GLEN ROCK CATCHMENT PROTECTION AND WATER PRODUCTION ASSESSMENT

Department of Natural Resources

by

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Queensland Government
Department of Natural Resources

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TABLE OF CONTENTS

FIGURES AND TABLES

LIST OF FIGURES

LIST OF TABLES

1 SUMMARY AND CONCLUSIONS

Major conclusions arising out of the Glen Rock Catchment Protection and Water Production Assessment are as follows.

Planning units (PUIDs) with the higher scores are generally situated adjacent to or in the headwaters of Blackfellow Creek. The planning units that achieved the highest water quality ratings (i.e., score >6), were PUID #1, which is located at the entrance of the property and PUID #70 situated in the headwaters of Blackfellow Creek. These areas achieved scores of 6.9 and 6.3 respectively. Given the sensitivity of these planning units, it is recommended that any form of intensive development proposed for these areas be thoroughly scrutinised.

There is a lack of hydrologic and water quality data, with only one rainfall station and no stream gauging stations located within the property. The Water Production and Catchment Protection Resource Assessment Team believes that the collection of baseline information is critical in order to make informed management decisions and recommends that the RMG gives consideration to the establishment of rainfall and/or stream gauging stations and that regular water quality sampling be undertaken on the property.

There are three cattle dips located on the property near Main, Abbott's and Top Yards. It is recommended that an assessment be made of these areas to determine whether or not they are likely to pose a significant risk to the water quality of streams, particularly Blackfellow Creek.

The Water Production and Catchment Protection Resource Assessment Team also recommend that weed control be given a high priority. It has been noted that there are significant infestations of noxious weeds on the property (e.g., lantana), particularly in the riparian areas adjacent to watercourses.

2 INTRODUCTION AND METHODOLOGY

2.1 Introduction

In 1995, the Queensland Government purchased 'Glen Rock', a working cattle property near Gatton, as part of an ongoing strategy to preserve open space in South East Queensland. Responsibility for the management of State land lies with the Queensland Department of Natural Resources (DNR). To ensure the sustainable future use and management of the property, DNR has commissioned the Forest Planning and Sustainable Use Unit to assist with the preparation of a management plan for Glen Rock.

There are a number of planning and environmental values, which need to be considered in formulating policies for future land use, development and management. It is the purpose of this report to assess one of these values - Catchment Protection and Water Production. With this aim in mind, the following objectives were formulated:

- ·To develop a suitable methodology to assess the Catchment Protection and Water Production value; and
- ·To apply the methodology to the plan area - Glen Rock.

2.2 The Plan Area

Glen Rock is a 6 300 hectare cattle property, located approximately 40 kilometres south of Gatton. The Great Dividing Range forms the southern boundary of Glen Rock, which is also the catchment divide between the easterly flowing streams and those that drain south to the Murray-Darling River system. The property contains the headwaters of Blackfellow Creek, which is a major tributary of Tenthill Creek. The location of Glen Rock is shown in Figure 1.

2.3 Methodology

The approach adopted for this study comprised four main stages. The first step in the process was to request assistance from local people with knowledge and expertise who would like to participate in the planning process and become members of the Water Production and Catchment Protection Resource Assessment Team.

The next step was to collect and collate all available information. This involved reviewing Departmental reports and local council planning documents, liasing with staff from local and State government agencies, and conducting site inspections.

In order to determine the potential impacts of land use activities on water quality, an assessment model was developed for inclusion in the management planning process. The Catchment Protection and Water Production Model considers a number of aspects

including the potential of the land for producing high quality water and the existing consumptive and non-consumptive users of the water.

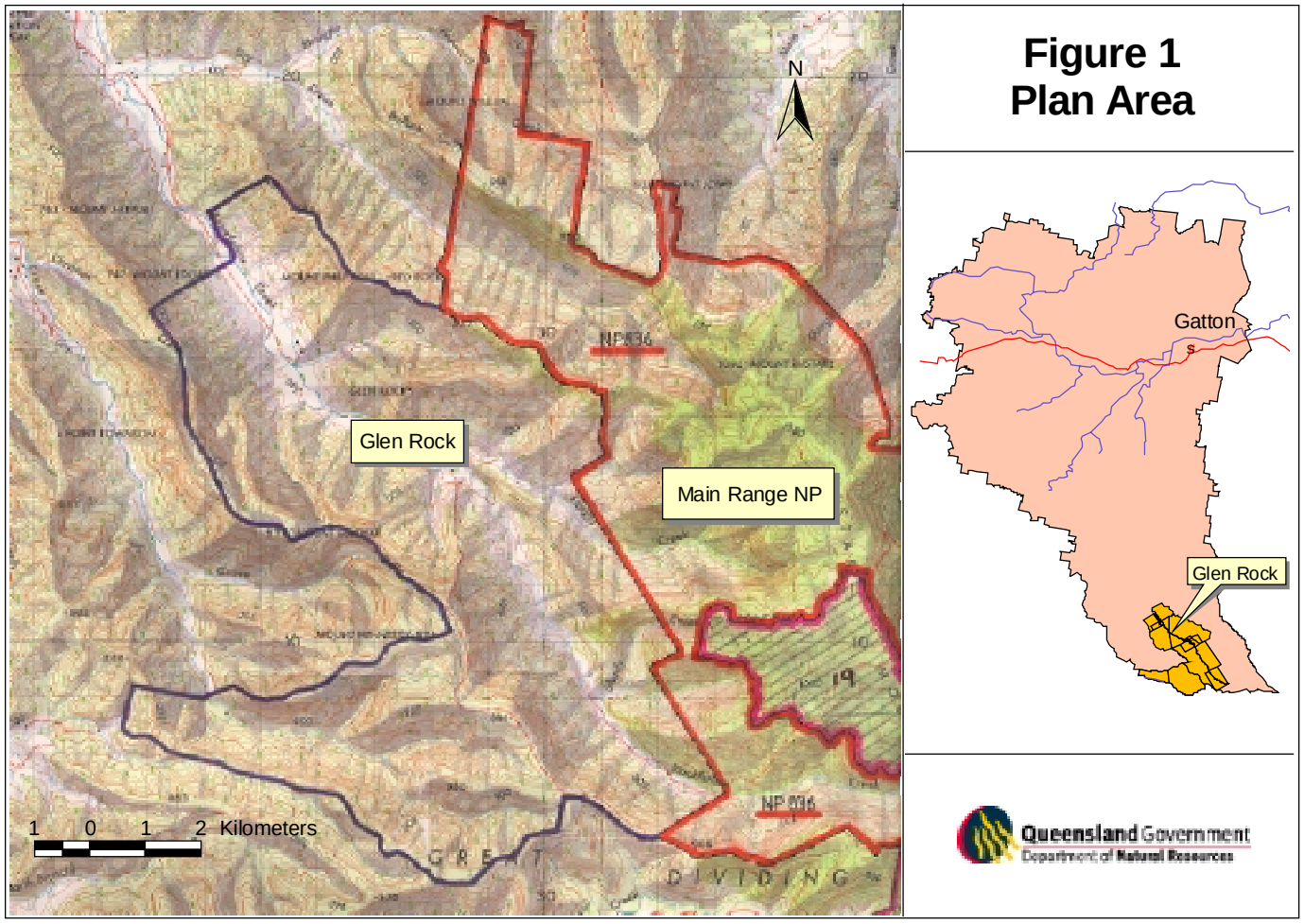


Figure 1
Plan Area
N
Glen Rock
Main Range NP
NP 836
NP 836
1 0 1 2 Kilometers
GREAT DIVIDING
Gatton
Glen Rock
Queensland Government
Department of Natural Resources

These criteria are assessed and interact to produce a one-dimensional rating of significance. A description of the model including a detailed explanation of the criteria can be found in Appendix 1.

The fourth and final step was to apply the model to the plan area in order to assess the Catchment Protection and Water Production value within specific planning units.

3 WATER RESOURCES

3.1 Rainfall

Average annual rainfall for Glen Rock is generally in the range from 800 millimetres to 1 000 millimetres. However, in the more elevated parts, particularly along the eastern boundary of the property, rainfall is greater, reaching some 1 200 millimetres in the headwaters of Flaggy Creek. Mean annual rainfall over the property is shown in Figure 2.

Records are available from one Bureau of Meteorology recording station on Glen Rock, which operated from 1961 to 1966. The average annual rainfall recorded at 'Blackfellows' (station number 040297) was approximately 800 millimetres. For comparison, the mean annual rainfall recorded at 'Rockview' (station number 040605), some 10 kilometres north-east of 'Blackfellows', was approximately 1 000 millimetres. Rainfall statistics for both of these stations are contained in Table 1.

3.2 Surface Water

The headwaters of Blackfellow and Black Duck Creeks are mostly contained within the property. The principal stream is Blackfellow Creek, which has a total length of approximately 40 km and a catchment area of some 300 km2. From its source in the Great Dividing Range, Blackfellow Creek flows west for a distance of approximately five kilometres, before turning north and joining Tenthill Creek at Mt. Sylvia. Major tributaries of Blackfellow Creek include Black Duck, Flaggy and Shady Creeks.

As previously mentioned, there are no stream gauging stations operating within or in the immediate vicinity of Glen Rock. However, in 1990, Gutteridge, Haskins and Davey investigated several potential storage sites on Blackfellow, Black Duck and Tenthill Creeks. Yield assessments were undertaken for one site on Black Duck Creek and two sites on Blackfellow Creek. The locations of these identified storage sites are shown on Figure 2.

For the site on Blackfellow Creek, located immediately downstream of Glen Rock (site #3), the mean annual runoff was assessed as being some 6 500 megalitres. This compares with a mean annual runoff of approximately 5 400 megalitres for the Black Duck Creek site. Hydrologic details of all three potential storage sites can be found in Table 2.

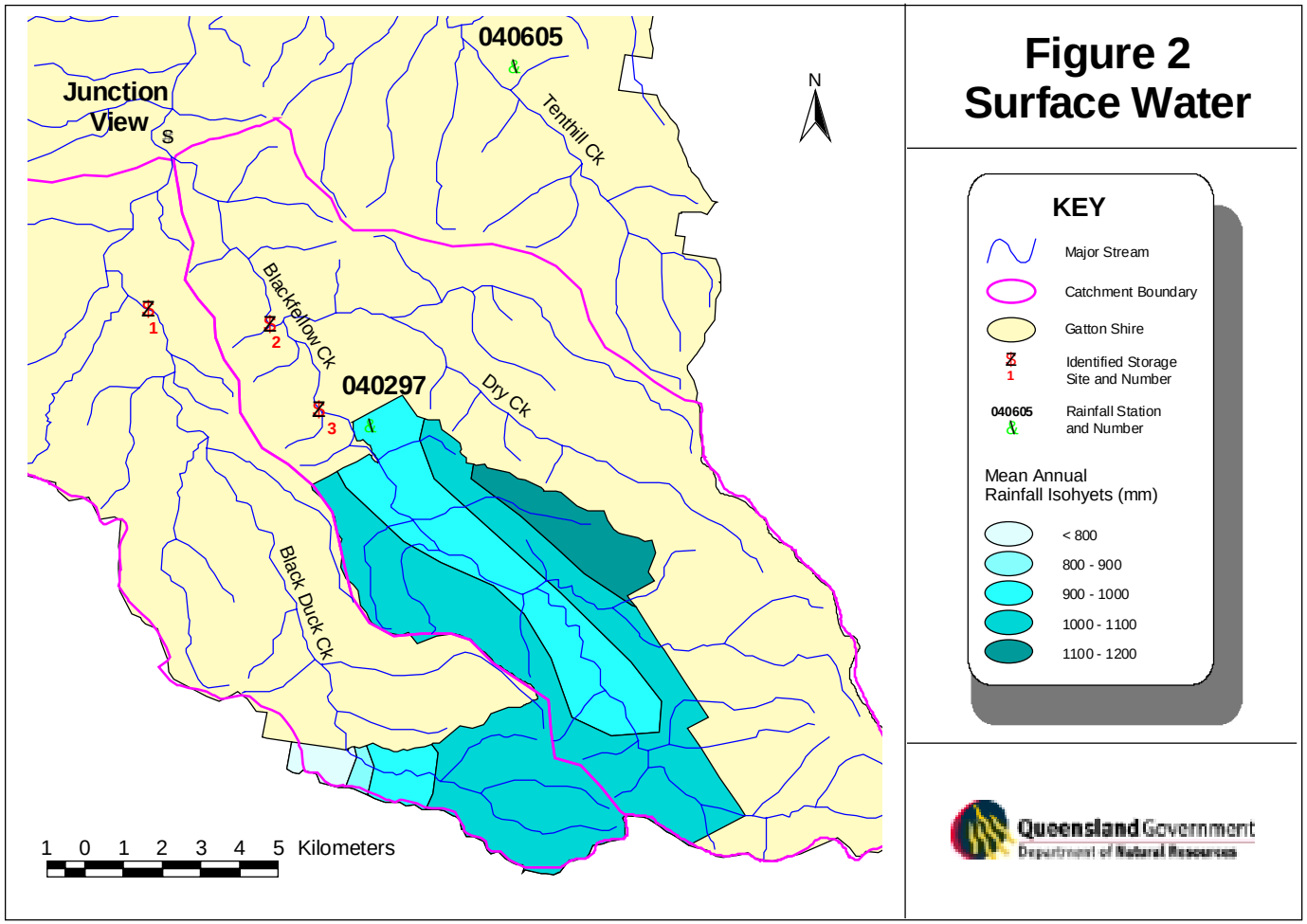


Figure 2
Surface Water
040605
Junction View
Tenthill Ck
Blackfellow Ck
040297
Dry Ck
Black Duck Ck
N
1 0 1 2 3 4 5 Kilometers
KEY
Major Stream
Catchment Boundary
Gatton Shire
Identified Storage Site and Number
040605
Rainfall Station and Number
Mean Annual Rainfall Isohyets (mm)
< 800
800 - 900
900 - 1000
1000 - 1100
1100 - 1200
Queensland Government
Department of Natural Resources

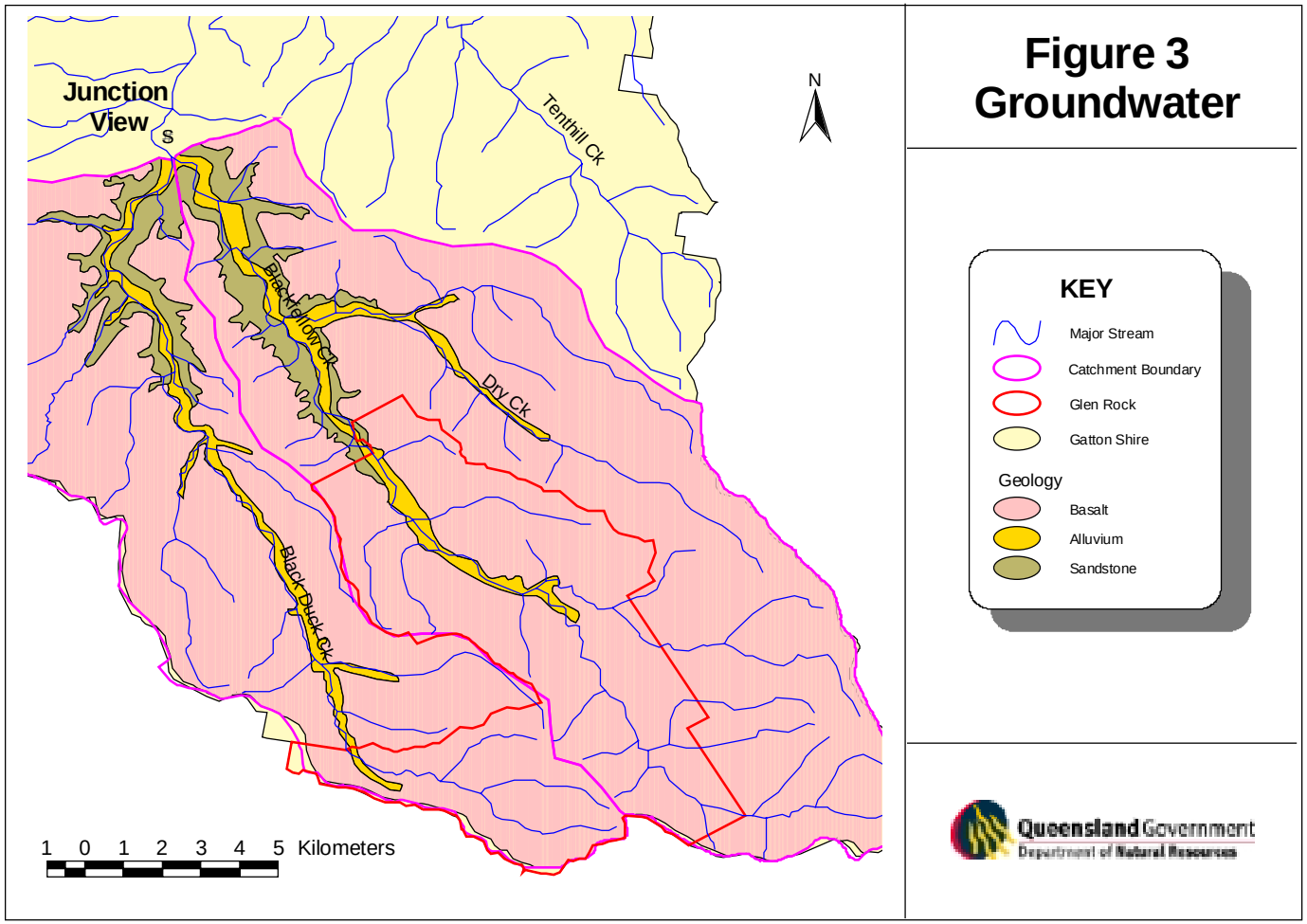
Table 1 Rainfall Statistics

Station	Blackfellows			Rockview		
Number	040297			040605		
Period	1961 - 1966			1919 - 1969		
	Rainfall (mm)			**Rainfall (mm)**		
Month	Max	Mean	Min	Max	Mean	Min
Jan	116	85	34	627	140	18
Feb	70	48	28	576	26	13
Mar	278	154	0	292	103	5
Apr	115	42	2	199	72	1
May	101	41	5	285	72	0
Jun	80	29	4	244	74	0
July	169	56	1	273	70	0
Aug	122	51	30	123	39	1
Sep	75	40	19	98	40	0
Oct	97	57	19	184	63	0
Nov	173	92	37	292	78	14
Dec	183	135	92	445	128	33
Annual	947	818	651	1 531	1 004	598

Table 2 Stream Discharge Statistics

Dam Site Number	Stream	AMTD (km)	Catchment Area (km^2)	Estimated Mean Annual Runoff* (mm)	Estimated Mean Annual Discharge* (ML)
1	Black Duck Creek	19	84	77	5 400
2	Blackfellow Creek	6	70	77	9 200
3	Blackfellow Creek	16	134	69	6 500

*Source: ‘Study of Black Duck and Blackfellow Creek Dam Sites Report’, Vol. 2, GHD, 1990


Junction View
Tenthill Ck
N
Blacktown Ck
Dry Ck
Black Duck Ck
1 0 1 2 3 4 5 Kilometers
Figure 3
Groundwater
KEY
Major Stream
Catchment Boundary
Glen Rock
Gatton Shire
Geology
Basalt
Alluvium
Sandstone
Queensland Government
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A number of small dams have been constructed throughout the property. Most are used for stock watering purposes.

3.3 Groundwater

The principal geological units yielding useful supplies of groundwater are unconsolidated sediments (alluvium) and consolidated rocks (basalt and sandstone). Most of the water used for irrigation and domestic purposes on the property is obtained from the alluvium associated with Blackfellow Creek. Two wells have been constructed adjacent to Blackfellow Creek to augment supply to Glen Rock homestead and the Casuarina Day Use Area. Figure 3 shows the location of groundwater aquifers on the property.

4 APPLICATION OF THE MODEL

4.1 Planning Unit Identifiers (PUIDs)

Seventy-seven planning units were identified within the property. The delineation of PUIDs was based largely on a combination of the vegetation types and recreational opportunities. Figure 4 shows the planning unit boundaries.

4.2 Modifications to the Model

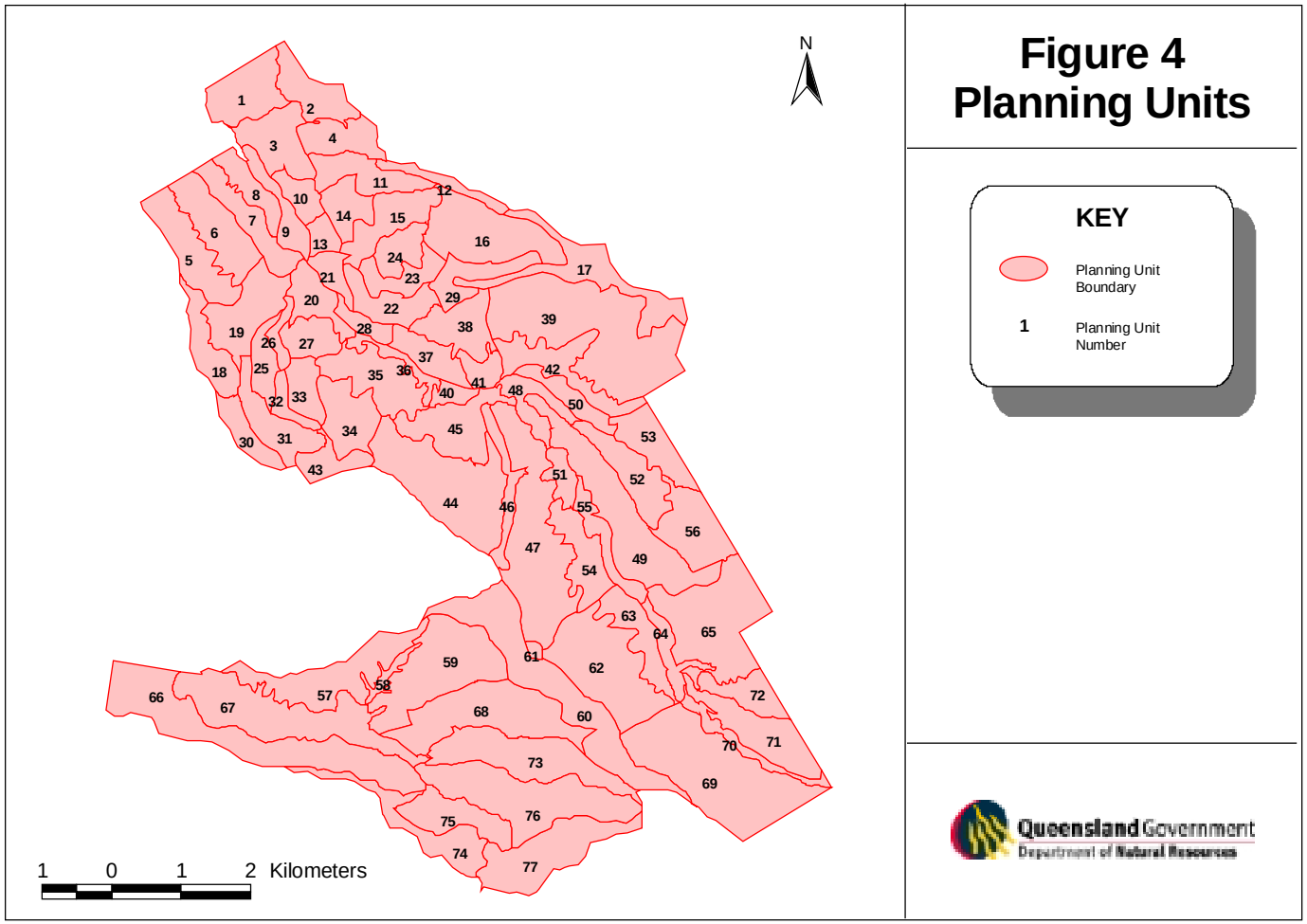
The Resource Assessment Team reviewed the Catchment Protection and Water Production Model developed for forest management planning and determined that modifications were necessary. One area where the model was deemed to be deficient was that it did not take into account the variation in runoff between PUIDs. As a means of addressing this issue, a 'Runoff Factor' was developed for inclusion in the model. This criterion was based on a combination of the average slope and land cover of each PUID. The formula used to calculate the overall rating or score was also revised to take into account this modification.

4.3 Resource Assessment

The baseline information collected during the first and second stages of the planning process was used as input data for the model. Various physical aspects of Glen Rock were considered during the assessment, including rainfall, land use, average slope and runoff. Details of the information sources can be found in Appendix 2.

4.4 Results

Preliminary results of this assessment indicate that PUIDs located adjacent to or in the headwaters of the major streams received the highest Catchment Protection and Water Production ratings. While those PUIDs situated along the boundary of the property generally received lower scores. Planning Unit #1, located at the entrance to Glen Rock had the highest rating (6.9). As shown in Figure 5, this PUID contains the Angophora Day Use Area and is situated adjacent to a couple of swimming holes. Planning Unit #70 also rated highly, achieving a score of 6.3. Ratings for all planning units are shown on Figure 5.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60
61
62
63
64
65
66
67
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77
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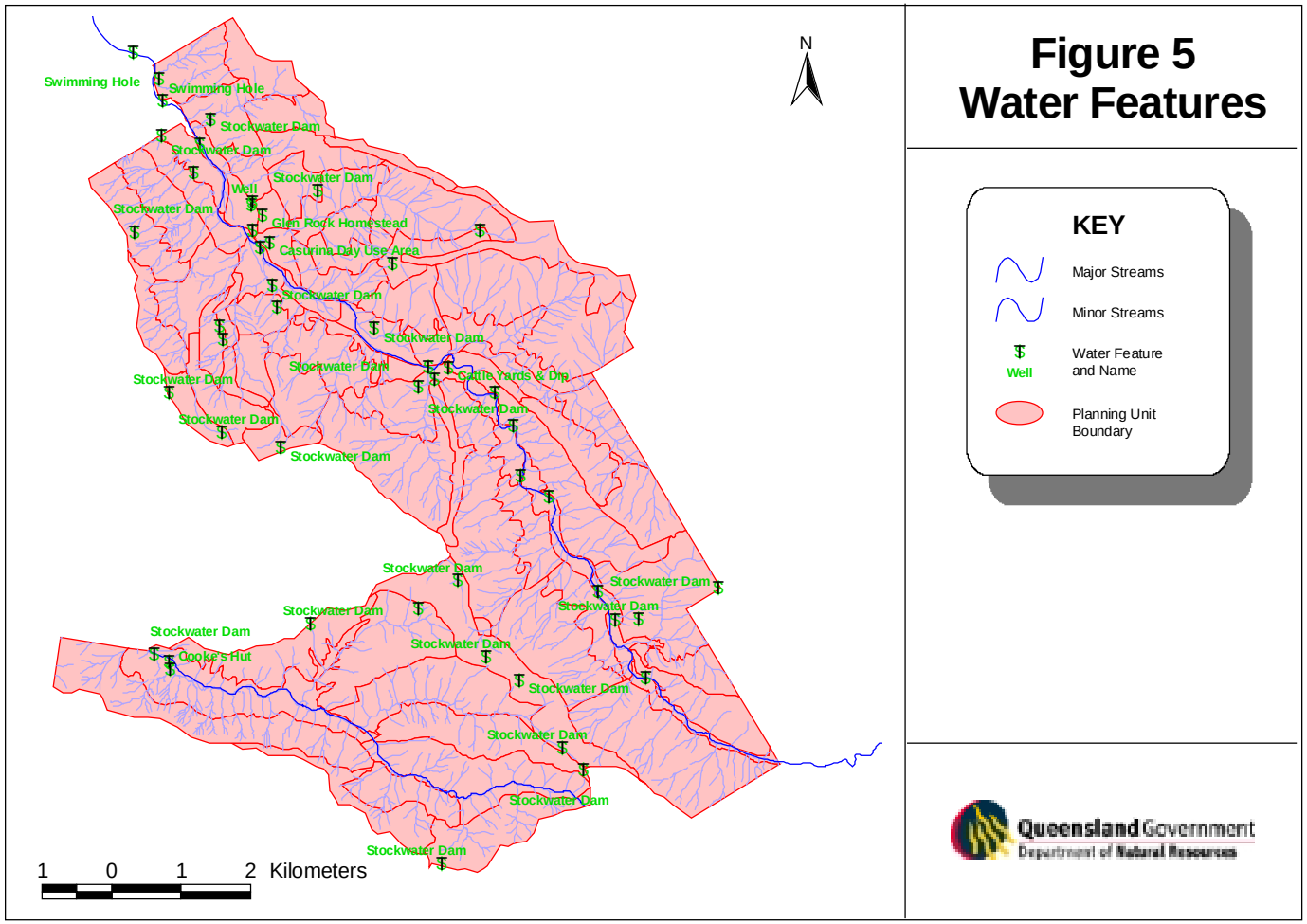
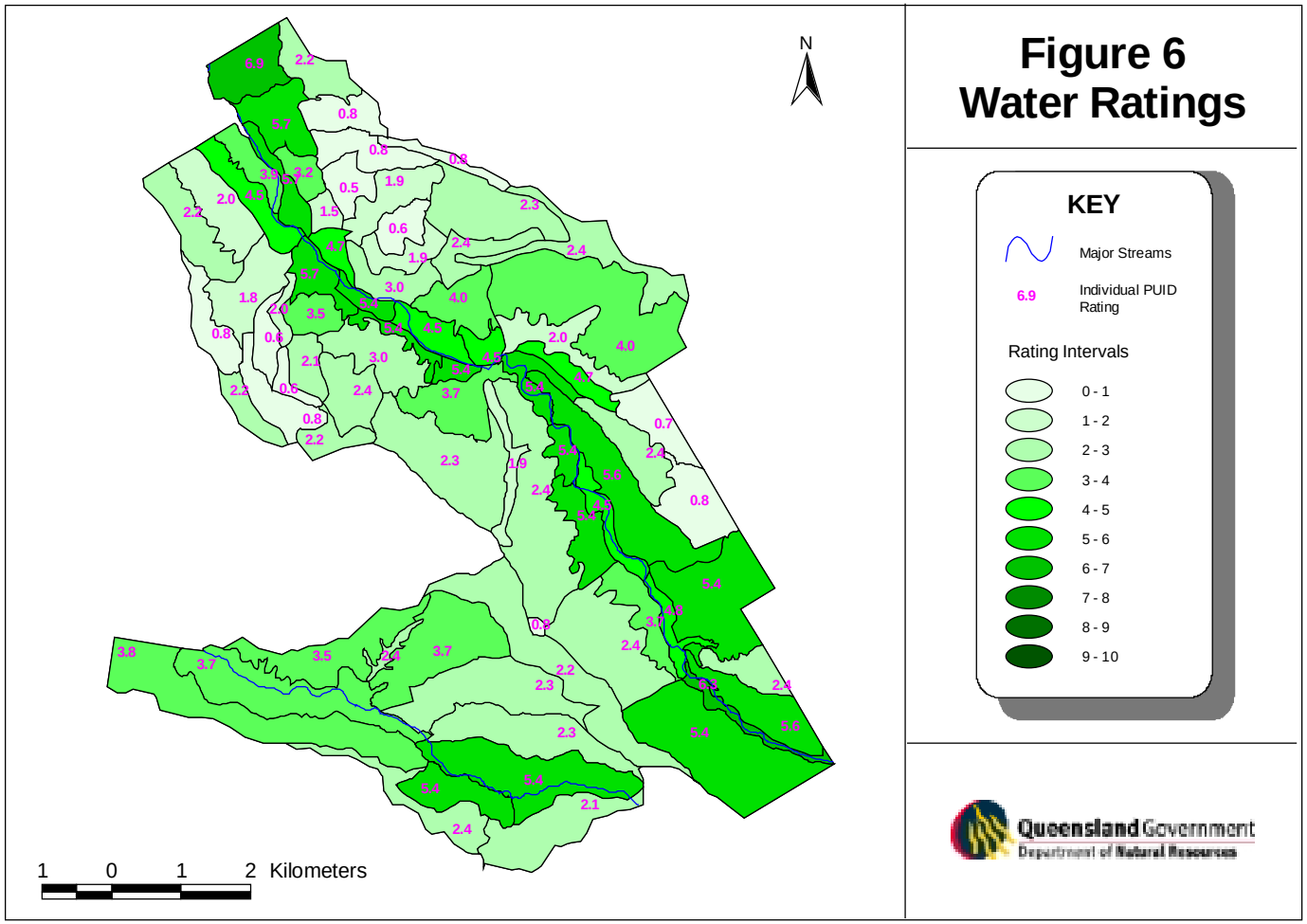
Figure 4
Planning Units
KEY
Planning Unit Boundary
1 Planning Unit Number
Queensland Government
Department of Natural Resources


Swimming Hole
Swimming Hole
Stockwater Dam
Stockwater Dam
Stockwater Dam
Well
Stockwater Dam
Glen Rock Homestead
Casurina Day Use Area
Stockwater Dam
Stockwater Dam
Stockwater Dam
Stockwater Dam
Cattle Yards & Dip
Stockwater Dam
Stockwater Dam
Stockwater Dam
Stockwater Dam
Stockwater Dam
Stockwater Dam
Stockwater Dam
Stockwater Dam
Cooke's Hut
Stockwater Dam
Stockwater Dam
Stockwater Dam
Stockwater Dam
Stockwater Dam
N
1 0 1 2 Kilometers
Figure 5
Water Features
KEY
Major Streams
Minor Streams
Well
Water Feature and Name
Planning Unit Boundary
Queensland Government
Department of Natural Resources


N
1 0 1 2 Kilometers
Figure 6
Water Ratings
KEY
Major Streams
6.9
Individual PUID Rating
Rating Intervals
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
8 - 9
9 - 10
Queensland Government
Department of Natural Resources

APPENDIX 1 WATER MODEL

INTRODUCTION

It is widely accepted that a relationship exists between land use and water quality and quantity. Poor land management practices can adversely impact on the surface water and groundwater resources. For this reason, catchment protection and water production has been identified as one of the key values to consider when undertaking a management planning exercise.

In order to determine the potential impacts of forestry activities/operations on water quality, an assessment model has been developed for inclusion in the Forest Planning process. The Catchment Protection and Water Production Model considers a number of aspects including the potential of the land for producing high quality water and the existing consumptive and non-consumptive users of the water. These criteria are assessed and interact to produce a one-dimensional rating of significance.

It is hoped that this model, along with locally developed criteria, will assist in making informed land use planning decisions.

EXPLANATION OF THE CRITERIA

In order to assess whether or not water quality is likely to be an issue in a particular catchment, a number of factors should be considered. The Catchment Protection and Water Production Model uses five criteria:

- Condition;
- Proportion;
- Runoff factor;
- Filter factor; and
- Water use weighting.

A description of the criteria, their application and relevant relationships within the model are discussed in the following sections.

Condition

Condition relates to the ability of the area to supply high quality water or not contribute to deterioration in water quality.

Past and present land use patterns can influence the condition rating within planning unit identifiers (PUIDs). Condition is proportionate to naturalness.

For example:

- Undisturbed (and unroaded) natural vegetation under a conservation tenure is afforded the highest value;
- PUIDs subject to low intensity timber harvesting and other direct uses are afforded lower values.

This relationship between landscape values and the site condition rating is shown in Table 3.

Proportion
The proportion is derived from the relationship between the areas of the PUID and the respective stream catchment over which the State has management control. Management control refers to land within the catchment, that is managed by DNR or another State government agency such as Queensland Parks and Wildlife Service. This is expressed as a ratio between 0.1 and 1.0, where 0.1 means that 10% or less of the catchment over which the State has management control is contained within the PUID while 1.0 suggests that the entire catchment is contained within the PUID.

Runoff Factor
The runoff factor is designed to take into account the physical features of the PUID such as slope and land cover. Both of these attributes affect the amount of runoff generated within a catchment.

For example, PUIDs that have been cleared and contain steep slopes (>20%) would be afforded the highest value (ie., 10). Whilst PUIDs that haven't been cleared and are located on gently sloping land (<5% gradient) would be assigned lower scores.

The relationship between physical features and the runoff factor is shown in Table 4.

Filter Factor
The filter factor is derived from a consideration of the land use/activity in relation to the distance of the PUID from an area of high water quality importance such as a water storage or important habitat area (eg., Platypus pool), and the likely effect(s) of forestry activities/operations within the PUID on water quality.

The impact of the filter factor on the Water Quality Rating may vary from 0.1 (maximum effect) to 1.0 (minimum effect). For example:

- A 0.1 filter factor would be applied if a land use/activity is a distance of more than 1 kilometre from an intermittent stream or water storage;
- A 1.0 filter factor would be applied if a land use/activity were adjacent (ie., less than 100 metres) to a permanent stream or water storage.

This relationship between distance and watercourse type is shown in Table 5.

Water Use Weighting
Water uses related either to the PUID itself or to downstream consumptive and non-consumptive uses, and whether in-stream or off-stream activities contribute to its significance relative to catchment protection.

End uses associated with the habitat of endangered, vulnerable or rare flora and fauna are assigned the highest water use weighting, as are waters intended for human consumption and recreation.

The relationship between Water Use, Water Quality, Flow Standard and Water Use Weighting is shown in Table 6.

VALUE CALCULATION

The overall Water Quality Rating is calculated using the following formula:

- WQR = [(C + W + R)/3]*F*P

Where:
WQR = Water Quality Rating
C = Condition
W = Water Use Weighting
R = Runoff Factor
F = Filter Factor
P = Proportion

APPLYING THE CRITERIA

The following sections outline the information needs and level of analysis required for each of the five criteria in the Catchment Protection and Water Production Model.

Condition

Land use is an important consideration for this criterion. Current and historical land use information should be collected for the PUID and also the surrounding locality. This material can be obtained from site inspections and through interpretation of aerial photographs, topographic maps and satellite imagery.

Proportion

As previously mentioned, this criterion is based on the ratio of the size of the PUID relative to the area of the catchment over which the State has management control. Catchment area information can be obtained through querying water-related GIS spatial data sets as well as water resource databases and publications.

Runoff Factor

The runoff factor is dependent upon information relating to the physical features of the PUID. As mentioned above, land cover and slope information can be obtained from site inspections and through interpretation of aerial photographs, topographic maps and satellite imagery.

Filter Factor

This criterion will require the identification of the major consumptive and non-consumptive water users in the catchment, situated downstream of the PUID (eg., water storages, platypus pool, swimming hole). You will also need to identify the locations on the watercourse at which those uses/activities occur.

The filter factor should also take into account the stream order and flow characteristics of the watercourse ie., whether it is an ephemeral or perennial stream. For example, if the PUID is located near a permanent watercourse (as opposed to a stream that flows intermittently), then the filter factor should be scaled up accordingly. A diagrammatic representation of stream ordering is contained in Table 2. Definitions of the four stream order classifications are contained in the Glossary.

Water Use Weighting

For this criterion, the water uses/activities identified in the PUID's catchment are weighted. The weightings assigned to the various consumptive and non-consumptive uses are based on a 10-point scale, with urban and environmental uses accorded the highest values (ie., '10'), while agricultural and industrial uses are given the lowest values. In addition to identifying significant consumptive and non-consumptive water users in the catchment, information relating to fauna habitats and stream condition should also be collected.

Table 3 Site Condition Rating Table

SITE CONDITION	RATING (C)
natural – undisturbed	10
natural – limited disturbance (eg., low intensity recreation)	8
natural – limited disturbance (eg., low intensity timber harvesting)	7
semi-natural – partially modified (eg., high intensity recreation)	6
semi-natural – partially modified (eg., high intensity timber harvesting)	4
non-natural – totally modified (eg., rural setting)	2
non-natural – totally modified (eg., urban setting)	0

Table 4 Runoff Factor Table

PHYSICAL FEATURES	SLOPE		
Land Cover	**<5%**	**5 – 20%**	**>20%**
Uncleared	2	5	8
Regrowth	3	6	9
Cleared	4	7	10

Table 5 Filter Factor Table

STREAM ORDER	DISTANCE OF PUID FROM STREAM/WATER STORAGE		
	< 100 m	**100 m – 1 km**	**> 1 km**
Waterway	0.5	0.3	0.1
Gully	0.7	0.5	0.3
Minor stream (eg., creek)	0.9	0.7	0.5
Major stream (eg., river)	1.0	0.8	0.6

Stream Order Definitions

Clarification of what is a river, creek, gully or waterway is based on stream ordering: ie., waterway = stream order 1, gully = stream order 2, creek = stream order 3, and river = stream order 4. This is to be derived from the 1:250 000 scale topographic map series. Figure 1 provides a diagrammatic explanation of stream ordering.

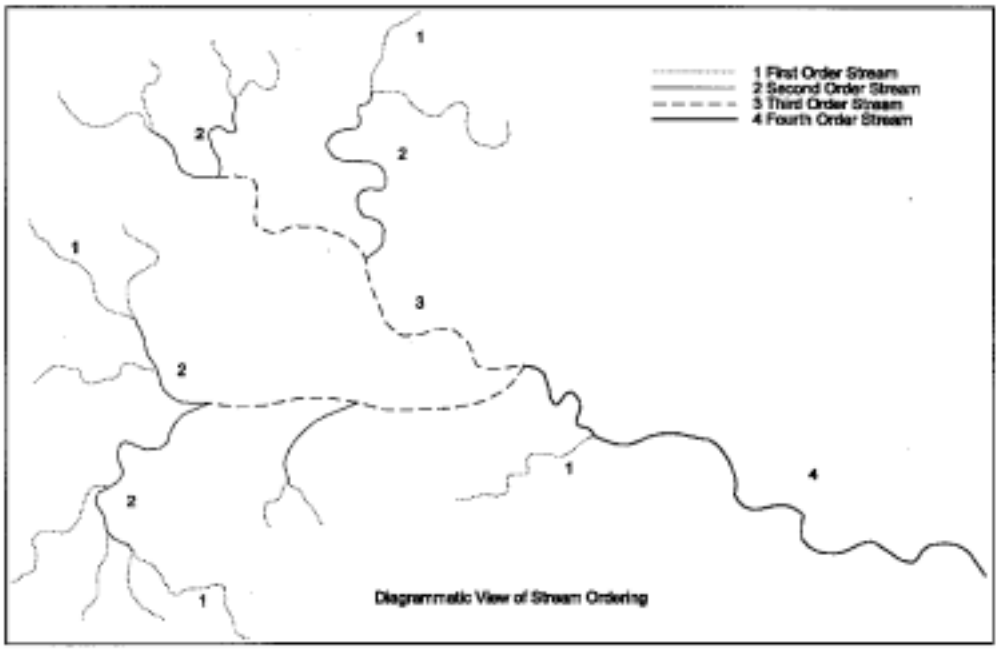


Figure 1 - Stream ordering: When two streams of the same order join, the resulting watercourse becomes one stream order larger. If two streams of different order join, the resultant stream order is that of the larger stream.

(Source: Broadscale Tree Clearing Policy for Leasehold Land, DNR, 1999).

Table 6 Water Use Weighting Table

WATER USE	WATER QUALITY STANDARD	NATURAL STREAM FLOW STANDARD	WATER USE WEIGHTING
Fauna habitat • threatened species • conservation area • unregulated stream/river system • general	very high high high medium	very high high high medium	10 9 9 6
Domestic • untreated • treated	very high high	very high very high	10 8
Stream-based recreation • body contact • non-body contact	very high medium	very high medium	8 5
Water storage-based recreation • body contact • non-body contact	high medium	medium low	8 5
Stock water	high	very high	4
Aquaculture	high	very high	4
Irrigation water	medium	very high	3
Industrial water	medium	very high	3
Landscape amenity	low	low	3

APPENDIX 2 RESOURCE DATA MATRIX

Master PUID No.	Mean Annual Rainfall (mm) [1]	Land Use [2]	Geology [3]	Av. Slope [4] (%)	Stream/ Order (1 - 4)
1	1000	Cleared/regrowth/recreation area	Basalt	28	Blackfellow Ck (2)
2	1050	Regrowth/uncleared	Basalt	54	UT Blackfellow Ck (3)
3	1000	Cleared/regrowth	Basalt	23	UT Blackfellow Ck (3)
4	1050	Regrowth/uncleared	Basalt	57	UT Blackfellow Ck (4)
5	1100	Uncleared	Basalt	43	UT Blackfellow Ck (3)
6	1050	Cleared/regrowth	Basalt	30	UT Blackfellow Ck (3)
7	1000	Cleared	Basalt	17	Blackfellow Ck (2)
8	1000	Cleared - cultivation/improved pasture	Sandstone	6	Blackfellow Ck (2)
9	1000	Cleared - cultivation/improved pasture	Alluvium	6	Blackfellow Ck (2)
10	1000	Regrowth	Basalt	26	UT Blackfellow Ck (3)
11	1100	Regrowth/uncleared	Basalt	53	UT Blackfellow Ck (4)
12	1200	Uncleared	Basalt	63	UT Blackfellow Ck (4)
13	1000	Regrowth	Basalt	18	UT Blackfellow Ck (4)
14	1050	Regrowth/uncleared	Basalt	41	UT Blackfellow Ck (4)
15	1100	Regrowth/uncleared	Basalt	37	UT Blackfellow Ck (3)
16	1200	Regrowth/uncleared	Basalt	56	UT Blackfellow Ck (3)
17	1200	Uncleared	Basalt	39	UT Blackfellow Ck (3)
18	1100	Uncleared	Basalt	67	UT Blackfellow Ck (4)
19	1100	Cleared/regrowth/uncleared	Basalt	36	UT Blackfellow Ck (3)
20	1000	Cleared/regrowth	Alluvium/basalt	10	Blackfellow Ck (2)
21	1000	Cleared/regrowth/recreation area	Alluvium/basalt	11	UT Blackfellow Ck (3)
22	1000	Regrowth/uncleared	Basalt	39	UT Blackfellow Ck (3)
23	1000	Regrowth/uncleared	Basalt	47	UT Blackfellow Ck (4)
24	1050	Regrowth/uncleared	Basalt	39	UT Blackfellow Ck (4)

25	1100	Regrowth/uncleared	Basalt	44	UT Blackfellow Ck (4)
26	1100	Cleared/regrowth	Basalt	31	UT Blackfellow Ck (3)
27	1100	Regrowth/uncleared	Basalt	35	UT Blackfellow Ck (3)
28	1000	Regrowth/cleared - cultivation/improved pasture	Alluvium	10	Blackfellow Ck (2)
29	1100	Uncleared	Basalt	75	UT Blackfellow Ck (3)
30	1100	Uncleared	Basalt	34	UT Blackfellow Ck (3)
31	1100	Uncleared	Basalt	52	UT Blackfellow Ck (4)
32	1100	Regrowth	Basalt	44	UT Blackfellow Ck (4)
33	1100	Regrowth/uncleared	Basalt	45	UT Blackfellow Ck (3)
34	1100	Uncleared	Basalt	55	UT Blackfellow Ck (3)
35	1100	Regrowth	Basalt	35	UT Blackfellow Ck (3)
36	1000	Cleared	Alluvium/basalt	23	Blackfellow Ck (2)
37	1000	Cleared/regrowth	Alluvium/basalt	14	Blackfellow Ck (2)
38	1050	Uncleared	Basalt	45	UT Blackfellow Ck (3)
39	1200	Uncleared	Basalt	58	UT Flaggy Ck (4)
40	1000	Regrowth	Alluvium/basalt	36	Blackfellow Ck (2)
41	1000	Regrowth	Alluvium/basalt	20	Blackfellow Ck (2)
42	1150	Regrowth/uncleared	Basalt	30	UT Flaggy Ck (4)
43	1100	Uncleared	Basalt	46	UT Blackfellow Ck (3)
44	1100	Uncleared	Basalt	49	UT Blackfellow Ck (3)
45	1050	Regrowth	Basalt	34	UT Blackfellow Ck (3)
46	1050	Regrowth/uncleared	Basalt	42	UT Blackfellow Ck (4)
47	1050	Uncleared	Basalt	48	UT Blackfellow Ck (4)
48	1000	Cleared/regrowth	Alluvium/basalt	18	Blackfellow Ck (2)
49	1000	Uncleared	Basalt	43	UT Blackfellow Ck (3)
50	1000	Regrowth/uncleared	Colluvium/basalt	26	Flaggy Ck (3)
51	1000	Regrowth	Basalt	20	Blackfellow Ck (2)
52	1100	Uncleared	Basalt	38	UT Flaggy Ck (4)
53	1100	Regrowth/uncleared	Basalt	31	UT Flaggy Ck (4)

54	1000	Regrowth/uncleared	Basalt	31	UT Blackfellow Ck (3)
55	1000	Cleared/regrowth/uncleared	Basalt	15	Blackfellow Ck (2)
56	1100	Uncleared	Basalt	50	UT Flaggy Ck (4)
57	1050	Uncleared	Basalt	49	UT Black Duck Ck (4)
58	1100	Uncleared	Basalt	65	UT Black Duck Ck (3)
59	1100	Uncleared	Basalt	38	UT Black Duck Ck (3)
60	1100	Uncleared	Basalt	35	Grave Ck (3)
61	1100	Uncleared	Basalt	80	UT Blackfellow Ck (4)
62	1050	Uncleared	Basalt	50	UT Blackfellow Ck (3)
63	1050	Uncleared	Basalt	32	UT Blackfellow Ck (3)
64	1050	Regrowth/cleared	Basalt	15	Blackfellow Ck (2)
65	1050	Uncleared	Basalt	42	Shady Ck (3)
66	900	Uncleared	Basalt	49	UT Black Duck Ck (4)
67	950	Regrowth	Alluvium/basalt	34	Black Duck Ck (2)
68	1100	Uncleared	Basalt	48	UT Black Duck Ck (3)
69	1100	Uncleared	Basalt	47	UT Blackfellow Ck (3)
70	1100	Regrowth/uncleared	Basalt	23	Blackfellow Ck (2)
71	1100	Uncleared	Basalt	47	UT Blackfellow Ck (3)
72	1100	Uncleared	Basalt	43	UT Shady Ck (4)
73	1100	Regrowth/uncleared	Basalt	45	UT Black Duck Ck (3)
74	1100	Uncleared	Basalt	48	UT Black Duck Ck (4)
75	1100	Uncleared	Basalt	55	Black Duck Ck (2)
76	1100	Regrowth/uncleared	Basalt	46	Black Duck Ck (2)
77	1100	Uncleared	Basalt	39	UT Black Duck Ck (4)

***Notes**

1 - 50 Year Mean Annual Rainfall Isohyets for the period 1920 - 1969 (WRC, 1970)
2 - Gatton Shire Vegetation Study (Paul Grimshaw - EPA, 1999), 1:25 000 Mapping
3 - Lockyer Ck Land Degradation Study (DPI, 1978), 1:100 000 Land Units Map
4 - Derived from contour info generated by Colin Wade
5 - Derived using Aussie Grass Model (Wayne Hall - RSK, 2000)
6 - Proportion = 1 because that part of the catchment upstream of Glen Rock is NP

APPENDIX 3 MODEL CRITERIA RATINGS

Master PUID No.	Condition	Runoff 5	Proportion 6	Filter Factor	Water Use Weighting	Score
1	6	9	1.0	0.9	8	**6.9**
2	8	8	1.0	0.3	6	**2.2**
3	6	9	1.0	0.9	4	**5.7**
4	9	8	1.0	0.1	6	**0.8**
5	10	8	1.0	0.3	4	**2.2**
6	5	9	1.0	0.3	6	**2.0**
7	2	7	1.0	0.9	6	**4.5**
8	2	7	1.0	0.9	4	**3.9**
9	2	7	1.0	0.9	10	**5.7**
10	4	9	1.0	0.5	6	**3.2**
11	9	8	1.0	0.1	6	**0.8**
12	10	8	1.0	0.1	6	**0.8**
13	5	6	1.0	0.3	4	**1.5**
14	3	9	1.0	0.1	4	**0.5**
15	6	9	1.0	0.3	4	**1.9**
16	9	8	1.0	0.3	6	**2.3**
17	10	8	1.0	0.3	6	**2.4**
18	10	8	1.0	0.1	6	**0.8**
19	5	9	1.0	0.3	4	**1.8**
20	5	6	1.0	0.9	8	**5.7**
21	6	6	1.0	0.7	8	**4.7**
22	3	9	1.0	0.5	6	**3.0**
23	4	9	1.0	0.3	6	**1.9**
24	5	8	1.0	0.1	6	**0.6**
25	4	9	1.0	0.1	4	**0.6**

26	5	9	1.0	0.3	6	**2.0**
27	7	8	1.0	0.5	6	**3.5**
28	5	7	1.0	0.9	6	**5.4**
29	10	8	1.0	0.3	6	**2.4**
30	10	8	1.0	0.3	4	**2.2**
31	10	8	1.0	0.1	6	**0.8**
32	3	9	1.0	0.1	6	**0.6**
33	7	8	1.0	0.3	6	**2.1**
34	10	8	1.0	0.3	6	**2.4**
35	3	9	1.0	0.5	6	**3.0**
36	2	10	1.0	0.9	6	**5.4**
37	5	6	1.0	0.9	4	**4.5**
38	10	8	1.0	0.5	6	**4.0**
39	10	8	1.0	0.5	6	**4.0**
40	3	9	1.0	0.9	6	**5.4**
41	3	6	1.0	0.9	6	**4.5**
42	5	9	1.0	0.3	6	**2.0**
43	10	8	1.0	0.3	4	**2.2**
44	9	8	1.0	0.3	6	**2.3**
45	3	9	1.0	0.7	4	**3.7**
46	7	8	1.0	0.3	4	**1.9**
47	10	8	1.0	0.3	6	**2.4**
48	6	6	1.0	0.9	6	**5.4**
49	10	8	1.0	0.7	6	**5.6**
50	5	9	1.0	0.7	6	**4.7**
51	3	9	1.0	0.9	6	**5.4**
52	10	8	1.0	0.3	6	**2.4**
53	6	8	1.0	0.1	6	**0.7**
54	9	8	1.0	0.7	6	**5.4**

55	3	6	1.0	0.9	6	**4.5**
56	10	8	1.0	0.1	6	**0.8**
57	9	8	1.0	0.5	4	**3.5**
58	10	8	1.0	0.3	6	**2.4**
59	10	8	1.0	0.5	4	**3.7**
60	10	8	1.0	0.3	4	**2.2**
61	10	8	1.0	0.1	6	**0.8**
62	10	8	1.0	0.3	6	**2.4**
63	8	8	1.0	0.5	6	**3.7**
64	4	6	1.0	0.9	6	**4.8**
65	9	8	1.0	0.7	6	**5.4**
66	9	8	1.0	0.5	6	**3.8**
67	3	9	1.0	0.7	4	**3.7**
68	9	8	1.0	0.3	6	**2.3**
69	9	8	1.0	0.7	6	**5.4**
70	7	8	1.0	0.9	6	**6.3**
71	10	8	1.0	0.7	6	**5.6**
72	10	8	1.0	0.3	6	**2.4**
73	9	8	1.0	0.3	6	**2.3**
74	10	8	1.0	0.3	6	**2.4**
75	9	8	1.0	0.7	6	**5.4**
76	9	8	1.0	0.7	6	**5.4**
77	9	8	1.0	0.3	4	**2.1**

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GLOSSARY OF TERMS

Alluvium	Unconsolidated water borne sediments associated with streams.
AMTD	Adopted Middle Thread Distance. The distance in kilometres from the most downstream point on a watercourse.
Aquifer	An underground layer which holds water and allows water to pass through it.
Catchment	The area determined by topographic features within which rainfall will contribute to runoff.
Consumptive use	The use of water by people for purposes such as urban supply, irrigation or stock watering, resulting in the total removal of water from the water resource from which it is taken.
Ephemeral stream	A stream that flows briefly and only in direct response to rainfall.
Gully	Water flow is intermittent and may occur during or immediately after periods of heavy rain. Stream bed has evidence of soil erosion/deposition and/or incision.
Major stream	Water flow is permanent, semi-permanent or > 1 month per year in most years. Is a locally known water source that may contain waterholes or a series of waterholes (eg., river).
Megalitre	A volume of one million litres or one thousand cubic metres. This is equivalent to a depth of 100 millimetres over a hectare.
Minor stream	Water flow is intermittent and may occur during or for some time after periods of heavy rain. Waterholes are generally absent, but the (dry) stream bed has characteristic vegetation indicating frequent recharge of shallow groundwater aquifers (eg., creek).
Non-consumptive use	The use of water for beneficial uses such as recreation, environmental flow requirements or hydro-electric power generation, resulting in the non-removal of water from the water resource from which it is taken
Perennial stream	A permanently flowing stream
Runoff	That portion of rainfall not immediately absorbed into or detained on the soil and which thus becomes a surface water flow

Stream order	A stream hierarchy classification system, based on bed and bank characteristics as well as flow patterns
Unregulated stream	A stream where natural flow is not regulated by surface water storages (ie., dams, weirs etc.).
Waterways	Water may flow after heavy rain and the area may be seasonally waterlogged with ground vegetation indicative of a wetter microclimate.
Yield	The rate of extraction of water from a storage or aquifer. Yield is usually expressed as megalitres per annum.