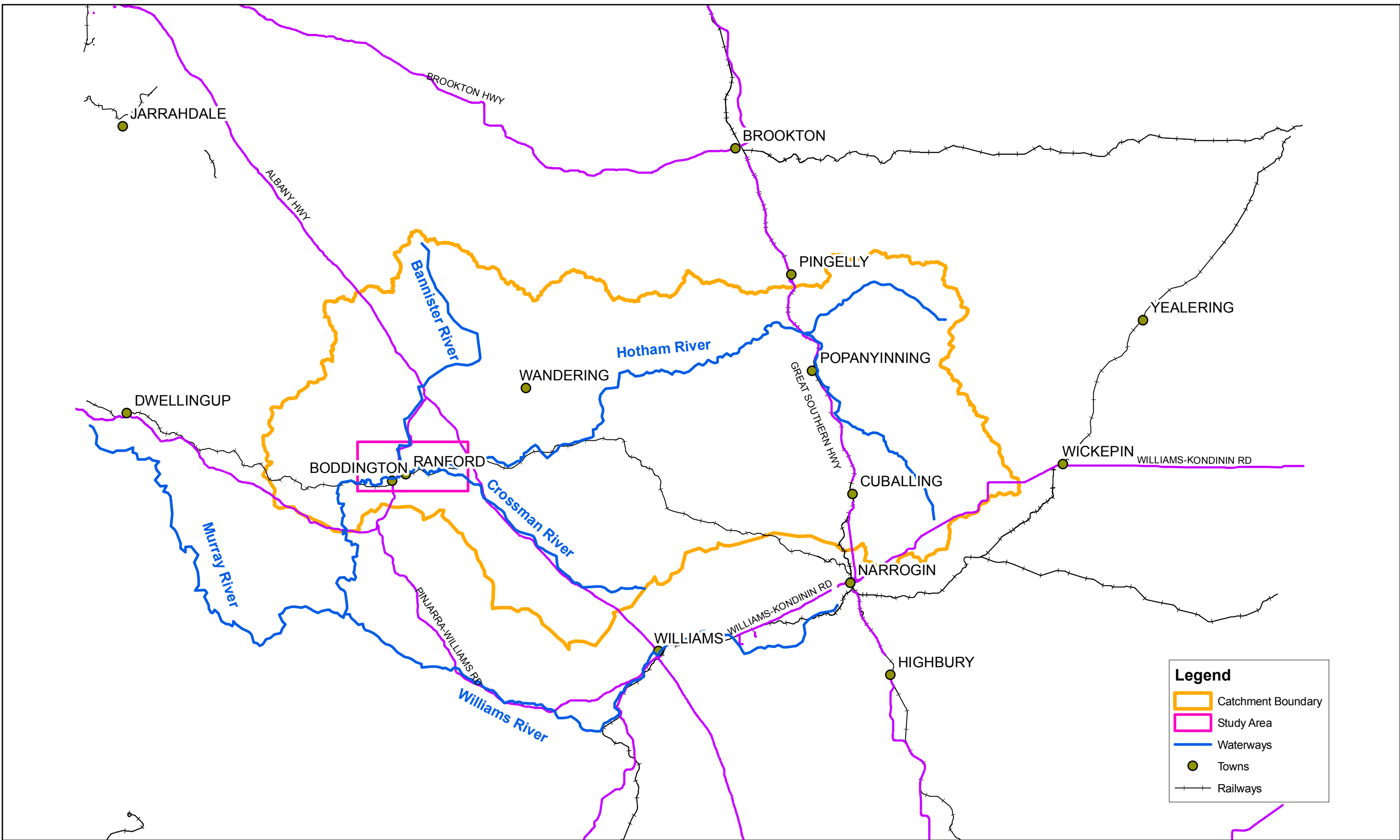
These objectives were adopted for this investigation.

1.2 Study Area

The study area is located approximately 120 km south east of Perth. The study area for the Project included the towns of Boddington and Ranford as well as the Hotham, Bannister and Crossman Rivers as shown in **Figure 1-1**.

The Shire of Boddington Local Planning Strategy, which was adopted by the Council in April 2007 and endorsed by the Western Australia Planning Commission in August 2007, provides the strategic land use planning framework for the municipality. The Shire of Boddington Town Planning Scheme No. 2 (Planning Scheme) provides the local statutory planning framework for the municipality and is presented in **Figure 1-2**. The Planning Scheme for the study area comprised primarily of rural, rural residential and rural small holding. There are also areas designated as residential in and around the existing town sites. The rivers have been designated as parks and recreation.

There is expected to be substantial growth in the Shire of Boddington due to the imminent opening of a gold mine at the time of the study.



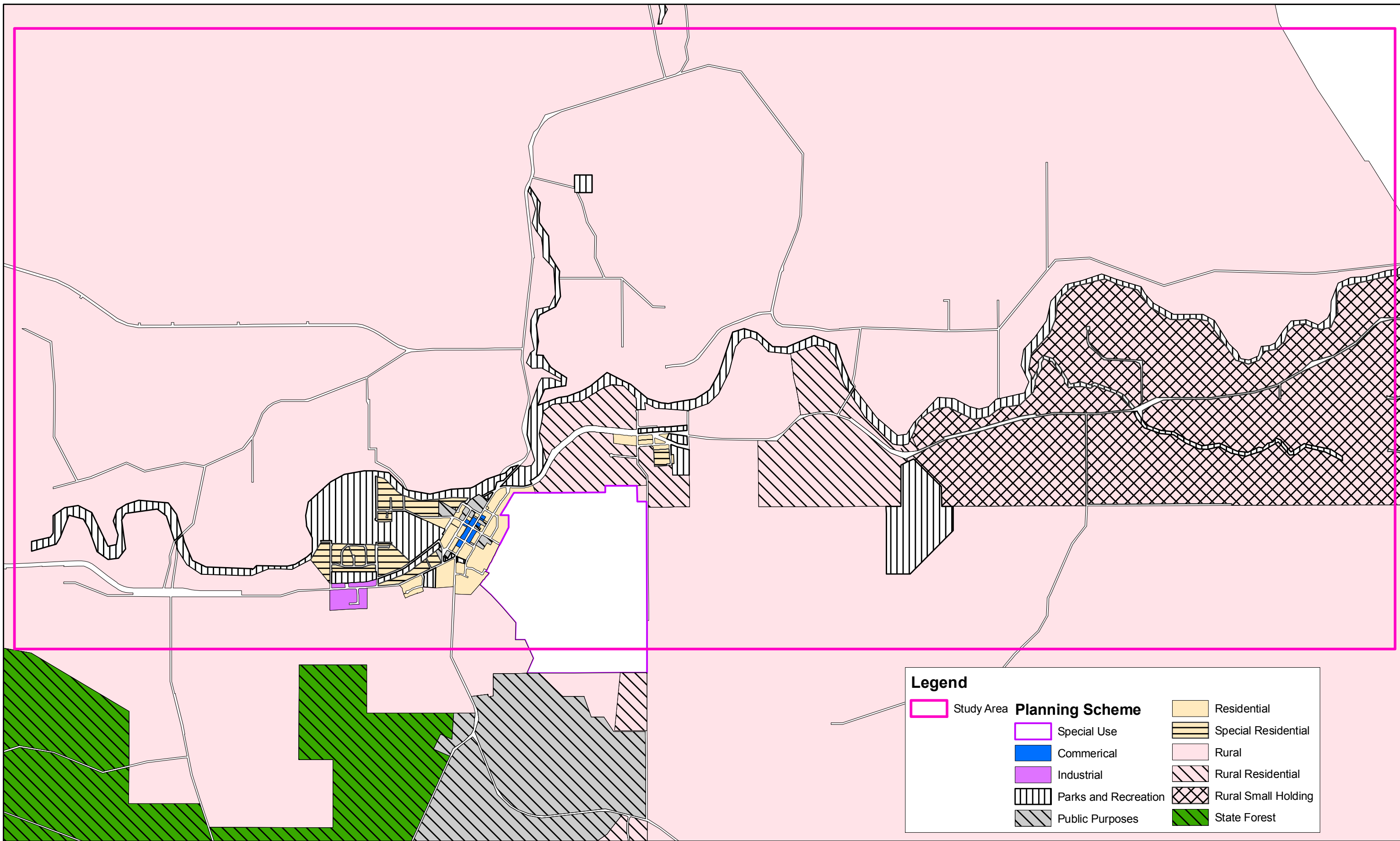
BODDINGTON FLOODPLAIN MANAGEMENT STUDY

Figure 1-1 Locality Plan



Author: Sarah Gosling
 Date: 03/07/09
 Job No: QE09456





Legend

Study Area	Planning Scheme	Residential
Special Use	Special Residential	Rural
Commercial	Rural Residential	Rural Small Holding
Industrial	Parks and Recreation	State Forest
Public Purposes		

BODDINGTON FLOODPLAIN MANAGEMENT STUDY

Figure 1-2 Shire of Boddington Planning Scheme No. 2



Author: Sarah Gosling
Date: 03/07/09
Job No: QE09456





2. Physical Setting

The study area is situated approximately 120 km south-east of Perth in the Shire of Boddington. The Shire of Boddington has a population of approximately 1,500. The primary industries in the area are farming (including cattle, sheep and cereal crops), plantations and mining (bauxite and gold). The Boddington area has farm stays and bed & breakfast accommodation for tourists to enjoy the area. The Lions Weir is located on the Hotham River in Boddington as shown in **Figure 2-1**. The weir was constructed in 1981 to provide amenity to the area, catering for fishing and water sports.



■ **Figure 2-1 Boddington Weir**

There are development pressures in the area with the construction of the Boddington Gold Mine by Newmont. The mine is due to commence production in 2009. The mine is predicted to have a peak operational workforce of 650 people. BHP Billiton is also extending its bauxite mining operations near Boddington as part of the Worsley Alumina expansion project.



2.1 Waterway Description

2.1.1 Hotham River

The Hotham River is a major river with headwaters to the west of Popanyinning and a catchment area of approximately 3,700 km² to the downstream extent of the study area. The Hotham River flows primarily in a westerly direction where it joins with the Crossman River. The Hotham River continues to flow west and then joins with the Bannister River and then continues west before flowing south to join with the Williams River. The river then becomes the Murray River.

The Hotham River is a meandering river with pools and medium to dense vegetation in the river channel and along the along its bank. The Hotham River is an ephemeral river with the majority of the larger flows occurring in the winter months. **Figure 2-2** illustrates a pool in the Hotham River as well as the vegetation on the banks of the river. **Figure 2-3** shows the dense vegetation typical the Hotham River channel.



■ **Figure 2-2 Pool in Hotham River**



■ **Figure 2-3 Typical Vegetation of the Hotham River**

2.1.2 Crossman River

The Crossman River has its headwaters north of Williams and then flows in a north-westerly direction to join with the Hotham River. The Crossman River catchment is a combination of forested and rural land uses. The Crossman River is ephemeral with the larger flows predominantly in winter. The Crossman River has medium to dense vegetation and some pools similar to the Hotham River (as shown in **Figure 2-4**).



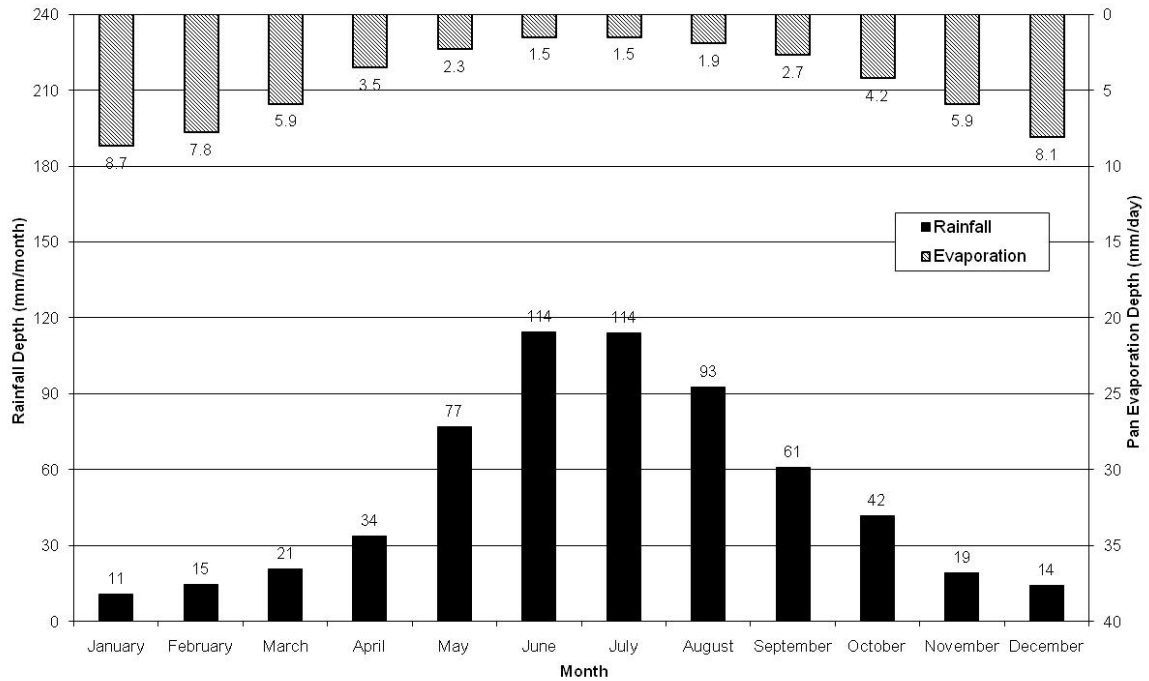
■ **Figure 2-4 Typical Vegetation of the Crossman River**

2.1.3 Bannister River

The Bannister River has its headwaters north-west of Wandering and then flows in a southerly direction to join with the Hotham River. The Bannister River catchment is a combination of forested and rural uses. The Bannister River is ephemeral with the larger flows predominantly in winter.

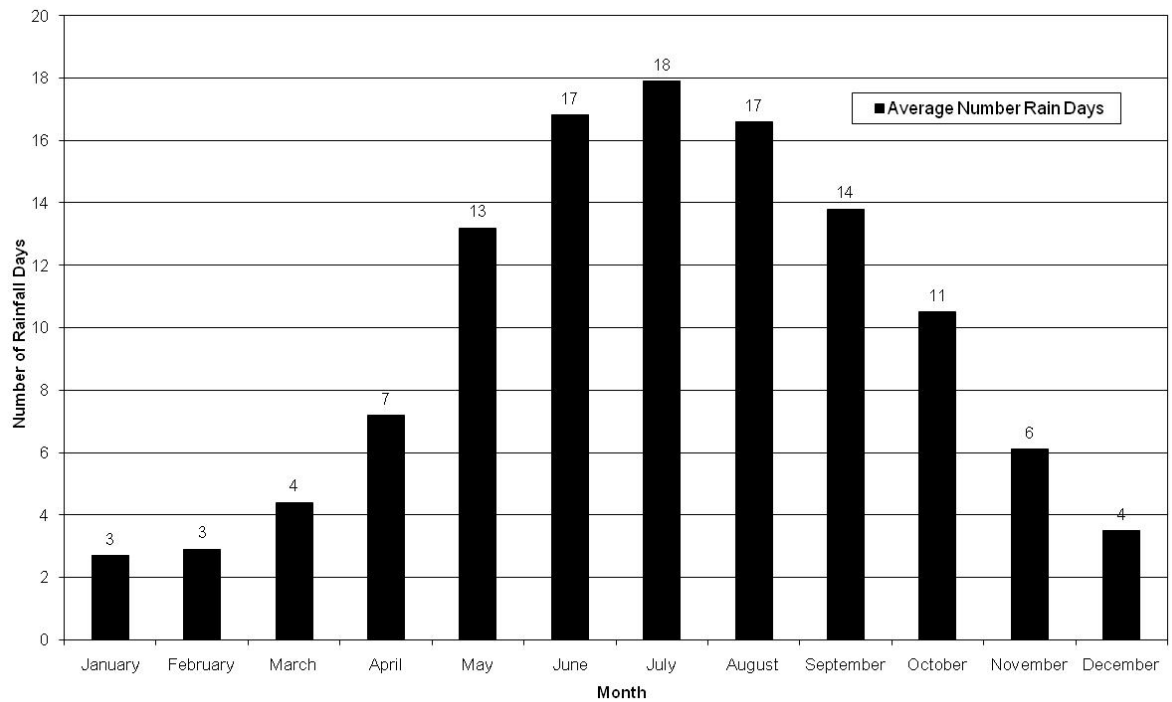
2.2 Climate

The study area climate is characterised by high rainfall in the winter months typically between May and September. This is illustrated in **Figure 2-5** which presents the average rainfall and evaporation by month. This is further demonstrated by **Figure 2-6**, which indicates that the average number of rain days is significantly greater in the winter months. On average there are 18 days of rain in July compared to 3 in February. **Figure 2-7** presents the average daytime maximum temperature for each month and illustrates the change of seasons. The rainfall in the winter months means the significant rainfall events and resultant flooding is most likely to occur in winter. However the historical records show there has been significant summer rainfall events likely caused by the remains of cyclonic activity.

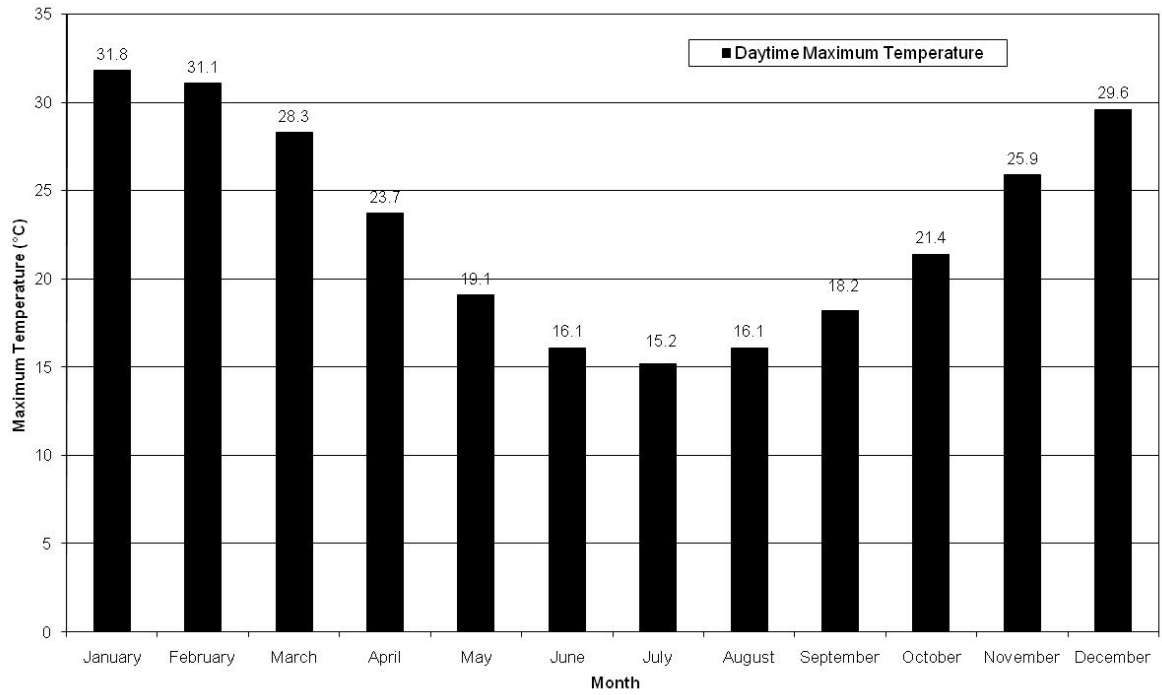


■ **Figure 2-5 Average Rainfall and Daily Evaporation by Month**

Source: Australian Bureau of Meteorology



■ **Figure 2-6 Average Number of Rain Days by Month**



■ **Figure 2-7 Average Daytime Maximum Temperature by Month**

The climate data presented in **Figure 2-5** to **Figure 2-7** was derived from the Bureau of Meteorology (BoM) rainfall and evaporation gauges 010648 and 010614 respectively.



3. Flooding Characteristics

This report covers the three main rivers of the study area, the Hotham River, Crossman River and Bannister River as shown in **Figure 1-1**. A number of smaller watercourses have been included in the study to ensure correct representation of flow in the main rivers which are the focus of the study.

3.1 History of Flooding

The Shire of Boddington is located on the confluence of three rivers, the major river being the Hotham River and two smaller rivers the Crossman and Bannister. Throughout the history of the Shire the rivers have been both a liability and an asset. The rivers have provided the area with the ability to develop farming in the area. The rivers have also claimed people lives in the area and have caused flood damage. The earliest record of a drowning was in 1878 and two young brothers drowned while playing in the river in 1956 (Ferrell, 1992).

There has also been a number of floods causing property damage and disruption to the Shire. Large floods occurred in 1872, 1939, 1945, 1955. Flooding has occurred in the past 50 years however it is not considered major flooding. Local residents have many memories of flooding and the impacts of flooding including isolation with roads being cut and property damage. **Figures 3-1 to 3-3** shows photographs of historic flooding. These photographs show the bridges being overwhelmed by floodwaters and homes being surrounded by floodwater.



Source (Ferrell, 1992)

- **Figure 3-1 Camballing Bridge 1939 Flood**



Source (Ferrell, 1992)

- **Figure 3-2 Flooding in Boddington (Date Unknown)**



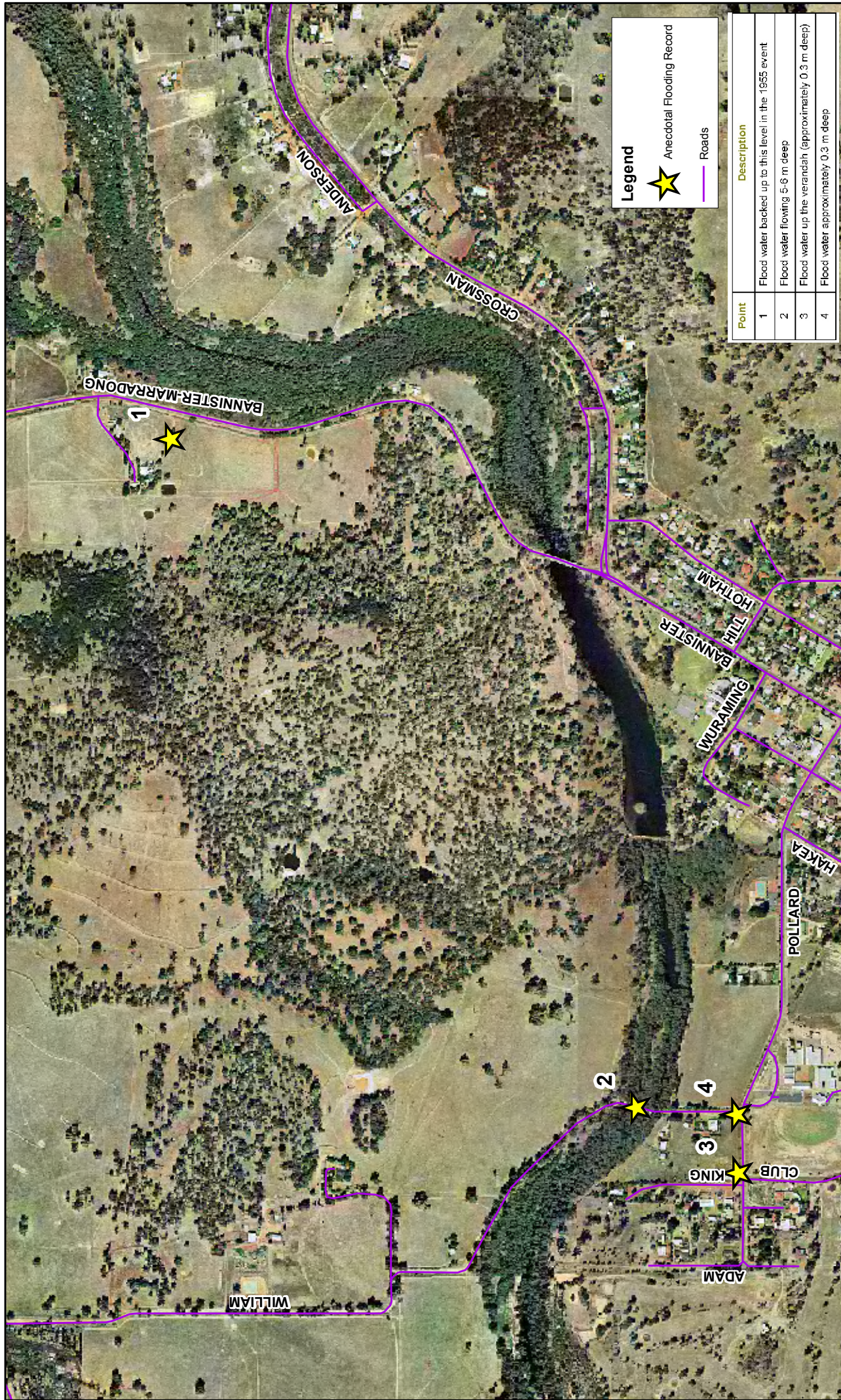
(Source: Charlie Firms)

■ **Figure 3-3 Bannister-Marradong Road Bridge 1955 Flood**

There were no historical surveyed flood levels recorded in the study area. However, there was anecdotal flooding information collected from a number of residents as part of the site visit. There were a number of points where residents remember flooding for the 1955 event including approximate level and inundation extent as shown in **Figure 3-4** and **Figure 3-5**.



■ Figure 3-4 1955 Flood Mark



Legend

- Anecdotal Flooding Record
- Roads

Point	Description
1	Flood water backed up to this level in the 1955 event
2	Flood water flowing 5-6 m deep
3	Flood water up the verandah (approximately 0.3 m deep)
4	Flood water approximately 0.3 m deep

BODDINGTON FLOODPLAIN MANAGEMENT STUDY

Figure 3-5 Anecdotal Flooding Information



Author: Sarah Gosling
 Date: 03/07/09
 Job No: QE09456



3.2 History of Floodplain Development

There has been limited development in the floodplain in the Shire of Boddington. Development of the Boddington and Ranford townships has occurred in areas where the Hotham River is well defined and has a limited floodplain.

3.3 Institutional Framework

The Department of Water (DoW) provides guidance on floodplain management in Western Australia and is the State's lead floodplain management institution. It is the Department's responsibility to "develop plans for and provide advice on flood management". These activities are advisory only as the Department is not a decision making authority.

The DoW assists Councils in the development of floodplain management strategies. DoW adopts risk based floodplain management principles as set out in documents such as *Floodplain Management in Australia – Best Practice Principles and Guidelines* (SCARM73, CSIRO, 2000).

3.4 Catchment Response to Rainfall

Flood modelling was undertaken to better understand the catchment response to rainfall. This was undertaken in two parts; by constructing a hydrologic model to estimate flow and then a hydraulic model to predict flow patterns and inundation. The development of the hydrologic and hydraulic models was presented in detail in a separate report *Boddington Floodplain Management Study – Flood Modelling Report* (SKM, 2009) and a summary is presented here.

There was a streamflow gauge at Marradong Road Bridge (614224) which had a period of record from 1966 to present. This gauge was located approximately 10 km downstream of the study area with a catchment area of approximately 4,000 km².

The response of the Hotham River catchment to rainfall is dependent on the frequency and intensity of the rainfall event along with the ground conditions at the time of rainfall. The majority of the rainfall in the area is received in the winter months when the ground is saturated and therefore the rate of rainfall exceeds the rate of infiltration and flooding occurs. There has been significant rainfall recorded which has fallen in the summer months. However, due to the limited amount of saturation at this time of year, the majority of the rainfall infiltrates into the soil. An example of this was the largest recorded flow at the Marradong Road Bridge gauge (614224) was 268 m³/s in June 1983; this was a result of 90 mm of rainfall across the catchment. In January 1982 there was a rainfall event of 150 mm of rainfall across the catchment and this produced a flow of 190 m³/s. The representation of catchment response to rainfall with season is important in the correct estimation of the design flood flows.

The rivers in the study area have well defined channels and the significant proportion of the 100 year ARI flow remains in the river channel. There are breakouts in a 100 year ARI flood event but the majority of the flow passes in the main waterway of the River. Widespread flooding was predicted



at the confluences of the rivers and at the sharp bends in the Hotham River at the downstream end of the study area.

Further details and mapping of the flooding behaviour is contained in **Section 3.4.3**. Full details on the hydrologic and hydraulic modelling are contained in the *Boddington Floodplain Management Study – Flood Modelling Report* (SKM, 2009).

3.4.1 Hydraulic Model Calibration

Calibration of the flood model was not possible as there were no recorded flood levels for the historic flood events. However, there was anecdotal evidence of inundation extents for a historical flood event. Hydraulic model results for the 100 year ARI flood event showed that the predicted inundation extent was similar to the inundation extent reported for the 1955 event.

3.4.2 Design Rainfall and Flow Estimation

Design rainfall estimates were developed as part of the flood modelling. Hydrologic model runs were conducted for 72, 48, 36, 24 and 18 hour storm durations for the 10, 25 and 100 year ARI events. The critical duration was determined to be the 24 and 36 hour events based on the hydrologic assessment. This was verified in the hydraulic modelling (refer to **Section 3.4.3**). **Table 3-1** shows how these rainfall depths translated to flow discharges. The results tabulated in **Table 3-1** give indicative peak flow at key locations.

■ Table 3-1 Summary of Design Flood Peak Discharges in the Study Area

Location	Peak Discharge (m ³ /s)		
	10 Year ARI	25 Year ARI	100 Year ARI
Hotham River (upstream extent study area)	235	313	466
Hotham River (downstream extent study area)	318	422	619
Hotham River – Marradong Rd Bridge Gauge	326	433	635
Crossman River (upstream extent study area)	64	87	126
Bannister River (upstream extent study area)	59	79	116

3.4.3 Design Flood Inundation

The design floods were modelled in a hydraulic model for the 72, 48, 36, 24 and 18 hour storm durations. Inundation extents and flow characteristics were developed for the 10, 25 and 100 year ARI flood events.

The hydraulic model was used to determine the critical duration storm for the study area. The critical storm duration was deemed to be the rainfall event that caused the deepest flooding depth. From this, the 24 and 36 hour storm event was found to be critical for the majority of the study area.



In the 100 year ARI flood modelling of the existing conditions, the rivers are generally contained in well defined channels. There are some breakouts in the 100 year ARI flood event and they occurred at the following locations:

- at the confluence of the Hotham and Crossman Rivers;
- at the confluence of the Hotham and Bannister Rivers; and
- at bends in the Hotham River near Castle Rock Road, Palmer Road, William Road and Anderson Road.



4. Flood Hazard Assessment and Floodplain Management Measures

Floodplain management measures can be broadly categorised into four categories as described in SCARM73 and summarised as **Table 4-1**.

■ **Table 4-1 Summary of Available Floodplain Management Measures**

Floodplain Management Measure	Description	Appropriate for
Land use planning	<p>This non-structural measure was accepted as being the most cost effective through controlling development on flood prone land. Aspects of this measure includes:</p> <ul style="list-style-type: none"> ■ Incorporate land use planning for floodplain management into statutory planning instruments; ■ Voluntary land acquisition in more hazardous flood areas 	<p>Planning for future development and fixing existing problem areas where voluntary acquisition can occur.</p>
Development and building controls	<p>This non-structural measure encourages planning construction methods that reduce the likelihood of permanent damage to properties. Measures include:</p> <ul style="list-style-type: none"> ■ Appropriate siting and setting of minimum habitable for levels for dwellings and planning for road corridors to support evacuation and flood mitigation; ■ Encourage construction methods appropriate to flood prone lands; and ■ Consider the introduction and certification of flood proofing of individual dwellings 	<p>Planning for future development and fixing existing flooding problems if dwellings can be flood proofed after initial construction.</p>
Structural measures	<p>Structural measures need to be developed with consideration that, unless designed for the PMF, they may eventually be overwhelmed. When this occurs, they may exacerbate flooding problems rather than alleviate them.</p> <p>Structural measures need continuous maintenance and upkeep and, therefore, must be accepted as an asset by the Council and managed as such.</p> <p>Such measures include:</p> <ul style="list-style-type: none"> ■ Levees; ■ Detention basins; and ■ Diversion channels 	<p>Planning for future development and fixing existing flooding problems.</p>
Flood emergency response plans	<p>Flood emergency response plans accept that there is a residual flood risk and plans for appropriate response and recovery. This measure requires the development of a flood emergency response plan complimentary to this floodplain management plan and with consideration of flood events up to the PMF.</p>	<p>Planning for existing and future development.</p>



This section outlines the objectives of the floodplain management plan and the methodology used to develop possible floodplain management measures. It discusses the existing flood hazard and the relative effectiveness of the mitigation flood measures that have been considered.

4.1 Objectives for Floodplain Management

SCARM73 sets out the following principal objectives of floodplain management:

- 1) limit to acceptable levels the effect of flooding on the well-being, health and safety of flood-prone individuals and communities;
- 2) limit to acceptable levels the damage caused by flooding to private and public property;
- 3) ensure that the natural function of the floodplain, to convey and store floodwater during a flood, is preserved and where necessary enhanced, along with any flood-dependent ecosystems;
- 4) encourage the planning and use of floodplains as a valuable and sustainable resource capable of multiple, but compatible, land uses of benefit to the community.

These objectives were adopted for this investigation.

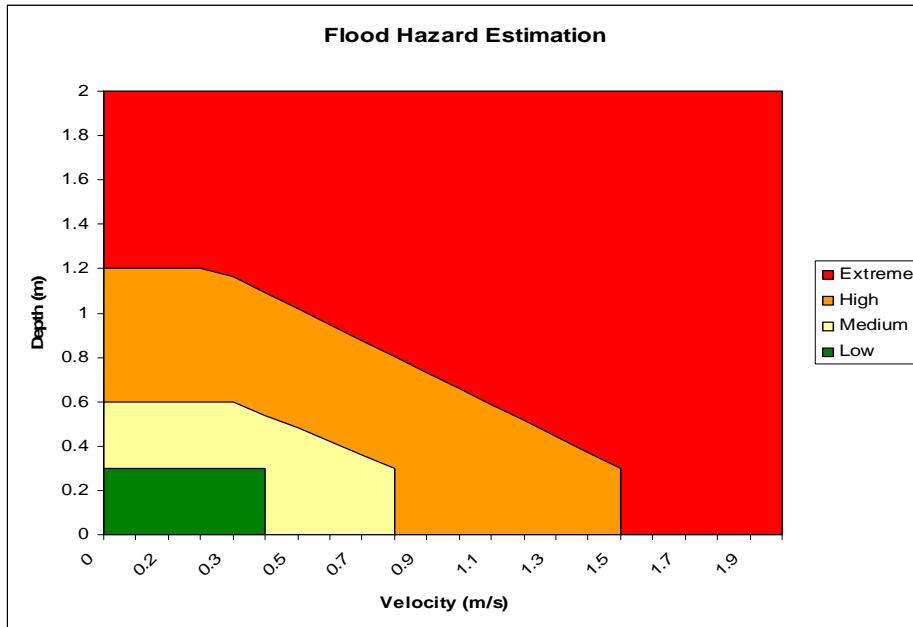
4.2 Development of Floodplain Management Options

The development of floodplain management options was guided by SCARM73 and the DoW.

SCARM73 recommended that flood hazard should be considered as a function of flood depth and velocity as well as considering the ability to evacuate populated areas. **Figure 4-1** schematises these flood hazard categories. The assessment of flood hazard by this method required that the flood depth and velocity be known throughout the study area and the combination of the results were assessed against the graph to give the relevant hazard category.

Table 4-2 describes the typical flow conditions associated with each hazard category as defined by the SCARM73 report.

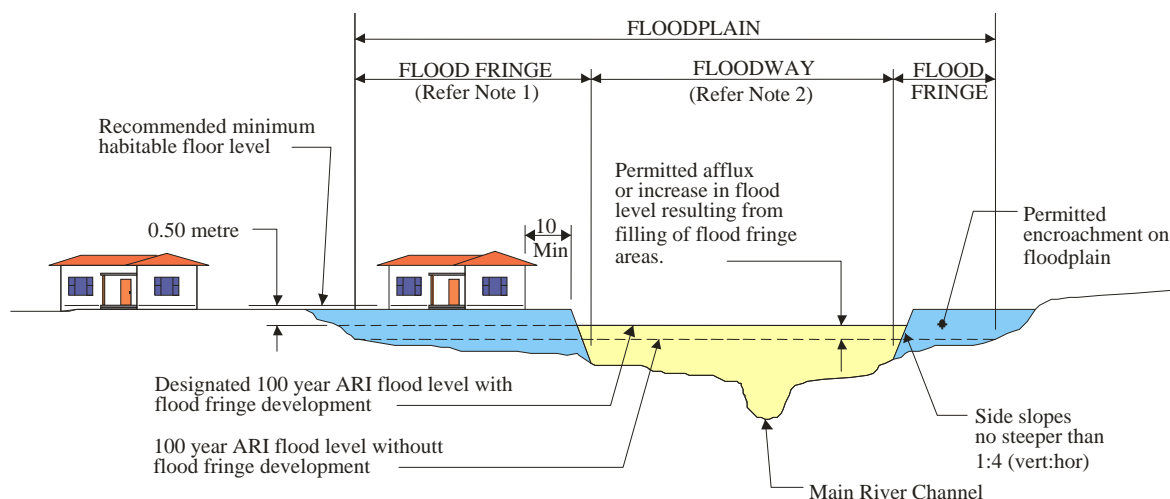
The DoW provided their recommended floodplain development strategy and this is shown in **Figure 4-2**.



■ **Figure 4-1 SCARM73 Flood Hazard Categories**

■ **Table 4-2 SCARM73 Hazard Category Descriptions and Appropriate Land Uses**

Hazard Category	Description	Appropriate Land Uses
Low	<ul style="list-style-type: none"> ■ No significant evacuation problems with short evacuation distances. ■ Children and the elderly can wade safely. ■ Evacuation is possible in a small sedan vehicle. ■ There is ample time for flood warning and flood forecasting and evacuation. 	<ul style="list-style-type: none"> ■ All including residential and commercial. ■ Emergency services. ■ Communication facilities.
Medium	<ul style="list-style-type: none"> ■ Fit adults can wade safely but children and adults may have difficulty. ■ Evacuation distances are longer. ■ Maximum flood depth and velocities are higher. ■ Evacuation by small sedan type vehicle is possible in the early stages of flooding after which 4WD vehicles are suitable. 	<ul style="list-style-type: none"> ■ Residential and commercial ■ No emergency services.
High	<ul style="list-style-type: none"> ■ Fit adults can wade with difficulty. ■ Flood depths are up to 1.0 m and velocities exceeding 1.5 m/s ■ 4WDs and trucks are the only vehicles able to evacuate. ■ Boats and helicopters may be required. ■ Evacuation routes remain trafficable only up to the minimum time. 	<ul style="list-style-type: none"> ■ Open space ■ No residential. ■ Commercial and industrial with acceptance of flood risk as a “business risk” ■ Club houses with appropriate protection.
Extreme	<ul style="list-style-type: none"> ■ Boats and helicopters are required for evacuation. ■ Wading is not an option. ■ Flood depths exceed 1.0 m and velocity exceeds 1.5 m/s 	<ul style="list-style-type: none"> ■ Open space ■ Club houses with appropriate protection



(SCALE: DIAGRAMMATIC)

General Notes

- 1) Proposed development (ie, filling, building, etc) that is located within the *flood fringe* is considered acceptable with respect to major flooding. However, a minimum habitable floor level of 0.50 metre above the adjacent 100 year ARI flood level is recommended to ensure adequate flood protection.
- 2) Proposed development (ie, filling, building, etc) that is located within the *floodway* and is considered obstructive to major flows is not acceptable as it would increase flood level upstream. No new dwellings are acceptable within the floodway.
- 3) A failure to properly adhere to these recommendations will result in a greater exposure to risks of flood damage. This advice is related to major flooding only and other planning issues, such as environmental and ecological considerations, may also need to be addressed.

■ **Figure 4-2 Department of Water Recommended Floodplain Development Strategy**

4.3 Assessment of Existing Flood Hazard

A hydraulic assessment of the existing flood hazard was conducted to understand how flood hazards affect the study area and the Planning Scheme. This was done to better understand the needs for floodplain management options.

The hydraulic model of the 100 year ARI flood event for the existing conditions was used as the basis of a flood hazard assessment and development of options for floodplain management. The model results were tested using the flood hazard estimation techniques outlined in SCARM73.

Flood hazard mapping was generated from the hydraulic modelling results using the Geographic Information System (GIS). The GIS analysis was based on the results of peak 100 year ARI flood



depth and velocity. This is a conservative analysis because it assumes that peak flood depth is coincident with the peak flood velocity. Nevertheless, experience with using this methodology has found that it generally does not exaggerate flood hazard and gives sound results.

The 100 year ARI flood hazard mapping is presented in **Appendix A**.

4.4 Review of the Shire of Boddington Planning Scheme

The flood hazard classification for the existing condition was compared with the Boddington Planning Scheme as shown in **Figure 4-3**. The comparison between the hydraulic assessment and the Planning Scheme highlights the provisions that should be made in future structure planning for sound floodplain management.

The majority of the area within the study area is currently zoned as rural, rural residential and rural small holding. There were potential conflicts between areas of flood hazard and the current planning scheme in areas around the confluence of the Hotham and Crossman Rivers and some locations along the Hotham River. The development of the appropriate floodplain management methods is important including the designations of floodway and flood fringe areas.

4.5 Floodplain Development Encroachment Analysis

A floodplain development encroachment analysis was undertaken for the Boddington FMS. The purpose of the encroachment analysis was to assess the flooding impacts as a result of filling areas of the floodplain and understand how the floodplain may be developed. The areas of the floodplain to be filled were developed in consultation with the DoW. The criteria, selected with consultation in the DoW, to be applied was that filling of the floodplain should not increase 100 year Ari flood levels by 150 mm. This encroachment analysis was used to define the floodway and flood fringe areas for the 100 year ARI floodplain.

The areas of potential floodplain fill identified in the encroachment analysis does not imply these areas are approved for filling by the Shire of Boddington. Filling areas of the floodplain will still require relevant Shire approval.

It should also be noted the increase in flood levels due to floodplain filling was not maximised to the full 150 mm criteria as part of the encroachment analysis. It would be inappropriate to maximise the developable area (utilise the full 150 mm allowance) without full knowledge of developments that may have significant regional benefit to the community (eg. new bridges, roads, tourism facilities, etc).



depth and velocity. This is a conservative analysis because it assumes that peak flood depth is coincident with the peak flood velocity. Nevertheless, experience with using this methodology has found that it generally does not exaggerate flood hazard and gives sound results.

The 100 year ARI flood hazard mapping is presented in **Appendix A**.

4.4 Review of the Shire of Boddington Planning Scheme

The flood hazard classification for the existing condition was compared with the Boddington Planning Scheme as shown in **Figure 4-3**. The comparison between the hydraulic assessment and the Planning Scheme highlights the provisions that should be made in future structure planning for sound floodplain management.

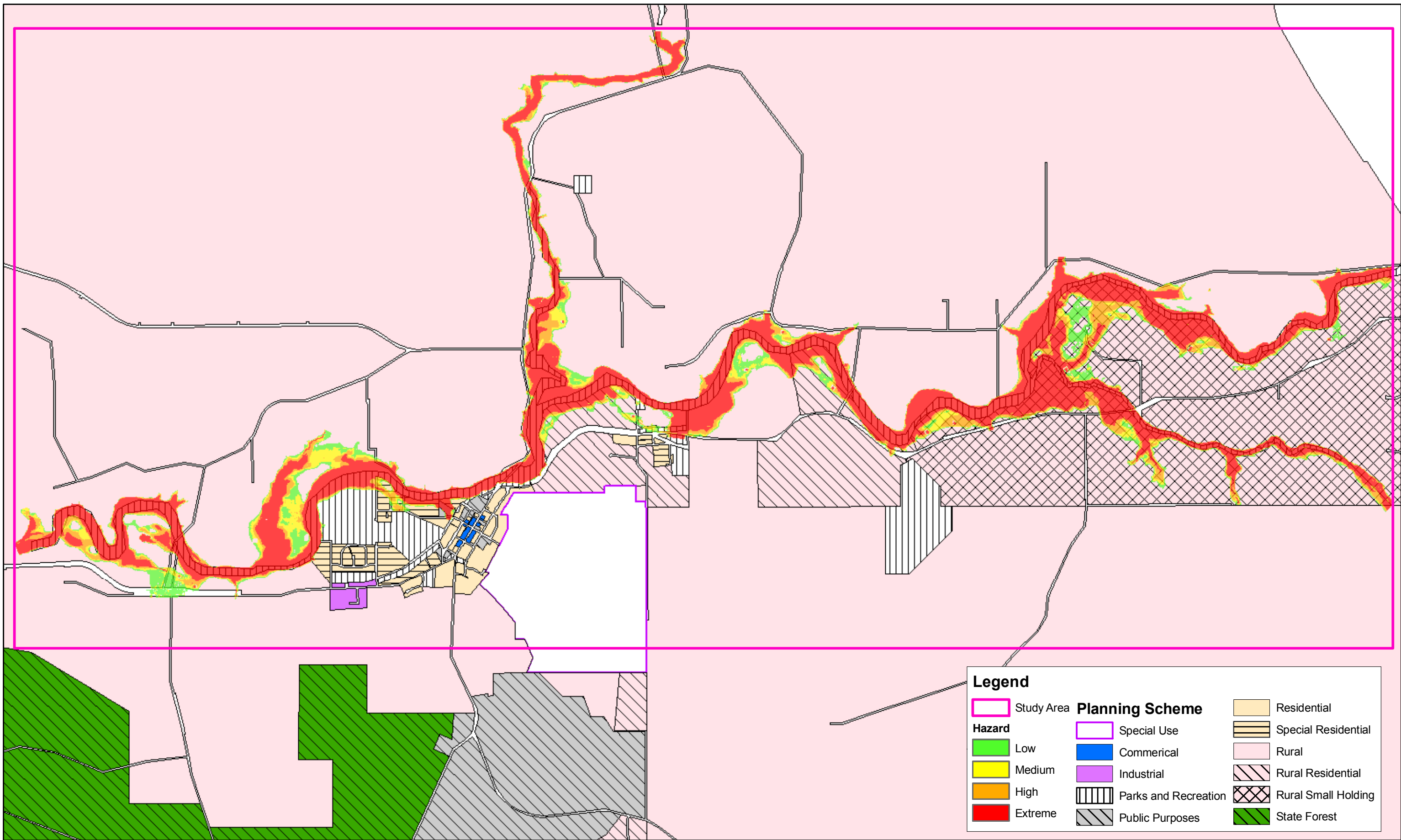
The majority of the area within the study area is currently zoned as rural, rural residential and rural small holding. There were potential conflicts between areas of flood hazard and the current planning scheme in areas around the confluence of the Hotham and Crossman Rivers and some locations along the Hotham River. The development of the appropriate floodplain management methods is important including the designations of floodway and flood fringe areas.

4.5 Floodplain Development Encroachment Analysis

A floodplain development encroachment analysis was undertaken for the Boddington FMS. The purpose of the encroachment analysis was to assess the flooding impacts as a result of filling areas of the floodplain and understand how the floodplain may be developed. The areas of the floodplain to be filled were developed in consultation with the DoW. The criteria, selected with consultation in the DoW, to be applied was that filling of the floodplain should not increase 100 year Ari flood levels by 150 mm. This encroachment analysis was used to define the floodway and flood fringe areas for the 100 year ARI floodplain.

The areas of potential floodplain fill identified in the encroachment analysis does not imply these areas are approved for filling by the Shire of Boddington. Filling areas of the floodplain will still require relevant Shire approval.

It should also be noted the increase in flood levels due to floodplain filling was not maximised to the full 150 mm criteria as part of the encroachment analysis. It would be inappropriate to maximise the developable area (utilise the full 150 mm allowance) without full knowledge of developments that may have significant regional benefit to the community (eg. new bridges, roads, tourism facilities, etc).



BODDINGTON FLOODPLAIN MANAGEMENT STUDY

Figure 4-3 100 Year ARI Event Flood Hazard Map and Boddington Planning Scheme



Author: Sarah Gosling
Date: 03/07/09
Job No: QE09456





4.6 Community Consultation

Community consultation was undertaken on the Floodplain Management Strategy in December 2008/January 2009. The community consultation was undertaken on *Boddington Floodplain Management Study – Flood Modelling Report – Revision 0* (SKM, 2008) and *Boddington Floodplain Management Study – Floodplain Management Strategy – Revision 0* (SKM, 2008) and included:

- an 8 week period allowing for review of the study and to receive submissions;
- site inspection and meeting with submitters by the Shire of Boddington Council members, Department of Water and SKM; and
- a response to each of the submitters prepared (**Appendix C**).

A Planning Policy has been developed by the Shire of Boddington to assist in the implementation of the Floodplain Management Strategy. This policy is Planning Policy 6 – Development in Flood Affected Areas. A full list of the properties determined to be Flood Affected as part of this Study is presented in **Appendix D**.



5. Proposed Floodplain Management Plan

As the study area is essentially a greenfield site, there is little need to investigate possible structural measures to mitigate existing flooding impacts, however there will be a need to manage major river flooding in the future planning of the area. The non-structural flood mitigation measures are focussed on managing potential flooding impacts in the area and to the adjacent land.

The DoW uses the following guiding principles to ensure proposed development in flood prone areas is acceptable with regard to major flooding:

- proposed development has adequate flood protection from a 100 year ARI flood; and
- proposed development does not detrimentally impact on the existing 100 year ARI flooding regime of the general area.

5.1 Non-Structural Flood Mitigation Measures

Non-structural measures are focussed on sound planning for appropriate land use and setting aside land to achieve sound floodplain management outcomes. They include land use planning, building controls, flood warning and flood emergency response planning.

5.1.1 Land Use Planning

This activity was aimed at setting aside land for the safe conveyance of flood waters through developed areas. The floodplain development encroachment analysis was used to determine designations of floodway and flood fringe areas for the flood affected areas.

The flood mapping series in **Appendix B** show the areas designated as floodway and flood fringe based on the encroachment analysis, consultation with DoW and the flood hazard assessment. New development should only be allowed in the flood fringe areas subject to a minimum habitable floor level of 0.5 m above the adjacent 100 year ARI flood level.

There is still a flooding risk outside of the extent of this study, as there a number of smaller tributaries that drain to the major rivers. The *Boddington Floodplain Management Study – Flood Modelling Report* (SKM, 2009) provides some indication of flood hazard in the tributaries. For development to occur near these tributaries, an appropriate flooding assessment needs to be undertaken and reviewed by the DoW.

The flood mapping series in **Appendix B** shows the extent and level of flooding for the 100 year ARI event with the complete development of the flood fringe area. Therefore, to determine the minimum habitable floor level for a development within the flood fringe, the 100 year ARI flood level adjacent to the development is selected from the flood mapping series and then add 0.50 m. Should the property fall between two marked 100 year ARI flood levels or is adjacent to multiple



marked 100 year ARI flood levels, advice can be sort from DoW to confirm the correct 100 year ARI flood level.

5.1.2 Development and Building Controls

The recommended floodplain management strategy for the Hotham, Crossman and Bannister Rivers floodplain is:

- proposed development (ie, filling, building, etc) that is located outside of the floodway is considered acceptable with respect to major river flooding. However, a minimum habitable floor level of 0.50 m above the adjacent 100 year ARI flood level is recommended to provide adequate flood protection; and
- proposed development (ie, filling, building, etc) that is located within the floodway and is considered obstructive to major flows is not acceptable as it would increase flood levels upstream. No new buildings are acceptable in the floodway.

It should be noted that all development should a minimum habitable floor level of 0.50 m above the adjacent 100 year ARI flood level. This is if a development is proposed outside the flood fringe it still must meet this requirement to provide adequate flood protection.

5.1.3 Flood Warning/Forecasting

A flood warning system helps to mitigate the impact of flooding by enabling the community to take preventative actions prior to the arrival of the floodwaters.

The Bureau of Meteorology in association with the Department of Water and the Fire and Emergency Services Authority (WA) provides a flood forecasting / warning service in Western Australia. However, at present only generalised flood warning information is provided for the Hotham River in Boddington.

The service relies on the collection and communication of rainfall and streamflow information at Boddington and throughout the upper catchment. At present, the DoW operates streamflow gauging stations upstream of Boddington on the Hotham and Crossman Rivers and 14 Mile Brook. There is also a network of rain gauges throughout the catchment operated by the Bureau of Meteorology and the Department of Water.

The maintenance and continued evaluation and enhancement of the existing data collection network, forecasting tools and communication networks is recommended to ensure the community is provided with an early warning of an impending flood.



5.1.4 Flood Emergency Response Planning

The step to follow on from Floodplain Management Planning is to develop a Local Flood Emergency Response Plan. With respect to flood emergency response planning, emergency service agencies (ie FESA) have responsibility to facilitate and assist Local Councils to prepare plans for management of flood emergencies.

Flood emergency response planning needs to consider evacuation routes and the location of emergency services required during severe flooding.

5.1.5 Floodplain Development Design and Review Process

This Strategy has required the development of detailed hydrologic and hydraulic modelling tools and these tools should become the basis of design for all future floodplain development. DoW will hold the hydraulic modelling tools and information for this study.

The ongoing management of the floodplain models will be critical to ensuring that development occurs without causing detrimental impacts. The strategy for managing the tools should aim to maintain knowledge of the systems with a single organisation or individual through the upcoming three to five years while the greatest development pressure is managed. The need for the management of the modelling tools should be reassessed at that stage.



6. References

CSIRO, (2000). *SCARM Report 73: Floodplain Management in Australia: Best Practice Principles and Guidelines*. CSIRO Publishing.

Department of Environment, Western Australia (2000). *WA CRC-Forge*.

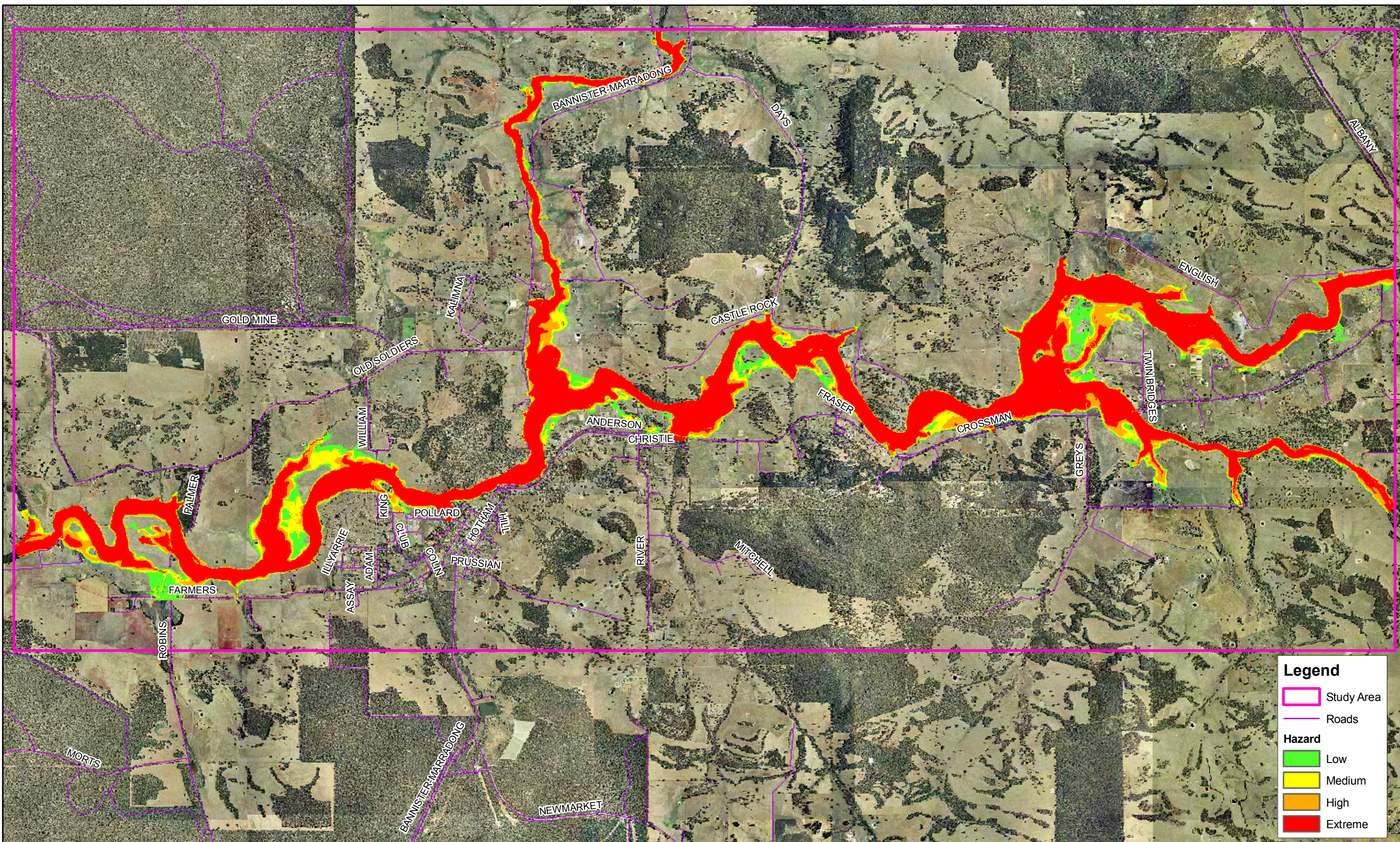
Ferrell, J. (1992) *Becoming Boddington*. Shire of Boddington.

Institution of Engineers Australia, (1987). *Australian Rainfall and Runoff: a guide to flood estimation*. Vol. 2. Institution of Engineers Australia.

SKM, (2009). *Boddington Floodplain Management Study – Flood Modelling Report*.



Appendix A Existing Flood Hazard Mapping



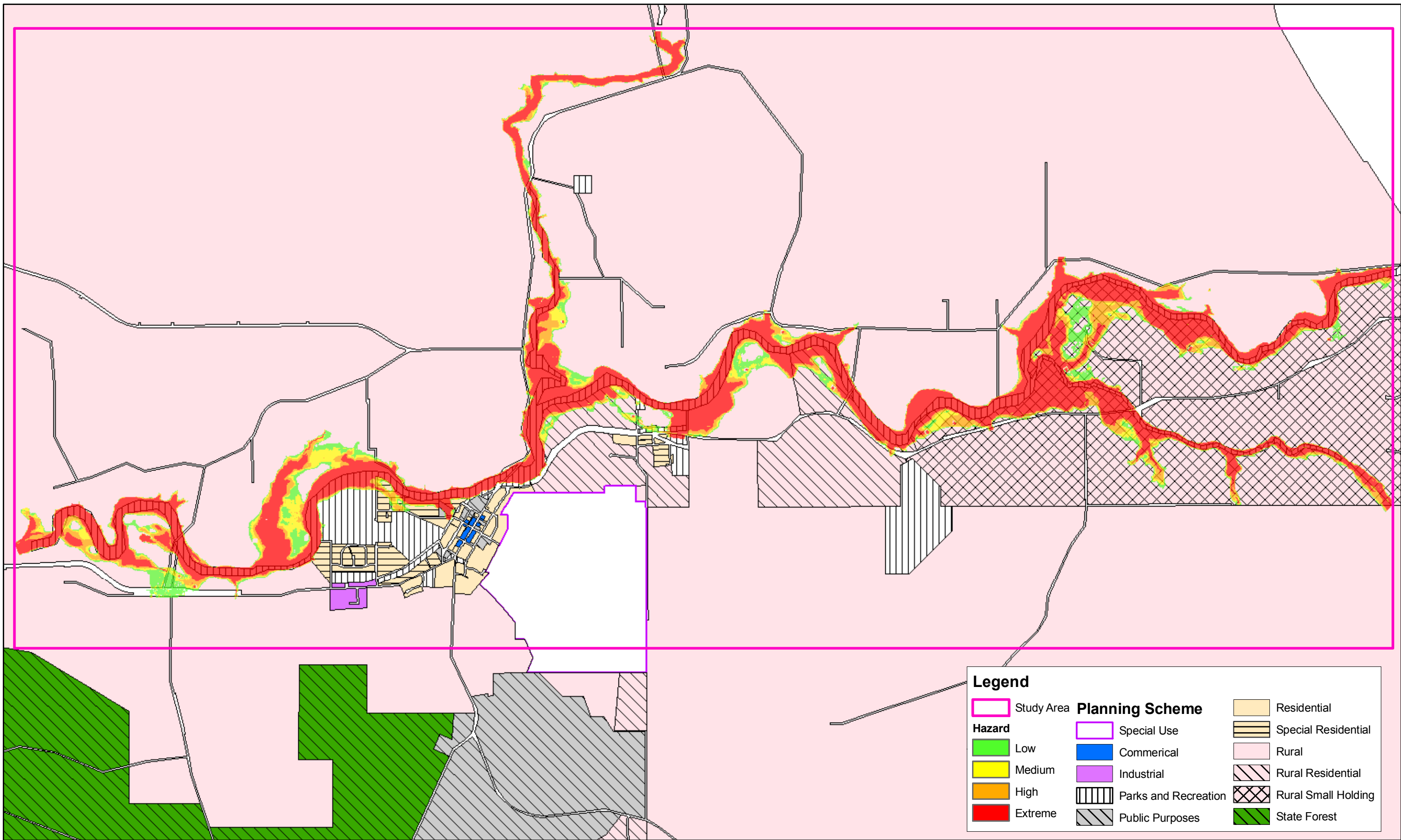
BODDINGTON FLOODPLAIN MANAGEMENT STUDY

Figure A-1 100 Year ARI Event Flood Hazard Map



Author: Sarah Gosling
 Date: 03/07/09
 Job No: QE09456





BODDINGTON FLOODPLAIN MANAGEMENT STUDY

Figure A-2 100 Year ARI Event Flood Hazard Map and Boddington Planning Scheme



Author: Sarah Gosling
Date: 03/07/09
Job No: QE09456





Appendix B Designated Floodway and Levels – 100 Year ARI Flood Mapping Series

- Refer A1 Map Series –



Appendix C Responses to Community Submissions

Sinclair Knight Merz
32 Cordelia Street
South Brisbane QLD 4101 Australia
PO Box 3848
South Brisbane QLD 4101 Australia

Tel: +61 7 3026 7100
Fax: +61 7 3026 7306
Web: www.skmconsulting.com

Steve Thompson
Shire of Boddington
PO Box 4
BODDINGTON WA 6390

3rd July 2009

QE09456_Boddington_Submission_Response_Rev1.doc
QE09456

Dear Steve

Boddington Floodplain Management Study
Responses to Submissions on Boddington Floodplain Management Study

SKM has reviewed the submissions received from the Boddington community on the Boddington Floodplain Management Study including the *Flood Modelling Report – Revision 0* (SKM, 2008) and *Floodplain Management Strategy – Revision 0* (SKM, 2008).

The responses have been developed by SKM in consultation with the Department of Water and after meeting with the submitters in Boddington on 23rd June 2009. A response to each of the submissions received is outlined below. SKM would like to thank each respondent for taking the time to make a submission on the Boddington Floodplain Management Study.

Respondent – JDA

Estimation of the 100 Year ARI Peak Discharge

It is acknowledged that the adopted 100 year ARI peak discharge at the Marradong Road Bridge gauge (614224) is higher than the value determined in the flood frequency analysis (FFA). However, it is not believed that adopted value is an overestimate of the 100 year ARI peak discharge for the following reasons:

- as discussed in Section 4.6 of the Flood Modelling Report, the Marradong Road Bridge gauge (614224) record was extended using the Baden Powell gauge (614006). The catchment downstream of the Marradong Road Bridge gauge (614224) to the Baden Powell Gauge (614006) has a large proportion of hilly forested terrain where as the catchment upstream of the Marradong Road Bridge gauge (614224) is largely cleared rolling pastures. This introduces some uncertainty into the extension of the series for the Marradong Road Bridge gauge (614224);
- Figure 4.2 of the Flood Modelling Report shows the correlation that was achieved between the streamflow gauges. This figure shows there is a reasonable amount of scatter

Sinclair Knight Merz Pty Limited

The SKM logo is a trade mark of Sinclair Knight Merz Pty Ltd. © Sinclair Knight Merz Pty Ltd, 2006 ABN 37 001 024 095
Offices across Australia, New Zealand, UK, South East Asia, Middle East, the Pacific and Americas



at the upper end of the gauged peak discharges. This scatter introduces some uncertainty into the estimates of the upper end of the FFA;

- the hydrologic model parameters were determined from a calibration of a number of historic events and from the sensitivity analysis of these parameters; and
- the hydraulic model results are comparable to the anecdotal information from historic events.

For these reasons it is believed the 100 year ARI peak discharge determined by the hydrologic model, while higher than the FFA, is appropriate for use in this study.

Flood Encroachment Analysis

It is acknowledge that the floodway definition under the Department of Water recommendation of proposed development increasing flood levels by a maximum of 150 mm was not maximised in this study. It would be inappropriate to maximise the developable area (utilise the full 150 mm allowance) without full knowledge of developments that may have significant regional benefit to the community (eg. new bridges, roads, tourism facilities, etc). Further discussion will be added to the Floodplain Management Strategy Report to explain this further.

The Department of Water have advised they may consider adjustments to the floodway in the future. However, the proponent would need to demonstrate, using appropriate hydraulic modelling, that the proposal does not detrimentally impact on the existing flooding regime. Any costs associated with the hydraulic modelling is the responsibility of the proponent.

A refinement of the floodway will be undertaken in the area based on the site inspection of Lot 62 on Plan 144657.

Respondent – Mr Paul Johnson

It would be good if copies of the photographs of the 1955 flood quoted in Mr Johnson's submission could be obtained. The information regarding the flood level at Lot 56 (ie. ~ 200 mm below floor height should be surveyed to determine the level for comparison with modelled results).

The methodology and models adopted during the Boddington Floodplain Management Study are considered appropriate for the Hotham River and are considered best-practise within the industry at the present time. These methods utilised as part of this study are endorsed by the Department of Water.



With regard to the specific questions within the response, the proposed floodplain management strategy for Boddington would be supported by advice from the Department of Water on new developments that may be affected by flooding. Under the Floodplain Management Strategy for the area, a garage is not considered habitable and therefore would not be required to be constructed to above the 100 year ARI flood level. Similarly, proposed minor extensions to existing dwellings (along the lines within the response) may not be subject to the minimum habitable floor level recommendation.

Floodway definition has been modified to flood fringe based on consultation with the Department of Water.

Respondent – Mr Michael Fitzgerald

The photograph at Lot 19 Crossman Road appears to add support to the similarity of the 1955 flood level to the 100 year ARI flood estimate.

The anecdotal flood information near the 212 m label on adjoining property (Lot 450 Bobo Crt) should be surveyed to determine the level for comparison with modelled flood levels.

The floodway definition has been modified in this area based on the photographic information supplied to reflect the development that has occurred.

The changes in flood level in this area considered to be reasonable as it is consistent with the variation in the terrain levels in the river in this area. There are deeper pools in the river here, which give way to dense vegetation and higher terrain in the river as you move upstream.

The floodway and flood fringe definitions are based on the 100 year ARI flood event. Each flood event in the area will be different and while previous flooding in the area provides indication of flooding it does not represent the 100 year ARI flood event.

Respondent – Mr Jeffrey Gibbs

The observed reduction in annual rainfall in the south-west of WA is of limited relevance to major flooding. There is no current information that supports a similar affect on large flood events. Indeed, there are some references that suggest that extreme events (large rainfalls and droughts) may increase in frequency into the future.

Therefore, it is not considered appropriate to reduce estimates for the 100 year ARI flood level determined in this study.



Yours sincerely,

A handwritten signature in black ink that reads 'Gosling'. The signature is written in a cursive style with a large, prominent 'G'.

Sarah Gosling

Project Manager

Phone: +61 7 3026 7180

Fax: +61 7 3026 7306

E-mail: sgosling@skm.com.au



Appendix D Flood Affected Areas Summary

Lot Number	PiParcel	Lot Type	Address	Street Name
0	R 26566	RESVE		
0	R 26566	RESVE		
0	R 26566	RESVE		
0	R 26566	RESVE		
0	R 26566	RESVE		
0	R 26566	RESVE		
0	R 26566	RESVE		
0	R 26566	RESVE		
0	R 26566	RESVE		
0	R 26566	RESVE		
0	R 26566	RESVE		
0	R 5531	RESVE		
0	R 42234	RESVE		
0	R 42234	RESVE		
0	CCLOSED ROAD	OTHER		
0	V CROWN LAND	OTHER		
0	V CROWN LAND	OTHER		
0	V CROWN LAND	OTHER		
0	V CROWN LAND	OTHER		
0	V CROWN LAND	OTHER		
0	P ROAD	ROAD		
0	P ROAD	ROAD		
0	P ROAD	ROAD		
0	P ROAD	ROAD		
0	P ROAD	ROAD		
0	P ROAD	ROAD		
0	P ROAD	ROAD		
0	P ROAD	ROAD		
0	P ROAD	ROAD		
0	P ROAD	ROAD		
0	P ROAD	ROAD		
0	P ROAD	ROAD		
0	P ROAD	ROAD		
0	R 48917	RESVE		

Lot Number	PiParcel	Lot Type	Address	Street Name
0	BODDIT 00084	CROWN		
0	MURRAL 01435	CROWN		
0	P ROAD	ROAD		
0	R 14963	RESVE		
0	R 14963	RESVE		
0	R 14963	RESVE		
0	R 17428	RESVE		
0	R 37731	RESVE		
0	R 40315	RESVE		
0	R 40332	RESVE		
0	R 14977	RESVE		
1	D069235 1	FHOLD	104 GREYS ROAD BODDINGTON 6390	GREYS ROAD
1	D098742 1	FHOLD	42A CROSSMAN ROAD RANFORD 6390	CROSSMAN ROAD
1	S029143	SSPLN	905 CROSSMAN ROAD CROSSMAN 6390	CROSSMAN ROAD
1	D013430 1	FHOLD		
1	D013430 1	FHOLD	86 WILLIAM STREET BODDINGTON 6390	WILLIAM STREET
1	D061177 1	FHOLD	245 FARMERS AVENUE BODDINGTON 6390	FARMERS AVENUE
1	P013029 1	FHOLD	LOT 1 CROSSMAN ROAD BODDINGTON 6390	CROSSMAN ROAD
1	D012053 1	FHOLD	28 POLLARD STREET BODDINGTON 6390	POLLARD STREET
2	D098742 2	FHOLD	42 CROSSMAN ROAD RANFORD 6390	CROSSMAN ROAD
2	S029143	SSPLN	907 CROSSMAN ROAD CROSSMAN 6390	CROSSMAN ROAD
2	P013029 2	FHOLD	LOT 1 CROSSMAN ROAD BODDINGTON 6390	CROSSMAN ROAD
2	D016287 2	FHOLD	17 POLLARD STREET BODDINGTON 6390	POLLARD STREET
3	S029143	SSPLN	909 CROSSMAN ROAD CROSSMAN 6390	CROSSMAN ROAD
3	P013029 3	FHOLD	LOT 1 CROSSMAN ROAD BODDINGTON 6390	CROSSMAN ROAD
4	P024204 4	FHOLD	LOT 4 CASTLE ROCK WAY BANNISTER 6390	CASTLE ROCK WAY
7	D072997 7	FHOLD	6 KING STREET BODDINGTON 6390	KING STREET
8	P024204 8	FHOLD	137 CASTLE ROCK WAY BANNISTER 6390	CASTLE ROCK WAY
9	P024204 9	FHOLD	LOT 9 CASTLE ROCK WAY BANNISTER 6390	CASTLE ROCK WAY
10	P024204 10	FHOLD	11 CASTLE ROCK WAY BANNISTER 6390	CASTLE ROCK WAY
10	P041551 10	FHOLD	836 CROSSMAN ROAD CROSSMAN 6390	CROSSMAN ROAD
10	P058479 10	FHOLD		
11	P018628 11	FHOLD	123 MISTLETOE VIEW CROSSMAN 6390	MISTLETOE VIEW

Lot Number	PiParcel	Lot Type	Address	Street Name
11	P012661 11	FHOLD	526 CROSSMAN ROAD BODDINGTON 6390	CROSSMAN ROAD
11	P024204 11	FHOLD	386 DAYS ROAD BANNISTER 6390	DAYS ROAD
11	P041551 11	FHOLD	866 CROSSMAN ROAD CROSSMAN 6390	CROSSMAN ROAD
11	P058479 11	FHOLD		
12	P018628 12	FHOLD	119 MISTLETOE VIEW CROSSMAN 6390	MISTLETOE VIEW
12	P041551 12	FHOLD	876 CROSSMAN ROAD CROSSMAN 6390	CROSSMAN ROAD
12	P058479 12	FHOLD		
13	P058479 13	FHOLD		
15	P020861 15	FHOLD	563 CROSSMAN ROAD BODDINGTON 6390	CROSSMAN ROAD
16	P024213 16	FHOLD	920 BANNISTER-MARRADONG ROAD BANNISTER 6390	BANNISTER-MARRADONG ROAD
16	P020861 16	FHOLD	591 CROSSMAN ROAD BODDINGTON 6390	CROSSMAN ROAD
16	P023195 16	FHOLD	1153 BANNISTER-MARRADONG ROAD BANNISTER 6390	BANNISTER-MARRADONG ROAD
17	P024213 17	FHOLD	930 BANNISTER-MARRADONG ROAD BANNISTER 6390	BANNISTER-MARRADONG ROAD
21	P024214 21	FHOLD	LOT 21 BANNISTER-MARRADONG ROAD BANNISTER 6390	BANNISTER-MARRADONG ROAD
21	D082347 21	FHOLD	877 CROSSMAN ROAD CROSSMAN 6390	CROSSMAN ROAD
21	P030857 21	FHOLD	1056 BANNISTER-MARRADONG ROAD BANNISTER 6390	BANNISTER-MARRADONG ROAD
22	D082347 22	FHOLD	CROSSMAN ROAD BODDINGTON 6390	CROSSMAN ROAD
22	P030857 22	FHOLD	1056 BANNISTER-MARRADONG ROAD BANNISTER 6390	BANNISTER-MARRADONG ROAD
22	P030857 22	FHOLD		
23	P030857 23	FHOLD	1056 BANNISTER-MARRADONG ROAD BANNISTER 6390	BANNISTER-MARRADONG ROAD
24	P024214 24	FHOLD		
25	D082348 25	FHOLD	1035 CROSSMAN ROAD CROSSMAN 6390	CROSSMAN ROAD
27	D085540 27	FHOLD	LOT 27 CROSSMAN ROAD CROSSMAN 6390	CROSSMAN ROAD
28	D085540 28	FHOLD	1109 CROSSMAN ROAD BODDINGTON 6390	CROSSMAN ROAD
33	BODDIT 00033	CROWN		
33	P089615 33	CROWN		
35	D071526 35	FHOLD	44 CROSSMAN ROAD RANFORD 6390	CROSSMAN ROAD
36	D071526 36	FHOLD	46 CROSSMAN ROAD RANFORD 6390	CROSSMAN ROAD
37	P015900 37	FHOLD	74 ANDERSON ROAD RANFORD 6390	ANDERSON ROAD
38	P015900 38	FHOLD	70 ANDERSON ROAD RANFORD 6390	ANDERSON ROAD
39	P015900 39	FHOLD	54 ANDERSON ROAD RANFORD 6390	ANDERSON ROAD
40	P015900 40	FHOLD	44 ANDERSON ROAD RANFORD 6390	ANDERSON ROAD
42	P015900 42	FHOLD	24 ANDERSON ROAD RANFORD 6390	ANDERSON ROAD

Lot Number	PiParcel	Lot Type	Address	Street Name
43	D072337 43	FHOLD	4 RIVER ROAD RANFORD 6390	RIVER ROAD
44	D072337 44	FHOLD	2 RIVER ROAD RANFORD 6390	RIVER ROAD
45	D072337 45	FHOLD	6 RIVER ROAD RANFORD 6390	RIVER ROAD
46	P015900 46	FHOLD	24 RIVER ROAD RANFORD 6390	RIVER ROAD
50	D089525 50	FHOLD	67 TWIN BRIDGES PLACE CROSSMAN 6390	TWIN BRIDGES PLACE
51	D089525 51	FHOLD	73 TWIN BRIDGES PLACE CROSSMAN 6390	TWIN BRIDGES PLACE
52	D089525 52	FHOLD		
53	P020894 53	FHOLD	127 TWIN BRIDGES PLACE CROSSMAN 6390	TWIN BRIDGES PLACE
53	BODDIT 00053	CROWN	33 ADAM STREET BODDINGTON 6390	ADAM STREET
53	P143078 53	CROWN	33 ADAM STREET BODDINGTON 6390	ADAM STREET
54	P020894 54	FHOLD	139 TWIN BRIDGES PLACE CROSSMAN 6390	TWIN BRIDGES PLACE
54	BODDIT 00054	CROWN	8 KING STREET BODDINGTON 6390	KING STREET
54	P143078 54	CROWN	8 KING STREET BODDINGTON 6390	KING STREET
55	P020894 55	FHOLD	140 TWIN BRIDGES PLACE CROSSMAN 6390	TWIN BRIDGES PLACE
55	BODDIT 00055	CROWN	6 WILLIAM STREET BODDINGTON 6390	WILLIAM STREET
55	P143078 55	CROWN	6 WILLIAM STREET BODDINGTON 6390	WILLIAM STREET
56	P020894 56	FHOLD	142 TWIN BRIDGES PLACE CROSSMAN 6390	TWIN BRIDGES PLACE
57	P020894 57	FHOLD	LOT 57 TWIN BRIDGES PLACE CROSSMAN 6390	TWIN BRIDGES PLACE
57	BODDIT 00057	CROWN	22 POLLARD STREET BODDINGTON 6390	POLLARD STREET
57	P143078 57	CROWN	22 POLLARD STREET BODDINGTON 6390	POLLARD STREET
58	BODDIT 00058	CROWN	22 POLLARD STREET BODDINGTON 6390	POLLARD STREET
58	P143078 58	CROWN	22 POLLARD STREET BODDINGTON 6390	POLLARD STREET
59	P020894 59	FHOLD	LOT 59 TWIN BRIDGES PLACE CROSSMAN 6390	TWIN BRIDGES PLACE
59	BODDIT 00059	CROWN	22 POLLARD STREET BODDINGTON 6390	POLLARD STREET
59	P143078 59	CROWN	22 POLLARD STREET BODDINGTON 6390	POLLARD STREET
60	BODDIT 00060	CROWN	20 POLLARD STREET BODDINGTON 6390	POLLARD STREET
60	P143078 60	CROWN	20 POLLARD STREET BODDINGTON 6390	POLLARD STREET
62	P032513 62	FHOLD	CROSSMAN ROAD CROSSMAN 6390	CROSSMAN ROAD
62	BODDIT 00062	CROWN		
62	P144657 62	CROWN		
63	P032513 63	FHOLD	1002 CROSSMAN ROAD CROSSMAN 6390	CROSSMAN ROAD
64	P029044 64	FHOLD	916 CROSSMAN ROAD BODDINGTON 6390	CROSSMAN ROAD
65	P029044 65	FHOLD	900 CROSSMAN ROAD CROSSMAN 6390	CROSSMAN ROAD

Lot Number	PiParcel	Lot Type	Address	Street Name
66	P037892 66	FHOLD	944 CROSSMAN ROAD CROSSMAN 6390	CROSSMAN ROAD
67	P037892 67	FHOLD	960 CROSSMAN ROAD CROSSMAN 6390	CROSSMAN ROAD
70	WILLIL 00070	CROWN		
70	P245802 70	CROWN		
71	P050925 71	FHOLD	9132 ALBANY HIGHWAY CROSSMAN 6390	ALBANY HIGHWAY
71	D092428 71	FHOLD	52 TWIN BRIDGES PLACE CROSSMAN 6390	TWIN BRIDGES PLACE
72	D092428 72	FHOLD	833 CROSSMAN ROAD CROSSMAN 6390	CROSSMAN ROAD
81	BODDIT 00081	CROWN		
81	P159792 81	CROWN		
92	WILLIL 00092	CROWN		
92	P245636 92	CROWN		
101	P040564 101	FHOLD	573 DAYS ROAD BODDINGTON 6390	DAYS ROAD
102	P040564 102	FHOLD	102 CROSSMAN ROAD RANFORD 6390	CROSSMAN ROAD
103	P040564 103	FHOLD	527 CROSSMAN ROAD BODDINGTON 6390	CROSSMAN ROAD
103	P060284 103	FHOLD	5 ROBERTS ROAD RANFORD 6390	ROBERTS ROAD
104	P060284 104	FHOLD	7 ROBERTS ROAD RANFORD 6390	ROBERTS ROAD
124	P038648 124	FHOLD	1019 CROSSMAN ROAD CROSSMAN 6390	CROSSMAN ROAD
125	P038648 125	FHOLD	983 CROSSMAN ROAD CROSSMAN 6390	CROSSMAN ROAD
141	D079962 141	FHOLD	30 ANDERSON ROAD RANFORD 6390	ANDERSON ROAD
151	P046600 151	FHOLD	104 GREYS ROAD BODDINGTON 6390	GREYS ROAD
152	P046600 152	FHOLD	745 CROSSMAN ROAD BODDINGTON 6390	CROSSMAN ROAD
154	BODDIT 00154	CROWN		
154	P215188 154	CROWN		
156	BODDIT 00156	CROWN		
156	P215413 156	CROWN		
161	BODDIT 00161	CROWN		
161	P185831 161	CROWN		
163	BODDIT 00163	CROWN		
163	P188100 163	CROWN		
171	BODDIT 00171	CROWN		
171	P243154 171	CROWN		
172	BODDIT 00172	CROWN		
172	BODDIT 00172	CROWN		

Lot Number	PiParcel	Lot Type	Address	Street Name
172	P243154 172	CROWN		
172	P243154 172	CROWN		
173	BODDIT 00173	CROWN		
173	BODDIT 00173	CROWN		
173	P243154 173	CROWN		
173	P243154 173	CROWN		
177	BODDIT 00177	CROWN		
177	P220561 177	CROWN		
178	BODDIT 00178	CROWN		
178	P026704 178	CROWN		
179	MURRAL 00179	CROWN	327 OLD SOLDIERS ROAD BODDINGTON 6390	OLD SOLDIERS ROAD
179	P250631 179	CROWN	327 OLD SOLDIERS ROAD BODDINGTON 6390	OLD SOLDIERS ROAD
200	P061057 200	FHOLD	Lot 200 CROSSMAN ROAD CROSSMAN 6390	CROSSMAN ROAD
201	P061057 201	FHOLD	Lot 201 CROSSMAN ROAD CROSSMAN 6390	CROSSMAN ROAD
202	P061057 202	FHOLD	Lot 202 CROSSMAN ROAD CROSSMAN 6390	CROSSMAN ROAD
203	P061057 203	FHOLD	981 CROSSMAN ROAD CROSSMAN 6390	CROSSMAN ROAD
223	MURRAL 00223	CROWN	86 WILLIAM STREET BODDINGTON 6390	WILLIAM STREET
223	P100854 223	CROWN	86 WILLIAM STREET BODDINGTON 6390	WILLIAM STREET
304	MURRAL 00304	CROWN	291 FARMERS AVENUE BODDINGTON 6390	FARMERS AVENUE
304	P100855 304	CROWN	291 FARMERS AVENUE BODDINGTON 6390	FARMERS AVENUE
311	P049748 311	FHOLD	LOT 311 FRASER ROAD BODDINGTON 6390	FRASER ROAD
312	P049748 312	FHOLD	LOT 312 FRASER ROAD BODDINGTON 6390	FRASER ROAD
313	P049748 313	FHOLD	LOT 313 FRASER ROAD BODDINGTON 6390	FRASER ROAD
314	P049748 314	FHOLD	LOT 314 FRASER ROAD BODDINGTON 6390	FRASER ROAD
315	P049748 315	FHOLD	LOT 315 FRASER ROAD BODDINGTON 6390	FRASER ROAD
316	P049748 316	FHOLD	Lot 316 FRASER ROAD BODDINGTON 6390	FRASER ROAD
317	P049748 317	FHOLD	LOT 317 FRASER ROAD BODDINGTON 6390	FRASER ROAD
318	P044387 318	FHOLD		
351	WILLIL 00351	CROWN		
351	P250629 351	CROWN		
427	P301933 427	FHOLD	194 FARMERS AVENUE BODDINGTON 6390	FARMERS AVENUE
450	P301956 450	FHOLD	5 BOBO COURT RANFORD 6390	BOBO COURT
451	P301956 451	FHOLD	7 BOBO COURT BODDINGTON 6390	BOBO COURT

Lot Number	PiParcel	Lot Type	Address	Street Name
464	MURRAL 00464	CROWN		
464	P254689 464	CROWN		
469	MURRAL 00469	CROWN	86 WILLIAM STREET BODDINGTON 6390	WILLIAM STREET
469	P104920 469	CROWN	86 WILLIAM STREET BODDINGTON 6390	WILLIAM STREET
502	P301504 502	FHOLD	86 WILLIAM STREET BODDINGTON 6390	WILLIAM STREET
505	P301504 505	FHOLD	1056 BANNISTER-MARRADONG ROAD BANNISTER 6390	BANNISTER-MARRADONG ROAD
573	MURRAL 00573	CROWN		
573	P228536 573	CROWN		
609	MURRAL 00609	CROWN	BANNISTER-MARRADONG ROAD BODDINGTON 6390	BANNISTER-MARRADONG ROAD
609	P118569 609	CROWN	BANNISTER-MARRADONG ROAD BODDINGTON 6390	BANNISTER-MARRADONG ROAD
614	MURRAL 00614	CROWN	516 BANNISTER-MARRADONG ROAD BANNISTER 6390	BANNISTER-MARRADONG ROAD
614	P118620 614	CROWN	516 BANNISTER-MARRADONG ROAD BANNISTER 6390	BANNISTER-MARRADONG ROAD
615	MURRAL 00615	CROWN	516 BANNISTER-MARRADONG ROAD BANNISTER 6390	BANNISTER-MARRADONG ROAD
615	P121417 615	CROWN	516 BANNISTER-MARRADONG ROAD BANNISTER 6390	BANNISTER-MARRADONG ROAD
624	MURRAL 00624	CROWN	86 WILLIAM STREET BODDINGTON 6390	WILLIAM STREET
624	P121418 624	CROWN	86 WILLIAM STREET BODDINGTON 6390	WILLIAM STREET
646	MURRAL 00646	CROWN	1056 BANNISTER-MARRADONG ROAD BANNISTER 6390	BANNISTER-MARRADONG ROAD
646	P118621 646	CROWN	1056 BANNISTER-MARRADONG ROAD BANNISTER 6390	BANNISTER-MARRADONG ROAD
696	MURRAL 00696	CROWN	730 BANNISTER-MARRADONG ROAD BODDINGTON 6390	BANNISTER-MARRADONG ROAD
696	P127678 696	CROWN	730 BANNISTER-MARRADONG ROAD BODDINGTON 6390	BANNISTER-MARRADONG ROAD
800	P302737 800	FHOLD		
846	MURRAL 00846	CROWN	BANNISTER-MARRADONG ROAD BODDINGTON 6390	BANNISTER-MARRADONG ROAD
846	P088721 846	CROWN	BANNISTER-MARRADONG ROAD BODDINGTON 6390	BANNISTER-MARRADONG ROAD
848	MURRAL 00848	CROWN	BANNISTER-MARRADONG ROAD BODDINGTON 6390	BANNISTER-MARRADONG ROAD
848	P138998 848	CROWN	BANNISTER-MARRADONG ROAD BODDINGTON 6390	BANNISTER-MARRADONG ROAD
1204	MURRAL 01204	CROWN	BANNISTER-MARRADONG ROAD BODDINGTON 6390	BANNISTER-MARRADONG ROAD
1204	P143160 1204	CROWN	BANNISTER-MARRADONG ROAD BODDINGTON 6390	BANNISTER-MARRADONG ROAD
1210	MURRAL 01210	CROWN	327 OLD SOLDIERS ROAD BODDINGTON 6390	OLD SOLDIERS ROAD
1210	P251442 1210	CROWN	327 OLD SOLDIERS ROAD BODDINGTON 6390	OLD SOLDIERS ROAD
1297	MURRAL 01297	CROWN	291 FARMERS AVENUE BODDINGTON 6390	FARMERS AVENUE
1297	P228536 1297	CROWN	291 FARMERS AVENUE BODDINGTON 6390	FARMERS AVENUE
1878	WILLIL 01878	CROWN		
1878	WILLIL 01878	CROWN	644 CROSSMAN ROAD BODDINGTON 6390	CROSSMAN ROAD

Lot Number	PiParcel	Lot Type	Address	Street Name
1878	P114205 1878	CROWN	644 CROSSMAN ROAD BODDINGTON 6390	CROSSMAN ROAD
1878	P114205 1878	CROWN		
1920	MURRAL 01920	CROWN		
1920	MURRAL 01920	CROWN		
1920	MURRAL 01920	CROWN		
1920	MURRAL 01920	CROWN		
1920	P243154 1920	CROWN		
1920	P243154 1920	CROWN		
1920	P243154 1920	CROWN		
1920	P243154 1920	CROWN		
2313	P030857 2313	ROAD		
2920	AVON L 02920	CROWN	139 CASTLE ROCK WAY BANNISTER 6390	CASTLE ROCK WAY
2920	P100852 2920	CROWN	139 CASTLE ROCK WAY BANNISTER 6390	CASTLE ROCK WAY
2921	AVON L 02921	CROWN	139 CASTLE ROCK WAY BANNISTER 6390	CASTLE ROCK WAY
2921	P100853 2921	CROWN	139 CASTLE ROCK WAY BANNISTER 6390	CASTLE ROCK WAY
3540	WILLIL 03540	CROWN		
3540	P114206 3540	CROWN		
4247	WILLIL 04247	CROWN	104 GREYS ROAD BODDINGTON 6390	GREYS ROAD
4247	P114211 4247	CROWN	104 GREYS ROAD BODDINGTON 6390	GREYS ROAD
4579	AVON L 04579	CROWN	9104 ALBANY HIGHWAY CROSSMAN 6390	ALBANY HIGHWAY
4579	P224816 4579	CROWN		
4579	P224816 4579	CROWN	9104 ALBANY HIGHWAY CROSSMAN 6390	ALBANY HIGHWAY
4819	AVON L 04819	CROWN	516 BANNISTER-MARRADONG ROAD BANNISTER 6390	BANNISTER-MARRADONG ROAD
4819	P224343 4819	CROWN	516 BANNISTER-MARRADONG ROAD BANNISTER 6390	BANNISTER-MARRADONG ROAD
4819	P224343 4819	CROWN		
4819	P224343 4819	CROWN		
5557	AVON L 05557	CROWN	505 DAYS ROAD CROSSMAN 6390	DAYS ROAD
5557	P115286 5557	CROWN	505 DAYS ROAD CROSSMAN 6390	DAYS ROAD
5938	AVON L 05938	CROWN	9104 ALBANY HIGHWAY CROSSMAN 6390	ALBANY HIGHWAY
5938	AVON L 05938	CROWN		
5938	P115287 5938	CROWN		
5938	P115287 5938	CROWN	9104 ALBANY HIGHWAY CROSSMAN 6390	ALBANY HIGHWAY
6552	AVON L 06552	CROWN		

Lot Number	PiParcel	Lot Type	Address	Street Name
6552	P116448 6552	CROWN		
6553	AVON L 06553	CROWN	9104 ALBANY HIGHWAY CROSSMAN 6390	ALBANY HIGHWAY
6553	AVON L 06553	CROWN		
6553	P116448 6553	CROWN		
6553	P116448 6553	CROWN	9104 ALBANY HIGHWAY CROSSMAN 6390	ALBANY HIGHWAY
6950	AVON L 06950	CROWN	139 CASTLE ROCK WAY BANNISTER 6390	CASTLE ROCK WAY
6950	P118576 6950	CROWN	139 CASTLE ROCK WAY BANNISTER 6390	CASTLE ROCK WAY
6951	AVON L 06951	CROWN	505 DAYS ROAD CROSSMAN 6390	DAYS ROAD
6951	P118577 6951	CROWN	505 DAYS ROAD CROSSMAN 6390	DAYS ROAD
6952	AVON L 06952	CROWN	505 DAYS ROAD CROSSMAN 6390	DAYS ROAD
6952	P118578 6952	CROWN	505 DAYS ROAD CROSSMAN 6390	DAYS ROAD
7461	AVON L 07461	CROWN	505 DAYS ROAD CROSSMAN 6390	DAYS ROAD
7461	AVON L 07461	CROWN		
7461	AVON L 07461	CROWN		
7461	P121426 7461	CROWN		
7461	P121426 7461	CROWN		
7461	P121426 7461	CROWN	505 DAYS ROAD CROSSMAN 6390	DAYS ROAD
8795	WILLIL 08795	CROWN		
8795	WILLIL 08795	CROWN	291 FARMERS AVENUE BODDINGTON 6390	FARMERS AVENUE
8795	WILLIL 08795	CROWN		
8795	WILLIL 08795	CROWN		
8795	WILLIL 08795	CROWN		
8795	P251301 8795	CROWN		
8795	P251301 8795	CROWN		
8795	P251301 8795	CROWN		
8795	P251301 8795	CROWN	291 FARMERS AVENUE BODDINGTON 6390	FARMERS AVENUE
8795	P251301 8795	CROWN		
9752	WILLIL 09752	CROWN	194 FARMERS AVENUE BODDINGTON 6390	FARMERS AVENUE
9752	P252138 9752	CROWN	194 FARMERS AVENUE BODDINGTON 6390	FARMERS AVENUE
10629	AVON L 10629	CROWN	1056 BANNISTER-MARRADONG ROAD BANNISTER 6390	BANNISTER-MARRADONG ROAD
10629	P129547 10629	CROWN	1056 BANNISTER-MARRADONG ROAD BANNISTER 6390	BANNISTER-MARRADONG ROAD
13816	WILLIL 13816	CROWN	13 TANNIN PLACE RANFORD 6390	TANNIN PLACE
13816	P159037 13816	CROWN	13 TANNIN PLACE RANFORD 6390	TANNIN PLACE

Lot Number	PiParcel	Lot Type	Address	Street Name
13818	WILLIL 13818	CROWN	7 TANNIN PLACE RANFORD 6390	TANNIN PLACE
13818	P159085 13818	CROWN	7 TANNIN PLACE RANFORD 6390	TANNIN PLACE
13819	WILLIL 13819	CROWN		
13819	P159128 13819	CROWN		
15029	WILLIL 15029	CROWN	9476 ALBANY HIGHWAY CROSSMAN 6390	ALBANY HIGHWAY
15029	P208118 15029	CROWN	9476 ALBANY HIGHWAY CROSSMAN 6390	ALBANY HIGHWAY
15710	WILLIL 15710	CROWN		
15710	WILLIL 15710	CROWN		
15710	P215125 15710	CROWN		
15710	P215125 15710	CROWN		
15740	WILLIL 15740	CROWN		
15740	P216453 15740	CROWN		
15829	WILLIL 15829	CROWN		
15829	P243154 15829	CROWN		
16006	WILLIL 16006	CROWN		
16006	P033381 16006	CROWN		
16007	WILLIL 16007	CROWN		
16007	P033381 16007	CROWN		
16032	P040564 16032	FHOLD		
29098	AVON L 29098	CROWN		
29098	P243154 29098	CROWN		
29606	P030857 29606	ROAD		



Appendix E DoW Recommendations



Your ref:
Our ref: WT4717
Srod23.doc
Enquiries: Simon Rodgers (6364 6923)

Mr Gary Sherry
Chief Executive Officer
Shire of Boddington
PO Box 4
Boddington WA 6390

Dear Mr Sherry

Shire of Boddington - Floodplain Management Study by Sinclair Knight Merz

The Department of Water (DoW) has reviewed the two SKM reports that form the Shire of Boddington Floodplain Management Study:

- Flood Modelling Report (3 July 2009)
- Floodplain Management Strategy (3 July 2009)

The DoW considers the approach and methodology adopted for determining the design flow and flood level information is acceptable for the Hotham River and its tributaries.

The recommended Floodplain Management Strategy is consistent with current best practice. The DoW recommends that your Council adopt the recommendations of the Floodplain Management Study to guide future land planning and development proposals and to incorporate the strategy into your Town Planning Scheme.

The DoW in carrying out its role in floodplain management, will continue to support your Shire by providing advice and recommending guidelines for development on floodplains with the object of minimising flood risk and damage.

Yours faithfully

A handwritten signature in black ink that reads "Rick Bretnall".

Richard Bretnall
Manager, Water Resource Assessment
15 July 2009