

### **Murray Darling Basin Authority**

Constraints Management Strategy Prefeasibility - Goulburn Estimate of the cost to establish easements

5 December 2014

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### **Executive summary**

This report provides an estimate of the costs of acquiring easements on private agricultural land that might be required to secure an ongoing right to make overbank flows in the Goulburn River, one of the regions relevant to the Constraints Management Strategy (CMS). For the purposes of this analysis, the reach was divided into upper and lower segments each with four sub-reaches. The upper sub-reaches extend from Eildon Dam to Mitchellstown and the lower sub-reaches extend from Mitchellstown to Echuca.

Implementation of the CMS could change the frequency, duration, seasonality and extent of overbank flows from current patterns. These changes to flows could cause third party impacts.

The CMS is considering what the impacts might be from changes in frequency, timing and duration of flows along the Goulburn reach. In the Goulburn River, the flow rates under consideration are 12,000 ML/day, 15,000 ML/day and 20,000 ML/day for the upper sub-reaches (measured downstream of Lake Eildon) and 25,000 ML/day, 30,000 ML/day and 40,000 ML/day for the lower sub-reaches (measured downstream of Goulburn Weir). Flows at these rates would increase the area of inundated agricultural land. This report shows the increase in the extent of inundated agricultural land for these flows and assesses the impact on agricultural production and economic consequences. Based on these outcomes, the report estimates the costs to purchase easements on the land for the right to deliver the managed flows.

GHD obtained information on the impacts of different flow rate scenarios in the Goulburn River from analysis by Water Technology (2014) for the MDBA. GHD categorised the area of inundation by agricultural land use and the table below shows the inundated areas for the upper and lower sub-reaches by land use type for the relevant flow bands. The areas indicate the marginal increase in inundation for each flow band. For flows up to 20,000 ML/day in the upper Goulburn and flows up to 40,000 ML/day in the lower Goulburn, the total area of private agricultural land inundated is 6,838 hectares (1,201 ha in the upper sub-reaches and 5,637 ha in the lower sub-reaches). The areas inundated of higher value land use (cropping and horticulture) are relatively small but are likely to be overestimates based on preliminary additional analysis completed by GHD.

	Area adopted as inundated (ha) for modelling purposes, by flow band (ML/day)						
Land Use (ha)	Upper Goulburn (sub-reaches A- D)			Lower Goulburn (sub reaches E-H)			Total (ha)
	Bank full to 9,000	12,000 to 15,000	15,000 to 20,000	20,000 to 25,000	25,000 to 30,000	30,000 to 40,000	
Grazing Tolerant Pasture	152	124	254	631	1195	1047	3403
Grazing Vulnerable Pasture	114	109	201	166	303	282	1175
Dryland Broadacre Cropping	6	1	20	151	451	515	1144
Irrigated Pasture	62	32	38	86	258	326	802
Other Fruit	0	0	0	28	11	72	111
Grapes	0	0	0	0	30	29	59
Vegetables	57	10	20	0	3	0	90
Intensive Agriculture	1	0	0	17	28	8	54
Total	392	276	533	1079	2279	2279	6838

In addition to land being directly inundated, flooding also interrupts access to land that is not inundated (eg flood runners cause road closures which limits access for completing crop and livestock husbandry and marketing activities). For the purposes of the CMS prefeasibility analysis, the area of interrupted access land has been assumed to be a ratio of 0.3 of the inundated land area with land use in the same proportion as inundated land.

For the lower Goulburn reach, inundation is protected to some extent by levees, however the inundation areas presented above include both inside and outside levee inundation. GHD analysed data from Water Technology (2014) and additional shapefiles provided by MDBA to identify that the majority of land inundated outside the levees is within sub-reach H and that the proportions of total land inundated occurring outside the levees varies for the different flow bands as shown below (sub-reach H only). GHD separately calculated easement costs for sub-reach H to distinguish between inside and outside levee costs (see later). This information will assist the MDBA and Basin States to determine if works on levees to prevent inundation occurring outside the levees is an option that should be explored further in the feasibility phase.

	>20,000 ML/day	>25,000 ML/day	>30,000 ML/day
	and ≤25,000	and ≤30,000	and ≤40,000
	ML/day	ML/day	ML/day
Proportion of inundated land outside the levee	0.74	0.40	0.32

MDBA provided GHD with hydrological modelling data to show the change in occurrence (number of events over a modelled 114-year period) between baseline conditions and a modelled CMS flow regime scenario for downstream of Goulburn Weir (ie for sub-reaches E to H), represented by modelling outputs from the MDBA's "BP2800RC" model run as shown below.

	Flow band	Duratio	on ≥ 1 day & :	≤ 7 days	Duration > 7 days		
_	ML/day	Jun-Jul	Aug-Sep	Oct-Nov	Jun-Jul	Aug-Sep	Oct-Nov
Events over	> 20,000 ≤ 25,000	7	-22	6	0	10	1
114 vears	> 25,000 ≤ 30,000	10	-9	-9	7	13	8
,	> 30,000 ≤ 40,000	4	-9	6	4	7	0

Similar hydrological modelling for the upper sub-reaches (A-D) was not available and therefore GHD adopted increases in flows for reaches A-D of 11.4 in the number of all events by season, duration and flow over a 114 year period. These changes in the number of events in reaches A through D have been adopted on the basis that they are broadly comparable to the modelled increase in the number of events in reaches E through H.

The change in the number of events for different seasons and durations is provided because of the differential impacts that such changes in inundation have on pastures and crops. In summary, short duration inundation ( $\leq$  7 days) has less impact on pasture and crop growth compared to longer duration (> 7 days) in all seasons with the impacts increasing as the seasons advance from June/July to October/November.

GHD adopted gross margins for each land use type and then quantified the impacts on each gross margin from the changed duration and season of flooding. In addition, other costs associated with flooding were identified and quantified (eg clean-up costs, pasture restoration costs). The difference in costs between the post-CMS and pre-CMS flow regimes were calculated as a percentage to reflect the "degree of affectation" associated with the new flow regime. This degree of affectation was applied to the agricultural land worth for each land use type in each sub-reach to calculate an estimate of the cost of easements.

Note that GHD has calculated easement costs assuming that any benefits that may accrue to landholders as a result of a reduction in flow events (for example, the "-22" flow events in the Aug-Sep column in the table above) would not be reflected in the costs of easements. In other words, the costs of easements would reflect only the *negative* impacts of changes in flows.

The estimate of the one-off easement costs for the **upper** Goulburn reach for both inundated and interrupted access land, including a contingency of 10%, is shown in the table below. The table shows the marginal cost for each of the three flow bands. If the decision was made to adopt a flow rate in the upper Goulburn of 20,000 ML/day, the easement cost (excluding negotiation and legal costs) would be **\$2,591,880** (ie the sum of costs for inundated and interrupted access land for the three flow bands).

Flow Band	>Bank-full flow and ≤12,000 ML/day		>12,000 a ML	nd ≤15,000 /day	>15,000 and ≤20,000 ML/day	
	Inundated	Interrupted	Inundated	Interrupted	Inundated	Interrupted
Marginal easement cost	\$739,006	\$41,261	\$538,269	\$25,637	\$963,966	\$48,114
Contingency (%)	10%	10%	10%	10%	10%	10%
Marginal Contingency cost	\$73,901	\$4,126	\$53,827	\$2,564	\$96,397	\$4,811
Marginal Total easement cost	\$812,907	\$45,387	\$592,096	\$28,201	\$1,060,363	\$52,926

The estimate of the one-off easement costs for the **lower** Goulburn reach for both inundated and interrupted access land, including a contingency of 10%, is shown in the table below. The table shows the marginal cost for each of the three flow bands. If the decision was made to adopt a flow rate in the lower Goulburn of 40,000 ML/day, the easement cost (excluding negotiation and legal costs) would be **\$3,183,393** (ie the sum of costs for inundated and interrupted access land for the three flow bands). This includes the cost of inundation inside and outside the levees. If the easement costs for the lower Goulburn were restricted to inside the levee, GHD estimates the cost of easements (excluding negotiation and legal costs) to be **\$2,409,728** (ie \$773,665 less as a result of removing impacts due to inundation outside the levees).

Flow Band	>20,000 and ≤25,000 ML/day		>25,000 ar ML/	nd ≤30,000 ′day	>30,000 and ≤40,000 ML/day	
	Inundated	Interrupted	Inundated	Interrupted	Inundated	Interrupted
Marginal easement cost	\$451,951	\$26,560	\$1,520,315	\$101,947	\$744,912	\$48,311
Contingency (%)	10%	10%	10%	10%	10%	10%
Marginal Contingency cost	\$45,195	\$2,656	\$152,031	\$10,195	\$74,491	\$4,831
Marginal Total easement cost	\$497,146	\$29,215	\$1,672,346	\$112,141	\$819,403	\$53,142

The report includes sensitivity analyses to consider +/- 20% changes in adopted values for agricultural land worth, clean-up costs, flow frequencies, interrupted access ratio and the area of land inundated.

If the decision is made to purchase easements there will be additional costs associated with negotiation with landholders and legal costs. If these are assumed to be \$5,000 per property for approximately 150 properties affected in the upper reach and 150 affected in the lower reach, this represents an additional \$750,000 for both the upper and lower portions of the Goulburn reach.

The total cost for easement in the upper sub-reaches of the Goulburn, including the negotiation and legal costs, would therefore be **\$3,341,880** (\$2,591,880 + \$750,000).

The total cost for easement in the lower sub-reaches of the Goulburn, including the negotiation and legal costs, would therefore be **\$3,933,393** (\$3,183,393+ \$750,000) for both inside and outside the levees.

If a decision was made to purchase easements inside the levees only, and assuming 130 landholders are inside the levees within sub-reaches E to H, the total cost for easement in the lower sub-reaches of the Goulburn, including the negotiation and legal costs, inside the levees would therefore be **\$3,059,728** (\$2,409,728 + \$650,000).

The combined **upper and lower** Goulburn total costs are estimated as **\$7,275,273** if both inside and outside the levees are included, or **\$6,401,608** if inundation outside the levees is excluded.

The above estimates are subject to a number of caveats. In preparing these assessments, GHD relied on a desktop-based analysis, drawing on Water Technology (2014) analysis, modelled inundation extents at the flow rates considered, and publicly available GIS-based spatial data on land use. There are inherent limits to the resolution of such datasets at a local level. GHD also used generalised values for modelling inputs such as land values, agricultural gross margins, and impacts. In reality, these values would vary from property to property. Furthermore, some of these inputs are robust in relation to the Goulburn CMS region and others are best estimates sourced from more general data and experiences of the consultants. A list of caveats is provided in the report and considerations for increasing the robustness of assumptions should be adopted if the CMS extends beyond the pre-feasibility stage.

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- Appendix B Holmes and Sackett Report Extract
- Appendix C Rapid Appraisal Method (RAM) For Floodplain Management

1. Introduction

#### **1.1 Purpose of this report**

This report provides an estimate of the costs of acquiring easements on private agricultural land that might be required to secure an ongoing right to make overbank flows in the Goulburn River, one of the regions relevant to the Constraints Management Strategy (CMS).

Implementation of the CMS could change the frequency, duration, seasonality and extent of overbank flows from current patterns. These changes to flows could cause third party impacts.

This report is based on the methodology titled Easement Costing Methodology dated 27 August 2014 prepared for MDBA by GHD.

#### **1.2 Scope and limitations**

This report has been prepared by GHD for the Murray Darling Basin Authority and may only be used and relied on by the Murray Darling Basin Authority for the purpose agreed between GHD and the Murray Darling Basin Authority as set out in section 1.1 of this report. GHD otherwise disclaims responsibility to any person other than the Murray Darling Basin Authority arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

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# 2. Background to the Goulburn CMS Reach

#### 2.1 Agricultural land use in the Goulburn

The Goulburn River is one of the River Murray's largest tributaries, providing 11% of the wider basin flow. The Goulburn Broken Catchment as a whole covers 2.4 million hectares with around two-thirds under private ownership. For the purposes of this project, the system commences at Eildon Dam before and flows in a north westerly direction before entering the Murray River at Echuca.

For the purposes of analysis to inform the CMS, the Goulburn River has been divided into eight sub-reaches as follows (see section 2.3 for location map):

Upper sub-reaches

- Sub-reach A Eildon Dam to Alexandra
- Sub-reach B Alexandra to Yea
- Sub-reach C Yea to Kerrisdale
- Sub-reach D Kerrisdale to Mitchellstown

#### Lower sub-reaches

- Sub-reach E- Mitchellstown to Murchison
- Sub-reach F Murchison to Toolamba
- Sub-reach G Toolamba to Undera
- Sub-reach H Undera to Echuca

The region supports a variety of productive enterprises. Dryland grazing is the dominant land use, however cropping, dairying, horticulture and viticulture exist along the system, as well as wider food processing, tourism and recreational (not included in this analysis). The combined value of all natural resource-based activities (including forestry) in the catchment is estimated at \$15.2 billion per year, and accounts for 22% of all employment in the region (Goulburn Broken CMA Annual Report 2012-13). Approximately 20% of the total value of Victoria's agricultural production is generated in this region, signifying the productive attributes of the land within this region.

#### 2.2 Flooding

The agricultural land along the reach is subject to flooding as a result of both natural and managed events when overbank flows occur. Flooding can bring both positive and negative impacts on agricultural production with the net effect depending on the agro-ecological zone and agricultural enterprise under consideration. Positive effects may include increased pasture production resulting from short duration flooding within the June to November period. Negative effects relate to the inability to graze pastures until flood water recedes, damage to pasture and crop yields from longer duration flooding in later seasons, infrastructure (fences) damage and debris clean-up costs.

The CMS is considering what the impacts might be from changes in frequency, timing and duration of flows at a range of maximum daily flow rates. In the Goulburn River, the flow rates under consideration are 12,000 ML/day, 15,000 ML/day and 20,000 ML/day for the upper sub-reaches (measured downstream of Lake Eildon) and 25,000 ML/day, 30,000 ML/day and 40,000 ML/day for the lower sub-reaches (measured downstream of Goulburn Weir). These

flow rates under investigation range from bank full to small overbank flows around the minor flood level. Flows at these rates would increase the area of inundated agricultural land. This report shows the increase in the extent of inundated agricultural land for these flows and assesses the impact on agricultural production and economic consequences. Based on these outcomes, the report estimates the costs to purchase easements on the land for the right to flood.

#### 2.3 Goulburn River map by sub-reach

Figure 1 shows the Goulburn River system and the boundary of the corresponding sub-reaches considered in this report. This map is sourced directly from Water Technology analysis, as presented in their November 2014 report.<sup>1</sup> Note that the source of the map for the Goulburn is different to in the other reaches being considered for the CMS, for which the MDBA provided GIS data layers to GHD.

<sup>&</sup>lt;sup>1</sup> Analysis of Goulburn River Constraints Modelling (November 2014), prepared by Water Technology Pty Ltd for MDBA.





Note: Map sourced from Water Technology (November 2014), page 32.

### 3. Brief Overview of Method

#### 3.1 The issue

Implementation of the CMS could change the frequency, duration, seasonality and extent of overbank flows from current patterns. These changes to flows could cause third party impacts.

Impacts to agriculture could potentially arise from changes to inundation (additional areas/longer duration), elevated water table, seepage, erosion and interrupted access. More significant impacts would occur if flows cross various key thresholds, particularly in regard to duration of inundation and growing season.

#### 3.2 Why estimate the cost of easements?

Easements have been used in the Murray-Darling Basin to secure rights from landholders to flood and erode land, deposit sediment, cause water logging and impede access to private land as a result of changed flooding regimes that can increase the duration and frequency of inundation. Some examples of previous easements include:

- Murray River between Hume Dam and Lake Mulwala;
- Mitta Mitta ex-gratia relief project;
- Mulwala surcharge easements; and
- Other easements created by state agencies.

If the CMS is implemented the MDBA and Basin States could determine that easements be established to reflect an ongoing right to release overbank flows to meet environmental objectives.

If easements are established, the terms of the easement would spell out the conditions and limits of the rights of environmental water managers. The easement would be recorded on title and entitle the responsible water manager to make releases within the limits stated in the conditions. The present rights of floodplain landholders would be preserved in relation to all management activities not specified in the easement. Easements would not be compulsorily acquired.

Compensation would be paid, as a single one-off payment, to acquire the easements. In other non-compulsory easement acquisition instances (eg Hume Dam to Lake Mulwala), the process involved extensive discussions between the affected parties and the water authority leading to an agreed process for assessing the level of compensation. The agreed process details were made available to all affected landholders and were applied consistently.

In this case, an easement registered on title will record the lasting right to change overbank flow characteristics within defined boundaries.

#### 3.3 Estimating the cost of easements

Agricultural enterprises conducted on the floodplain including grazing and cropping are particularly sensitive to duration of inundation and the advance of the growing season. Therefore, the cost of easements would primarily reflect the impacts on these agricultural activities. It is important to recognise that the cost of easements would reflect the marginal impacts that may result from the differences between current flow patterns and possible changes to flow patterns if the CMS was implemented. The flow characteristics of interest are volume (ML/day) that affects the area inundated, duration (number of days land is inundated), season (time of year) and frequency (number of events per decade).

The acquisition of easements would involve private land and exclude public land (Crown land) on the basis that public land is not a traded asset and hence does not depreciate or appreciate in value in response to changes flow regimes. The costing methodology does not anticipate dealing with floodplain businesses such as caravan parks, leisure enterprises and extractive businesses by way of easements.

#### **3.4 Process to arrive at easement cost**

The information required to prepare an estimate of the cost to acquire an easement is outlined below:

#### Step A: Base line

- Existing agricultural land use type and area (ha) is measured from footprints identified from Lidar data combined with ACLUMP land use data affected by a range of flows
- Average annual rainfall data for the floodplain which influences stocking rates and crop yields
- Indicative enterprise gross margins from stocking rates and crop yields by reaches are adopted
- Gross margins and land use areas are combined to generate aggregate gross margins by each CMS reach and sub-reach.

#### Step B: Flow Characteristics

- Consider the baseline flow characteristics (volume, duration, season and frequency);
- Consider the flow characteristics that may result from implementation of the CMS (volume, duration, season and frequency); and
- Calculate the marginal changes in terms of volumes, duration, season and frequency.

#### Step C: Flow Impacts

- Quantify the impacts on each land use gross margin from the changed duration and season
- Identify the marginal changes in areas affected and the marginal impact from changed frequency
- Consider the possibility of changed land use in response to the changed flow regime
- Apply marginal changes to the areas affected to generate a post CMS gross margin by reach
- Identify and quantify additional impacts eg clean up, interrupted access, interrupted management, cost of mitigation.

#### Step D: Degree of affectation

- Subtract the post CMS (affected) reach gross margin from the pre CMS (unaffected) reach gross margin
- Express the difference as a percentage of the pre CMS reach gross margin
- Adopt the percentage as the degree of affectation.

#### Agricultural land worth

- Review recent land sales and disaggregate into components: that portion that relates to productivity; buildings/infrastructure; and amenity/lifestyle
- Establish the appropriate relationship between land use productivity (stocking rates and crop yields) and agricultural land worth
- Adopt an agricultural land worth (\$/ha) by land use and sub-reach.

#### Easement cost

- Apply the degree of affectation to the agricultural land worth
- Add consideration for the cost to establish easements (contingency and implementation costs) based on experiences noted in section 3.2
- Prepare final estimate of costs of easements, including sensitivity analysis.

### 4. Data Sources

This section provides an outline of the data obtained through the MDBA and other sources.

#### 4.1 Input data provided by MDBA

#### 4.1.1 Impacts of flow rate scenarios

- a. GHD obtained information on the impacts of different flow rate scenarios in the Goulburn from Water Technology (2014) analysis for the MDBA.<sup>2</sup> The Water Technology analysis presented information including:
  - Areas of land inundated (in hectares) by modelled flow rate (ML/day) by sub-reach (A through H)
  - Land use type (eight categories) for the areas of land inundated
  - Assessment of area inundated, by land use type, inside and outside the levee system in the Lower Goulburn.
- b. The Water Technology analysis presented this information for the following modelled flow rates and sub-reaches:
  - Flows of up to 12,000 ML/day, 15,000 ML/day and 20,000 ML/day in the upper subreaches (A-D)
  - Flows above 20,000 ML/day and up to 25,000 ML/day, 30,000 ML/day and 40,000 ML/day for the lower sub-reaches (E-H).
- c. This methodology differs to the approach taken in other CMS reaches, for which GHD extracted information on the impacts of different flow rate scenarios by analysing GIS shapefiles provided by the MDBA, of (i) modelled inundation footprints at different flow rates and (ii) land use and management information from the Australian Collaborative Land Use and Management Program (ACLUMP).
- d. Water Technology (2014) extracted inundated land by sub-reach for private land from the above which shows the increase in inundated area along the upper sub-reaches of 598 hectares for bank full flows to 12,000 ML/day, 375 hectares for flows from 12,000 ML/day up to 15,000 ML/day and 735 hectares for flows from 15,000 ML/day up to 20,000 ML/day. For the lower sub-reaches there is an increase of 3,469 hectares for flows from 20,000 ML/day up to 25,000 ML/day, 1,656 hectares for flows from 25,000 ML/day up to 30,000 ML/day and 4,677 hectares for flows of 30,000 ML/day up to 40,000 ML/day (Table 1).

Table 1 shows the marginal area of affected land highlighted in green, for each sub-reach by the flow bands that are being considered by the CMS, as calculated from Table 4-3 to Table 4-8 in the Water Technology (2014) report<sup>3</sup>. Note that GHD has assumed inundation at reach E for flows of 25,000 ML/day as the mean of 20,000 ML/day and 30,000 ML/day, as the inundation extent at this flow band is absent from the Water Technology report.

Table 1 includes inundation area of non-agricultural land (eg services, river etc). The assessment of impacts on non-agricultural land is outside GHD's scope for this project.

<sup>&</sup>lt;sup>2</sup> The MDBA commissioned Water Technology to undertake analysis of results obtained from Water Technology hydrologic models constructed from previous Goulburn River Environmental Flow Hydraulics studies (Water Technology 2010 and 2011), to inform the CMS prefeasibility phase. The Water Technology analysis from this work was provided to GHD to inform their analysis. Water Technology subsequently consolidated their analysis into a November 2014 report for the MDBA, *Analysis of Goulburn River Constraints Modelling*.

<sup>&</sup>lt;sup>3</sup> Note that no detail is available on the inundation by land use at each sub reach and flow band across agricultural and non-agricultural related activities within the Water Technology (2014) report.

Table 1 Inundated land	(ha) by sub-reach #	and flow (bank	full flow to 40,000
ML/day)			

		Flow scenario (ML/day)							
	Bank-full – 12,000	12,000 – 15,000	15,000 – 20,000	20,000 – 25,000	25,000 – 30,000	30,000 – 40,000			
Sub- reach A	241	218	95						
Sub- reach B	52	83	447						
Sub- reach C	154	25	56						
Sub- reach D	151	49	137						
Sub- reach E				161	161	285			
Sub- reach F				864	56	713			
Sub- reach G				405	166	291			
Sub- reach H				2039	1273	3388			
Total (Ha)	598	375	735	3469	1656	4677			

Water Technology analysed the above data to prepare a land use table that reports on agricultural land use. The adopted areas of marginal land use for each flow band used in GHD's assessment are shown in Table 2 to Table 7. These land areas were sourced from the relevant flow and land use in Tables 3-6 to 3-13 of the Water Technology (2014) report except for sub-reach C. The areas in Table 2 to Table 7 for sub-reach C are sourced from Table 4-1 of the Water Technology (2014) report.<sup>4</sup>

<sup>&</sup>lt;sup>4</sup> The inundation totals for sub-reach C were re-mapped by Water Technology due to an inconsistency in the modelled inundation totals in Table 3-8 of the report. The inundation figures reported in Table 4-1 of the Water Technology (2014) report did not list totals by land use. Therefore GHD adopted the same proportions of land use types for this sub-reach that were listed in Table 4-28 of the report.

Land Use (Ha)	Sub-reach A	Sub-reach B	Sub-reach C	Sub-reach D	Total
Grazing Tolerant Pasture	49	9	56	38	152
Grazing Vulnerable Pasture	49	7	38	20	114
Dryland Broadacre Cropping	0	1	3	2	6
Irrigated Pasture	59	0	2	1	62
Other Fruit	0	0	0	0	0
Grapes	0	0	0	0	0
Vegetables	2	0	55	0	57
Intensive Agriculture	0	1	0	0	1
Agricultural Land Affected	159	18	154	60	391

# Table 2 Inundated agricultural land use adopted in the GHD assessment(bank-full flow to 12,000 ML/day)

## Table 3 Inundated agricultural land use adopted in the GHD assessment(12,000 ML/day to 15,000 ML/day)

Land Use (Ha)	Sub-reach A	Sub-reach B	Sub-reach C	Sub-reach D	Total
Grazing Tolerant Pasture	69	35	9	11	124
Grazing Vulnerable Pasture	69	28	6	6	109
Dryland Broadacre Cropping	0	0	0	1	1
Irrigated Pasture	30	1	0	1	32
Other Fruit	0	0	0	0	0
Grapes	0	0	0	0	0
Vegetables	1	0	9	0	10
Intensive Agriculture	0	0	0	0	0
Agricultural Land Affected	168	64	25	18	275

Land Use (Ha)	Sub-reach A	Sub-reach B	Sub-reach C	Sub-reach D	Total
Grazing Tolerant Pasture	45	147	20	42	254
Grazing Vulnerable Pasture	45	120	14	22	201
Dryland Broadacre Cropping	0	0	1	19	20
Irrigated Pasture	9	28	1	0	38
Other Fruit	0	0	0	0	0
Grapes	0	0	0	0	0
Vegetables	0	0	20	0	20
Intensive Agriculture	0	0	0	0	0
Agricultural Land Affected	99	295	56	83	533

# Table 4 Inundated agricultural land use adopted in the GHD assessment(15,000 ML/day to 20,000 ML/day)

### Table 5 Inundated agricultural land use adopted in the GHD assessment(20,000 ML/day to 25,000 ML/day)

Land Use (Ha)	Sub-reach E	Sub-reach F	Sub-reach G	Sub-reach H	Total
Grazing Tolerant Pasture	31	77	325	198	631
Grazing Vulnerable Pasture	13	26	81	46	166
Dryland Broadacre Cropping	18	3	6	124	151
Irrigated Pasture	2	16	25	43	86
Other Fruit	17	9	2	0	28
Grapes	0	0*	0	0	0
Vegetables	0	0	0	0	0
Intensive Agriculture	0	0	0	17	17
Agricultural Land Affected	81	130	439	428	1079

\* A marginal change of '-4' was recorded by Water Technology however GHD has adopted a value of '0' in the Excel model

Land Use (Ha)	Sub-reach E	Sub-reach F	Sub-reach G	Sub-reach H	Total
Grazing Tolerant Pasture	31	143	102	919	1195
Grazing Vulnerable Pasture	13	48	26	216	303
Dryland Broadacre Cropping	18	11	5	417	451
Irrigated Pasture	2	14	24	218	258
Other Fruit	17	-9	3	0.2	11
Grapes	0	30	0	0	30
Vegetables	0	3	0	0	3
Intensive Agriculture	0	0	0	28	28
Agricultural Land Affected	81	239	160	1798	2279

Table 6 Inundated agricultural land use adopted in the GHD assessment(25,000 ML/day to 30,000 ML/day)

### Table 7 Inundated agricultural land use adopted in the GHD assessment(30,000 ML/day to 40,000 ML/day)

Land Use (Ha)	Sub-reach E	Sub-reach F	Sub-reach G	Sub-reach H	Total
Grazing Tolerant Pasture	53	232	195	567	1047
Grazing Vulnerable Pasture	23	77	49	133	282
Dryland Broadacre Cropping	68	70	20	357	515
Irrigated Pasture	20	108	43	155	326
Other Fruit	71	0	1	0	72
Grapes	0	28	0	1	29
Vegetables	0	0	0	0	0
Intensive Agriculture	0	0	0	8	8
Agricultural Land Affected	235	516	305	1221	2277

Care is required in interpreting ACLUMP land use classification as classifications are often assigned on a whole of cadastre basis where the cadastre may include both inundated and non-inundated land. GHD has experience that land use on the elevated non-inundated portion (eg cropping) could also be assigned to the lower level inundated land within the same cadastre but which has an alternative use (eg grazing tolerant pastures) that reflects a more appropriate land use based on the flooding risk for this land.

While GHD has verified that a proportion of higher value land classified as "Intensive Agriculture" or "Grapes" in Table 2 to Table 7 may in fact be an alternative lower value land use that will experience inundation, the GHD assessment has adopted the land uses provided by Water Technology until a more comprehensive review of actual land use is completed. For this reason the assessment is likely to overestimate flood damage and subsequent easement cost, however, the total area of higher value land is relatively minor for the proposed flow regimes. If inundation does occur on this type of land use, the cost of damages would be significantly higher compared to grazing land.

#### 4.1.2 Interrupted access area

Table 1 to Table 7 refer to the increase in land area directly inundated by the proposed CMS flow regime. In addition to the direct impact, GHD's past experience has shown that inundation can interrupt access to land that is not inundated (eg flood runners cause road closures which limits access for completing crop and livestock husbandry and marketing activities).

The model used for this assessment takes into account interrupted access by assuming that it can be expressed as a ratio of the area of land inundated. The model also assumes that the land use on interrupted access land is in the same proportion as for inundated land – see Table 2 to Table 7.

For the purposes of CMS prefeasibility analysis, it has been assumed that for the Goulburn reach this ratio is 0.3. This is considered a reasonable assumption given the findings of more detailed analysis of interrupted access that the MDBA has undertaken in the Yarrawonga-Wakool reach, and GHD's past experience in the Hume-Yarrawonga reach. Recognising that it is just an assumption, GHD has undertaken sensitivity analysis of how cost estimates would change if the ratio were decreased to 0.24 or increased to 0.36 (ie +/- 20%). The findings of this sensitivity analysis are presented in section 6.1.2.

Assumptions about how interrupted access land is treated are given in sections 5.1.1 and 5.2.1. Table 8 presents the total amount of land that would suffer interrupted access at the proposed flows for this reach given the adopted ratio.

	Total	Assumed	Assumed area of land experiencing interrupted access (ha)								
Flow band	adopted inundated land (ha)	interrupted access ratio	Grazing tolerant pasture	Grazing vulnerable pasture	Dryland Broadacre Cropping	Irrigated Pasture	Other fruit	Grapes	Vegetables	Intensive agriculture	Total
Bank full flows to 12,000 ML/day	391	0.3	46	34	2	19			17		117
12,000 to 15,000 ML/day	275	0.3	37	33		10			3		82
15,000 to 20,000 ML/day	533	0.3	76	60	6	11			6		159
20,000 to 25,000 ML/day	1,078	0.3	189	50	45	26	8	1		5	322
25,000 to 30,000 ML/day	2,279	0.3	359	91	135	77	3	9	1	8	683
30,000 ML/day to 40,000 ML/day	2,278	0.3	314	85	155	98	22	9	1	2	683

#### Table 8 Assumed level of interrupted access area (ha) by flow and land use

#### 4.1.3 Area of land inundated outside the levees<sup>5</sup>

There may be potential, through infrastructure works on the levee system, to keep higher managed flows within the levees and remove the need to mitigate impacts outside the levees. The potential for these infrastructure works, and the possible costs associated with them, have been considered in separate reports.

If there were no need to mitigate impacts outside the levees, then easements would not be required outside the levees.

<sup>&</sup>lt;sup>5</sup> GHD shapefile analysis shows that 99.9% of all inundated land occurring outside the levee system occurs in sub-reach H; consideration of impacts outside levees are applied to sub-reach H only on this basis.

To inform a preliminary assessment of the potential costs associated with easements outside the levees, GHD has taken into account a preliminary assessment by Water Technology (2014) of the area of land inundated both inside and outside the levee, by land use type. Table 9 shows the marginal proportion of inundated agricultural land falling outside the levee (as applied to sub-reach H) based on Water Technology's (2014) assessment. The values shown in Table 9 are calculated using the inundated land area outside the levee as a proportion of total inundated land (inside and outside the levee) reported respectively in Table 4-26 and Table 4-27 of the Water Technology (2014) report.

	>20,000 ML/day	>25,000 ML/day	>30,000 ML/day
	and ≤25,000	and ≤30,000	and ≤40,000
	ML/day	ML/day	ML/day
Proportion of inundated land outside the levee	0.74	0.40	0.32

#### Table 9 Marginal proportion of land inundated outside the levee (sub-reach H)

Applying the proportions in Table 9 to the total marginal inundation areas for sub-reach H at the relevant marginal flow bands (see Table 5 to Table 7) will give the amount of inundated land outside the levee system at each flow band. The results for the assessment are shown in section 6.

#### 4.1.4 Modelled hydrological data on current vs CMS scenarios

MDBA provided GHD with hydrological modelling data to show the change in occurrence (number of events over a modelled 114-year period) between baseline conditions and a modelled CMS flow regime scenario for downstream of Goulburn Weir.<sup>6</sup> As an initial flow regime scenario for this analysis ("modelled flow regime scenario #1"), the CMS flow regime has been assumed to be represented by modelling outputs from the MDBA's "BP2800RC" model run.<sup>7</sup> If required, GHD could generate further estimates based on different hydrological assumptions.

The change in the number of events for different seasons and durations is shown in Table 10.

# Table 10 Change in number of events between baseline and modelled CMS flow regime Flow head Duration > 1 day % < 7 days</td>

	Flow band	Duration $\geq$ 1 day & $\leq$ 7 days			Duration > 7 days			
	ML/day	Jun-Jul	Aug-Sep	Oct-Nov	Jun-Jul	Aug-Sep	Oct-Nov	
Events	> 20,000 ≤ 25,000	7	-22	6	0	10	1	
over 114	> 25,000 ≤ 30,000	10	-9	-9	7	13	8	
years	> 30,000 ≤ 40,000	4	-9	6	4	7	0	

Similar hydrological modelling for the upper sub-reaches (A-D) was not available and therefore GHD has adopted average annual increases in flows as shown in Table 11 below. Note that the adopted average annual increases in flows for reaches A-D correspond to an increase by 11.4 in the number of all events over a 114 year period. These changes in the number of events in reaches A through D have been adopted on the basis that they are broadly

<sup>&</sup>lt;sup>6</sup> Note that the modelling data was calibrated with respect to McCoy's Bridge.

<sup>&</sup>lt;sup>7</sup> Refer to MDBA (October 2012) Hydrologic modelling of the relaxation of operational constraints in the southern connected system: methods and results.

comparable to the modelled increase in the number of events in reaches E through H. It is recognised that the adopted average annual increases do not necessarily represent what would be hydrologically feasible or desirable. However, for the purposes of the prefeasibility phase of the CMS it is considered that they provide a useful starting point for estimating the potential costs of easements.

GHD requested that the MDBA provide the modelled data for the durations and seasons (months) shown in Table 10 because of the differential impacts that such changes in inundation have on pastures and crops. In summary, short duration inundation ( $\leq$  7 days) has less impact on pasture and crop growth compared to longer duration (> 7 days) in all seasons with the impacts increasing as the seasons advance from June/July to October/November.

### 4.1.5 Average annual change in flows attributable to CMS flow regime scenario

For the GHD model, the information on changes in flood occurrence shown in Table 10 is converted to an average annual change in flows for each scenario. For example, seven extra flows in 114 years is equivalent to an average increase in events of 0.06 per year (7/114 = 0.06).

As noted above, for the upper sub-reaches (A through D) hydrological modelling data were not available and therefore GHD has adopted average annual increases in flows as shown in Table 11.

	Flow band	Duration $\geq$ 1 day & $\leq$ 7 days			Duration > 7 days			
	ML/day	Jun-Jul	Aug-Sep	Oct-Nov	Jun-Jul	Aug-Sep	Oct-Nov	
Average	> bank full ≤ 12,000	0.10	0.10	0.10	0.10	0.10	0.10	
annual change	> 12,000 ≤ 15,000	0.10	0.10	0.10	0.10	0.10	0.10	
in flows	> 15,000 ≤ 20,000	0.10	0.10	0.10	0.10	0.10	0.10	

#### Table 11 Average annual change in flows from proposed CMS regime – subreaches A through D

GHD has calculated easement costs assuming that any benefits that may accrue to landholders as a result of a reduction in flow events (for example, the "-22" flow events in the Aug-Sep column of Table 10) would not be reflected in the costs of easements. In other words, the costs of easements would reflect only the *negative* impacts of changes in flows.

This calculation was incorporated into the Excel model by limiting any post-CMS cost figures for a particular season/duration to zero. The calculation of the total cost for a particular land type (as discussed in section 5.2.2) thereby reflects only the negative impacts to landholders, and is not offset in any way by benefits.

In theory, a reduction in flow events could result in less impact to agricultural activities than currently experienced under baseline conditions (i.e. a benefit), which could offset the costs associated with an increase in the number of flow events with negative impacts. However, it is not possible, using the modelled flow data discussed in section 4.1.4, to assess the extent to which such benefits would actually be realised. For example, some of the reductions in flow events later in the season (Oct-Nov) may occur in the same years as increases in flow events early in the season (Jun-Sep), which would reduce the benefits from the reduced late-season flow events.

It is important to recognise that the above assumptions regarding costs and benefits have been made for the purposes of prefeasibility cost estimates. If easements were established, the basis

on which their costs would be calculated would depend on the agreed process by which they are negotiated (refer to sections 3.2 and 3.3 of this report), as well as refinement of inputs as described in section 7 of this report.

#### 4.2 Data sourced by GHD

GHD's model relies on a number of additional assumptions associated with agricultural production along the reach and the impact of flooding on the financial returns of the different land uses.

#### 4.2.1 Enterprise gross margins

Enterprise gross margins are a function of livestock and crop yields and product prices for differing agro-climatic regions less the direct variable production costs required. Gross margins are generally expressed as \$/hectare/year and vary between agro-climatic regions.

GHD sourced gross margin data for the Goulburn reach from the Victorian and NSW Departments of Primary Industries and the Grains Research and Development Corporation's (GRDC) farm gross margin guide (2012). Adopted gross margins for each sub-reach were guided by this work and are presented in Table 12.

Sub- Reach	Grazing Tolerant Pasture	Grazing Vulnerable Pasture	Dryland Broadacre cropping	Irrigated Pasture	Other fruit	Grapes	Vegetables	Intensive Agriculture
А	\$252	\$277	\$596	\$2,047	\$9,000	\$5,000	\$6,000	\$277
В	\$210	\$231	\$526	\$2,047	\$9,000	\$5,000	\$6,000	\$231
С	\$189	\$208	\$508	\$2,047	\$9,000	\$5,000	\$6,000	\$208
D	\$189	\$208	\$448	\$2,047	\$9,000	\$5,000	\$6,000	\$208
Е	\$168	\$185	\$458	\$2,047	\$9,000	\$5,000	\$6,000	\$185
F	\$158	\$173	\$391	\$2,047	\$9,000	\$5,000	\$6,000	\$173
G	\$126	\$139	\$413	\$2,047	\$9,000	\$5,000	\$6,000	\$139
Н	\$84	\$92	\$357	\$2,047	\$9,000	\$5,000	\$6,000	\$92

#### Table 12 Gross margin (\$/ha) for land use by sub-reach

#### 4.2.1 Agricultural land worth

Data on rural land sales were obtained from Victoria's 2012 Market Overview by Robert Marsh, Victorian Valuer-General<sup>8</sup>. Appendix A presents an analysis of property sales from this report for the four shires (Murrindindi, Strathbogie, Greater Shepparton and Campaspe) that cover the Goulburn CMS sub-reaches. GHD used this information in conjunction with past experience when calculating agricultural land values. The values adopted are shown in Table 13.

<sup>&</sup>lt;sup>8</sup> A Guide to Property Values. Data and analysis from the Valuer-General Victoria using 2012 property sales information for residential, commercial, industrial and rural property.

Sub- Reach	Grazing Tolerant Pasture	Grazing Vulnerable Pasture	Dryland Broadacre cropping	Irrigated Pasture	Other fruit	Grapes	Vegetables	Intensive Agriculture
А	\$4,500	\$4,950	\$5,277	\$9,375	\$4,500	\$4,500	\$4,500	\$5,625
В	\$3,750	\$4,125	\$4,659	\$9,375	\$4,500	\$4,500	\$4,500	\$5,625
С	\$3,375	\$3,713	\$4,498	\$9,375	\$4,500	\$4,500	\$4,500	\$5,625
D	\$3,375	\$3,713	\$3,966	\$9,375	\$4,500	\$4,500	\$4,500	\$5,625
Е	\$3,000	\$3,330	\$4,061	\$9,375	\$4,500	\$4,500	\$4,500	\$5,625
F	\$2,813	\$3,094	\$3,467	\$9,375	\$4,500	\$4,500	\$4,500	\$5,625
G	\$2,250	\$2,475	\$3,657	\$9,375	\$4,500	\$4,500	\$4,500	\$5,625
Н	\$1,500	\$1,650	\$3,161	\$9,375	\$4,500	\$4,500	\$4,500	\$5,625

#### Table 13 Agricultural land worth (\$/ha) by land use and sub-reach

In estimating agricultural land worth, GHD was guided by research on land values that were completed in the 2004 easement costing project for grazing land along the Murray River. In that project, the agricultural land worth of grazing pasture land was found to be correlated to the stocking rate (DSE<sup>9</sup>/ha) which was also a function of average annual rainfall. For the Goulburn reach, as the river system tracks west from the Eildon Dam, there is an associated fall in the stocking rate in line with rainfall. In addition, a land 'value factor' (\$/DSE) was estimated based on the underlying characteristics of the system, and the product of these was used to calculate agricultural land worth for grazing pasture (see Table 14).

Table 14 Stocking rate and value factor by sub-reach

Dry Stocking Rate	А	В	С	D	E	F	G	Н
Stocking rate (DSE/ha)	12	10	9	9	8	7.5	6	4
Value factor (\$/DSE)	\$375	\$375	\$375	\$375	\$375	\$375	\$375	\$375

GHD estimated the agricultural worth of dryland cropping land on the basis of expected yields from growing season rainfall<sup>10</sup> (April to October) using the function of 10 kg crop yield per mm of growing season rainfall. These yields were then multiplied by \$1,125/tonne to calculate land value based on information published by the NSW Land and property Information section.

It should be noted that the final agricultural land worth are estimates adopted by GHD without revised input from a registered rural land valuer. The accuracy of these figures would be improved with such input.

#### 4.2.2 Ratio of tolerant to vulnerable pasture

GHD has assumed that Water Technology's 'Grazing Modified Pasture' can be classified as either tolerant or vulnerable pasture. A ratio is applied to the 'Grazing Modified Pasture' inundated land when allocating between the two pasture types, as shown in Table 15. GHD

<sup>&</sup>lt;sup>9</sup> DSE = dry sheep equivalent.

<sup>&</sup>lt;sup>10</sup> Water Use Efficiency – see page 20, The Southern Mallee and Northern Wimmera Crop and Pasture Manual.

has assumed an increase in the ratio of tolerant to vulnerable pasture from the upper to lower sub-reaches.

#### Table 15 Ratio of tolerant to vulnerable pasture

Sub-reach	А	В	С	D	E	F	G	н
Ratio	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.81

### 5. Assumptions

Following is a description of assumptions underlying inputs to GHD's costing methodology for the Goulburn River.

#### 5.1 Land use categories and profitability

- a. Existing floodplain land use reflects the tolerable limit of interference from overbank flows experienced over the past 40 or so years and is expressed as the situation under current flow management. The history of overbank flows has generally led to land use and infrastructure on the floodplain that minimises the risk of intolerable losses.
- b. The cost estimate is prepared on the assumption that easements will only apply to private land and not Crown Land, as Crown Land is not traded and hence experiences no commercial diminution in value due to changes in flow management.
- c. Gross margins are inherently variable, as influenced by factors including market prices, enterprise size and management structure which in turn affect cost structures. While the best average estimates have been taken in all cases, significant variation is possible when assessment is conducted on an individual farm basis. The outputs from the assessment include sensitivity analyses that show the order of magnitude of adopting changes in key variables.
- d. Land use profitability will change with the introduction of altered overbank flows arising from managed releases of water for environmental enhancement and this may result in a future change in land use that may alter profitability. GHD has not included such changes in the assessment as there is no evidence of the possible management responses that might follow.

#### 5.1.1 Review of land use information

- a. GHD identified that land use classification in the shape files provided by MDBA and extracted by Water Technology may not accurately reflect actual land use of inundated areas (see section 4.1.1). GHD reviewed satellite imagery of a limited number of land parcels defined by cadastre boundaries considered to be misclassified and made a determination of the appropriate land use categories to be adopted in the GHD assessment.
- b. Water Technology has described land use as shown in Table 2 to Table 7. GHD has adopted land use categories that fit GHD's model and which are consistent with the original Water Technology land use and inundation definitions.
- c. As shown in Table 2 to Table 7, the GHD model assumes eight land use classifications as adopted by Water Technology for the Goulburn River: tolerant/vulnerable pasture (dryland pasture), dryland broadacre cropping, irrigated pasture, other fruit, grapes, vegetables and intensive agriculture. Tolerant pastures are generally native or locally naturalised pastures that are relatively tolerant of inundation. Vulnerable pastures are generally 'improved' pastures (ie planted with non-native grass and legume species) which are less tolerant of inundation. GHD has assumed that the Water Technology classification of "Dryland Pasture" is determined by a ratio ranging from 0.50 to 0.81, increasing as the river tracks downstream (see Table 15).
- d. For the purposes of this prefeasibility assessment, the area of land subject to interrupted access has been assumed to be 30% of the inundated land. The GHD model assumes that the land use on interrupted access land is in the same proportion as for inundated land see Table 2 to Table 8. GHD has undertaken sensitivity analysis of how costs would change if this percentage were varied (refer to section 6.1.2).

# **5.2 Assumed effects of inundation on agricultural production and costs**

#### 5.2.1 Inputs

Inundation can have a negative or positive impact on pasture and crop production depending on location (agri-climatic zone) and antecedent conditions. Impacts can be direct and indirect as described below:

#### **Direct**

- i. Impact on pasture growth and availability for grazing by livestock GHD has adopted 'foregone' grazing to reflect this impact
- ii. Increase in pasture growth as a result of flooding in this agro-ecological zone
- iii. Proliferation of weeds requiring control to avoid pasture deterioration for improved pastures only
- iv. Partial or complete loss of annual and perennial crops (including horticulture)
- v. Reduction in product quality reflected in reduced price of produce
- vi. Damage to infrastructure (especially fences)
- vii. Deposition of debris requiring clean-up cost and soil rejuvenation.

#### **Indirect**

Indirect impacts can occur as a result of interrupted access to agricultural land that is not inundated. Interrupted access can result in:

- i. Inability of livestock to access pastures resulting in delayed grazing
- ii. Additional costs to perform key husbandry and management activities
- iii. Decreases in product quality if there is a delay in the optimum harvest time for hay and grain.

The data adopted by GHD to reflect these direct and indirect costs are summarised in Table 16.

The cost of foregone grazing is calculated in the model by applying the daily cost of livestock agistment, taken as \$0.10/day per DSE, to the number of foregone grazing days due to the inundation loss of pasture. The number of foregone grazing days for intensive agriculture is assumed to equal that of irrigated pasture. The number of days also includes a recovery period.

	Duration	Season	Foregone Grazing (days)	Pasture restoration (\$/ha)*	Crop damages(\$/ha)	Clean-up costs (\$/ha)	
		Jun-Jul	30 (t/v/i)	\$30 (i)	\$100 (c) \$2000 (f) \$2500 (g) \$5600 (veg)	\$25 (t,v,i,c) \$350 (f,g,veg)	
	< 7 days	Aug-Sept	90 (t/v) 30 (i)	\$15 (v) \$30 (i)	\$100 (c) \$2,000 (f) \$2500 (g) \$5600 (veg)	\$25 (t,v,i,c) \$350 (f,g,veg)	
lation		Oct-Nov	120 (t) 150 (v) 30 (i)	\$30 (t/v/i)	\$100 (c) \$2000 (f) \$2500 (g) \$5600 (veg)	\$25 (t,v,i,c) \$350 (f,g,veg)	
Inunc			Jun-Jul	30 (t) 90(v) 240 (i)	\$30 (v) \$260 (i)	\$200 (c) \$4000 (f,g) \$5600 (veg)	\$25 (t,v,i,c) \$350 (f,g,veg)
	> 7 days	Aug-Sept	120 (t) 150 (v) 240 (i)	\$15 (t) \$30 (v) \$260 (i)	\$200 (c) \$4000 (f,g) \$5600 (veg)	\$25 (t,v,i,c) \$350 (f,g,veg)	
		Oct-Nov	150 (t) 270 (v) 240 (i)	\$30 (t) \$150 (v) \$260 (i)	\$200 (c) \$4000 (f,g) \$5600 (veg)	\$25 (t,v,i,c) \$350 (f,g,veg)	
		Jun-Jul	7 (t/v/i)	N/A	N/A	N/A	
	< 7 days	Aug-Sept	7 (t/v/i)	N/A	N/A	N/A	
SS		Oct-Nov	7 (t/v/i)	N/A	N/A	N/A	
acce		Jun-Jul	14 (t/v/i)	N/A	N/A	N/A	
upted		Aug-Sept	14 (t/v/i)	N/A	N/A	N/A	
luterrup > 2 q	> 7 days	> 7 days Oct-Nov	14 (t/v/i)	N/A	\$50 (c) \$4000 (f) \$5000 (g) \$5600 (veg)	N/A	

#### Table 16 Assumed impacts for GHD assessment (cost assumptions)\*

\* Table abbreviations:

(c) crop
(f) other fruit
(t) tolerant pasture
(v) vulnerable pasture
(i) irrigated pasture/intensive agriculture
(g) grapes
(veg) vegetables

"Pasture cost" considers the effect of both reduction in pasture production and costs of weed control. For vulnerable pastures, renovation includes weed control for lesser events, partial renovation with seed and fertiliser for intermediate events and full renovation for a late season event of long duration (see Appendix B).

Crop damages have been calculated based on GHD assumed impacts of damages and are based on gross margins for representative crops obtained from government websites (eg NSW Department of Primary Industries).

Clean-up costs have been adopted from averages presented in the Rapid Appraisal Method (RAM) for Floodplain Management published by the Victorian Government in 2000 (Appendix C).

#### 5.2.2 Total cost calculation

Total costs by season and duration from inundation therefore consist of foregone grazing, pasture and crop damage/restoration and clean-up costs. These costs will be constant for each sub-reach, except for foregone grazing where cost depends on the number of livestock grazing days which is assumed to change by sub-reach (Table 14).

A total cost for each sub-reach is then calculated to encompass all seasonal and duration effects into a single figure.

To achieve this, each cost figure by season and duration is multiplied by the respective average annual change in the number of flows within the flow band which the CMS flow regime applies and is then summed for all seasons and durations. Note that potential benefits from a reduction in post-CMS flows have been set to zero as discussed in section 4.1.5. The change in flow events was provided in Table 10.

### 6. Cost and Sensitivity Analysis

#### 6.1 Modelled flow regime scenario #1

#### 6.1.1 Results

The product of the degree of affectation (section 3.4) and respective agricultural land value (\$/ha) (Table 13) will give an estimate of the per hectare easement value by land use and subreach for the respective marginal flow level.

The estimated marginal cost to acquire easements is calculated by applying the per hectare cost to the marginal affected hectares by land use and sub-reach for the relevant flow band. The estimated marginal total easement cost is derived by adding a contingency allowance at 10% for each marginal flow band, before summing these marginal costs up to the relevant flow rate., The results of these calculations for the Goulburn are presented in Table 17 and Table 18. These tables report the easement cost for both inundated and interrupted access land, and should be summed together to arrive at the total marginal cost to landholders at the given flow band.

### Table 17 Estimated total easement cost for the upper Goulburn River bank-full flow to 20,000 ML/day flow

Flow Band	>Bank-full flow and ≤12,000 ML/day		>12,000 and ≤15,000 ML/day		>15,000 and ≤20,000 ML/day	
	Inundated	Interrupted	Inundated	Interrupted	Inundated	Interrupted
Marginal easement cost	\$739,006	\$41,261	\$538,269	\$25,637	\$963,966	\$48,114
Contingency (%)	10%	10%	10%	10%	10%	10%
Marginal Contingency cost	\$73,901	\$4,126	\$53,827	\$2,564	\$96,397	\$4,811
Marginal Total easement cost	\$812,907	\$45,387	\$592,096	\$28,201	\$1,060,363	\$52,926
Marginal Ha affected	391	117	275	82	531	159
Average marginal easement cost per Ha	\$2,079	\$387	\$2,154	\$342	\$1,997	\$332

Flow Band	>20,000 and ≤25,000 ML/day		>25,000 and ≤30,000 ML/day		>30,000 and ≤40,000 ML/day	
	Inundated	Interrupted	Inundated Interrupted		Inundated	Interrupted
Marginal easement cost	\$451,951	\$26,560	\$1,520,315	\$101,947	\$744,912	\$48,311
Contingency (%)	10%	10%	10%	10%	10%	10%
Marginal Contingency cost	\$45,195	\$2,656	\$152,031	\$10,195	\$74,491	\$4,831
Marginal Total easement cost	\$497,146	\$29,215	\$1,672,346	\$112,141	\$819,403	\$53,142
Marginal Ha affected	1,078	322	2,278	683	2,276	683
Average marginal easement cost per Ha	\$461	\$91	\$734	\$164	\$360	\$78

## Table 18 Estimated total easement cost for the lower Goulburn River 20,000ML/day to 40,000 ML/day flow

In addition to the cost of the easement, allowance must be made for a per-property negotiation cost, assumed to be \$5000 per property. This figure is based on previous experience in negotiating easements along the Hume-Yarrawonga and Mitta-Mitta regions. GHD estimates that approximately 300 properties will be affected by the proposed CMS along the Goulburn Rive, split equally between the upper and lower sub-reaches.

The negotiation costs (Table 19) must be added to the marginal total easement cost for the upper or low sub-reaches, reported in Table 17 / Table 18, before a complete cost figure is obtained. For example the total cost for flows of up to 15,000 ML/day in the upper Goulburn would be calculated as the sum of the marginal total easement costs (inundated and interrupted, including contingency costs) up to the flow rate: \$812,907 + \$45,398 (bank full flow to 12,000 ML/day); + \$592,096 + \$28,201 (12,000 to 15,000 ML/day); plus the negotiation costs for 150 properties at \$5000 per property (\$750,000) = \$2,228,602 (data extracted from Table 17). The negotiation costs are only considered after the total easement cost has been calculated (not on a marginal basis) as they are incurred on a one off basis.

#### Table 19 Estimated negotiation/implementation costs of easements

	Upper	Lower
Estimated number of affected properties	150	150
Easement cost per property	\$5,000	\$5,000
Total cost of negotiation/implementation	\$750,000	\$750,000

The results in Table 17 and Table 18 show that the marginal easement cost per hectare varies considerably from \$38 to \$2,154 with higher average values being reported in the upper sub-reaches for inundated land. This is due to the higher percentage of higher value land (vegetables and vulnerable pastures) that is affected in the upper sub-reaches. Figure 2 and Figure 3 show how the total marginal cost reported in Table 17 and Table 18 is allocated between the various land types.

# Figure 2 Proportion of marginal easement costs for land use types at proposed CMS flow bands (ML/day) for upper sub-reaches



# Figure 3 Proportion of marginal easement cost for land use types at proposed CMS flow bands (ML/day) for lower sub-reaches



#### Estimated easement cost accruing to inundated land outside the levee

GHD also calculated an indicative estimate of the costs of easements that might be associated with land inundated outside the levees (see section 4.1.3).

This estimate was calculated for flows from 20,000 ML/day up to 40,000 ML/day in sub-reach H, after GHD found that 99.9% of all inundated land that falls outside levees occurs in this sub-reach for the lower Goulburn. Table 20 shows the estimated easement cost for both inside and outside the levees for sub-reach H, while Table 21 shows the estimated easement cost for inundated land outside the levee only, after applying the ratios from Table 9 to the inundated land totals.

Flow Band	>20,000 ar ML/	nd ≤25,000 ′day	>25,000 and ≤30,000 ML/day		>30,000 and ≤40,000 ML/day	
	Inundated	Interrupted	Inundated	Interrupted	Inundated	Interrupted
Marginal easement cost	\$188,752	\$12,154	\$1,165,661	\$79,799	\$371,080	\$25,202
Contingency (%)	\$18,875	\$1,215	\$116,566	\$7,980	\$37,108	\$2,520
Marginal contingency cost	\$207,627	\$13,370	\$1,282,227	\$87,779	\$408,188	\$27,723
Marginal easement cost	\$188,752	\$12,154	\$1,165,661	\$79,799	\$371,080	\$25,202
Marginal Ha affected	428	129	1798	539	1221	366
Average marginal easement cost per Ha	\$441	\$94	\$648	\$148	\$304	\$69

### Table 20 Estimated easement cost inside/outside levees in the lowerGoulburn (sub-reach H) 20,000 ML/day to 40,000 ML/day

Flow Band	>20,000 and ≤25,000 ML/day		>25,000 and ≤30,000 ML/day		>30,000 and ≤40,000 ML/day	
	Inundated	Interrupted	Inundated	Interrupted	Inundated	Interrupted
Marginal easement cost	\$139,676	\$8,994	\$466,264	\$31,920	\$118,746	\$8,065
Contingency (%)	\$13,968	\$899	\$46,626	\$3,192	\$11,875	\$806
Marginal contingency cost	\$153,644	\$9,893	\$512,891	\$35,112	\$130,620	\$8,871
Marginal total easement cost	\$139,676	\$8,994	\$466,264	\$31,920	\$118,746	\$8,065
Marginal Ha affected	316	95	1,079	324	531	117
Average marginal easement cost per Ha	\$442	\$95	\$432	\$99	\$224	\$69

## Table 21 Estimated easement cost outside the levee in the lower Goulburn(sub-reach H) 20,000 ML/day to 40,000 ML/day

The total cost of inundation for inside and outside the levees for sub-reach H is \$1,842,648 (Table 20 for the three flow bands and including contingency). The total cost of inundation for outside the levees for sub-reach H is \$773,665 (Table 21) for the three flow bands and including contingency). Given that the majority of land inundated outside the levees occurs in sub-reach H, GHD considers that this cost can be used by MDBA and Basin States when considering the potential, through infrastructure works on the levee system, to keep higher managed flows within the levees and remove the need to mitigate impacts outside the levees (see section 4.1.3).

As above, in addition to the cost of the easement, allowance must be made for a per-property negotiation cost, assumed to be \$5,000 per property. If it is assumed that approximately 20 properties would be affected outside the levee system, the total negotiation costs have been estimated at \$100,000.

The total indicative estimate of the costs of easements outside the levees is therefore 773,665 + 100,000 = 873,665.

#### 6.1.2 Sensitivity

GHD completed a sensitivity analysis for the proposed flow scenarios (ie adoption of hydrological modelling data) modelled above, for key input assumptions. The analysis considered changes of +/- 20% in increments of 10% for the following input variables on marginal easement costs:

- Assumed land values for each affected agricultural land type as listed in Table 13 (agricultural land worth)
- Cost assumptions which reflect the sum of all applicable costs to each affected land type by season and duration, including foregone grazing, pasture/crop damage/ rejuvenation and clean-up costs listed in Table 16
- Average annual marginal change in flows for each CMS regime for both season and duration, as listed in Table 10
- The marginal affected area (inundation and interrupted access) for each marginal flow band, as listed in Table 2 to Table 7.

Table 22 to Table 27 show the total easement cost sensitivities (inclusive of contingency and exclusive of negotiation costs) to changes in agricultural land worth, enterprise gross margins, clean-up costs, average annual change in flows (historical flows) and inundated land respectively for the relevant CMS flows.

This sensitivity analysis shows that the greatest variation in easements will depend upon the flow band considered. Changes to the level of interrupted access will have the smallest effect on the easement cost.

% change	Agricultural Land Worth	Clean up costs	Modelled Flows	Interrupted Access	Marginal Affected Area
+20%	\$1,029,953	\$1,029,116	\$1,029,116	\$867,372	\$1,029,953
+10%	\$944,124	\$943,872	\$943,872	\$862,833	\$944,124
Base case	\$858,294	\$858,294	\$858,294	\$858,294	\$858,294
-10%	\$772,465	\$772,465	\$772,465	\$853,756	\$772,465
-20%	\$686,635	\$686,635	\$686,635	\$849,217	\$686,635

# Table 22 Sensitivity Analysis bank full flow -12,000 ML/day +/- 20% change (Upper Reach)

# Table 23 Sensitivity Analysis 12,000-15,000 ML/day +/- 20% change (Upper Reach)

% change	Agricultural Land Worth	Clean up costs	Modelled Flows	Interrupted Access	Marginal Affected Area
+20%	\$744,356	\$744,356	\$744,356	\$625,937	\$744,356
+10%	\$682,327	\$682,327	\$682,327	\$623,117	\$682,327
Base case	\$620,297	\$620,297	\$620,297	\$620,297	\$620,297
-10%	\$558,267	\$558,267	\$558,267	\$617,477	\$558,267
-20%	\$496,237	\$496,237	\$496,237	\$614,657	\$496,237

## Table 24 Sensitivity Analysis 15,000-20,000 ML/day +/- 20% change (Upper Reach)

% change	Agricultural Land Worth	Clean up costs	Modelled Flows	Interrupted Access	Marginal Affected Area
+20%	\$1,335,947	\$1,335,947	\$1,335,947	\$1,123,874	\$1,335,947
+10%	\$1,224,618	\$1,224,618	\$1,224,618	\$1,118,581	\$1,224,618
Base case	\$1,113,289	\$1,113,289	\$1,113,289	\$1,113,289	\$1,113,289
-10%	\$1,001,960	\$1,001,960	\$1,001,960	\$1,107,996	\$1,001,960
-20%	\$890,631	\$890,631	\$890,631	\$1,102,704	\$890,631

# Table 25 Sensitivity Analysis 20,000-25,000 ML/day +/- 20% change (Lower Reach)

% change	Agricultural Land Worth	Clean up costs	Modelled Flows	Interrupted Access	Marginal Affected Area
+20%	\$631,634	\$631,634	\$631,634	\$530,130	\$631,634
+10%	\$578,998	\$578,998	\$578,998	\$528,246	\$578,998
Base case	\$526,361	\$526,361	\$526,361	\$526,361	\$526,361
-10%	\$473,725	\$473,725	\$473,725	\$524,477	\$473,725
-20%	\$421,089	\$421,089	\$421,089	\$522,593	\$421,089

## Table 26 Sensitivity Analysis 25,000-30,000 ML/day +/- 20% change (Lower Reach)

% change	Agricultural Land Worth	Clean up costs	Modelled Flows	Interrupted Access	Marginal Affected Area
+20%	\$2,141,385	\$2,106,735	\$2,106,735	\$1,805,561	\$2,141,385
+10%	\$1,962,936	\$1,945,611	\$1,945,611	\$1,795,024	\$1,962,936
Base case	\$1,784,488	\$1,784,488	\$1,784,488	\$1,784,488	\$1,784,488
-10%	\$1,606,039	\$1,623,364	\$1,623,364	\$1,773,951	\$1,606,039
-20%	\$1,427,590	\$1,462,240	\$1,462,240	\$1,763,414	\$1,427,590

# Table 27 Sensitivity Analysis 30,000-40,000 ML/day +/- 20% change (Lower Reach)

% change	Agricultural Land Worth	Clean up costs	Modelled Flows	Interrupted Access	Marginal Affected Area
+20%	\$1,047,055	\$1,047,055	\$1,047,055	\$881,879	\$1,047,055
+10%	\$959,800	\$959,800	\$959,800	\$877,212	\$959,800
Base case	\$872,546	\$872,546	\$872,546	\$872,546	\$872,546
-10%	\$785,291	\$785,291	\$785,291	\$867,879	\$785,291
-20%	\$698,036	\$698,036	\$698,036	\$863,212	\$698,036

### 7. Uncertainties and Caveats

In populating the inputs to the model, GHD relied on a range of sources – some of which are robust in relation to the Goulburn CMS region and others are best estimates sourced from more general data and experiences of the consultants. The following comments refer to those inputs that are the least robust and will benefit from comment by persons more familiar with the region and reaches.

- a. GHD has relied on the categories of land identified by Water Technology as representing the land uses experiencing inundation. GHD experience in analysing land classified on a cadastre basis for other CMS reaches in the Murray River has suggested that actual inundated land use could differ and is likely to be of lower value land use (ie flood tolerant). The adopted land types would benefit from a more consistent classification method
- b. The assumption in relation to agricultural land use is that land use has settled on forms that are relatively tolerant to inundation by flows within the range being considered. An indication of this view is the dominance of dryland grazing
- c. The estimated cost to acquire easements is influenced by production levels on the flood plain within the footprints for the flows under consideration. Given the land uses that are classified as dryland grazing and cropping are so important, inputs relating to stocking rates and crop yields are keys to flow change impacts. The accuracy of these estimates requires scrutiny by local qualified experienced person(s) and are likely to vary on a case-by-case basis
- d. Accompanying the issue above is the argument that the "other components" of value are not impacted ie lifestyle and infrastructure
- e. The area of land assumed to be impacted by interrupted access (30% of the inundated land for all reaches) and the land use assumed (the same proportion as for inundated land) is based on limited sampling by MDBA. The robustness of this component of cost would benefit from additional study
- f. The magnitude for pasture cost has been assumed on the basis of past experiences and characteristics with flooding along the Goulburn River. Comment from experienced landholders and/or local professionals would bring credibility to the adopted levels or result in changes that reflect local experiences
- g. The impact of the modelled CMS flow regime has been calculated through adopting average gross margins, land values and costs. It must be recognised that landholder impact from the CMS will vary by property, as dictated by individual farm characteristics including soil type, crop rotation, pasture quality and enterprise management. Care should be taken when interpreting the estimated costs on a per-property basis given the general nature of input assumptions adopted in the model
- h. The estimated number of properties affected by the proposed CMS regime, and their respective allocation to upper and lower sub-reaches would benefit from further investigation
- i. The marginal easement cost for an increasing flow regime depends on the caveat that affected land uses remain at constant proportions at all flow levels. However, it is likely that higher flow levels may in fact affect more vulnerable pasture species than tolerant species as well as higher valued cropping/horticulture land, serving to increase the marginal cost of inundation. Further investigation into the dynamic changes in land use for higher flow levels will improve model results in this respect.

j. The absence of hydrological modelling along the upper sub-reaches (A to D) meant that GHD adopted a constant flow change (Table 11) for these sub-reaches. The availability of hydrological data would improve the accuracy of results for the upper sub-reaches.

### **Appendices**

GHD | Report for Murray Darling Basin Authority - Constraints Management Strategy, 21/23242/01

**Appendix A** – Analysis of property sales for Murrindindi, Strathbogie, Greater Shepparton and Campaspe

# A Guide to Property Values

Data and analysis from the Valuer-General Victoria using 2012 property sales information for residential, commercial, industrial and rural property.





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# Land valuations summary from "A Guide to Property Values - Data and analysis from the Valuer-General Victoria using 2012 property sales information".

Model Reach	Locations	Shire	Mean sale price per hectare for different land use properties, incl no. of properties comprising the mean											
	(from URS 10 March 2010)													
			Livestock -	Sales	Livestock -	Sales	Livestock	Sales	Mixed farm no	Sales	Mixed	Sales	Vineyard	Sales
			beef		sheep		dairy		improvements		farm and			
											grazing			
A, B & C	Eildon, Alexandra, Ghin Ghin,	Murrindindi	\$14,200	3			\$26,800	1	\$5,800	8	\$11,600	49	\$115,400	1
	Kerrisdale													
D & E	Kerrisdale, Mitchellstown,	Strathbogie			\$2,400	2	\$5,900	1	\$6,600	6	\$5 <i>,</i> 300	64	\$4,800	4
	Wahring													
F & G	Wahring, Kialla, Bunbartha	Greater Shepparton	\$5,800	2	\$15,700	1	\$6,400	12	\$3,800	10	\$4,600	48		
Н	Bunbartha to Murray River	Campaspe	\$2,900	8			\$6,600	30	\$3,200	12	\$4,400	102		

Sub-reaches	Average for tolerant grazing* (A - H)						
	Total	Sales	Average				
A, B & C	\$89,000	11	\$8,090.91				
D & E	\$44,400	8	\$5,550.00				
F & G	\$65,300	13	\$5,023.08				
н	\$61,600	20	\$3,080.00				

\*Including livestock beef, livestock sheep and mixed farm no improvements

# Murrindindi Shire

# Analysis of property sales for 2012

Land Use	No of Sales	Mean Sales Price (\$)	Median Sales Price (\$)	Median Price per Unit Area	Median Block size	Price-Indices (base is 100) 2011 2007		Mean Block size	Mean Price per Unit Area
Commorcial				(\$/SM)	(SM)		2007	(SM)	(\$/\$M)
	2	144000	144000	105.82	1458.00	8 00<	62.61	1458.00	98.77
Dev Sile	2	45000	450000	00.82	4508.00	0.00~	02.01	4508.00	90.77
Pub/Taveni/Club Onsp	۱ ۵	144000	144000	105.82	1458.00	8.00~	62.61.c	1458.00	09.02
Retail Syle Occ Olisp	۲	50000	50000	10J.82	1430.00	0.00	02.01	1430.00	90.77 NA
	1	50000	50000	(¢(CM)	(014)	ND	UN	(011)	(¢ (CNA)
Gustrial		295000	295000	(\$/SIVI)	(SIVI)	111 50 <	ND	(SIVI)	(\$/ <b>5</b>  ¥])
	1	183450	183450	190.78	2018.00	244.60<	ND	2018.00	190.78
Marahayaa Unanaa	Z	163430	451000	90.91	12600.00	244.00	ND	12600.00	25.70
vvarenouse Unspec	1	451000	451000	35.79	12600.00	ND	150.33<	12600.00	35.79
ational Parks, etc		40000	40000	(\$/SIM)	(SM)	ND	ND	(SM)	(\$/SW)
Nature Reserve	1	40000	40000	NA (\$/QLD)		ND	ND		
rimary Production		500000	550000	(\$/SM)	(SM)	404 55 -		(SM)	(\$/SM)
Livestock – Beet	3	563333	550000	1.33	413400.00	121.55<	158.13<	396933.33	1.42
Livestock – Dairy	1	1200000	1200000	2.68	447700.00	ND	266.67<	447700.00	2.68
MixedFarm no impr	8	315562	283500	0.89	410300.00	64.99<	72.69<	540674.25	0.58
MixedFarm&GrazUnsp	49	765744	440000	1.48	433050.00	733.33<	90.26<	660848.80	1.16
Native Hardwood	2	324000	324000	11.99	57305.00	ND	190.59<	57305.00	5.65
Orchard Plantations	1	506002	506002	1.61	315100.00	38.05<	139.40<	315100.00	1.61
Vineyard	1	320000	320000	11.54	27730.00	ND	55.90<	27730.00	11.54
esidential				(\$/SM)	(SM)			(SM)	(\$/SM)
Cabin/Accommodation	1	120000	120000	91.05	1318.00	ND	ND	1318.00	91.05
Detached Home (new)	1	295000	295000	486.00	607.00	122.92<	113.46<	607.00	486.00
Detached Home Unsp	45	286751	260000	237.50	1000.00	ND	94.98<	1095.52	235.67
Detached Home(exist)	93	251727	245000	205.58	968.00	106.52<	106.52<	1282.42	195.01
Res/Rural Lstyle	93	430421	430000	35.58	12140.00	122.86<	123.39<	39082.14	11.01
ResLandWithImprovemt	1	50000	50000	0.62	80830.00	25.97<	19.90<	80830.00	0.62
Single Strata Unsp	4	154625	167500	626.70	367.00	ND	79.76<	367.00	626.70
Strata Unit/Flat Uns	2	207500	207500	NA	NA	92.22<	98.81<	NA	NA
Townhouse	5	234200	240000	NA	NA	106.67<	95.05<	NA	NA
Vac Res A	79	99539	95000	76.80	1106.00	120.25<	106.15<	1186.22	82.41
Vac Res B	32	129297	125000	75.61	2637.00	172.41<	92.42<	2709.72	47.72
Vac Res C	2	80000	80000	20.00	4000.00	59.26<	ND	4000.00	20.00
Vac Res/Rural Lstyle	62	177870	140750	10.89	8400.00	101.26<	93.83<	27942.71	6.37
ort/Hrtge/Cultural				(\$/SM)	(SM)			(SM)	(\$/SM)
OutdoorSportXCountry	1	936650	936650	15.46	60600.00	ND	ND	60600.00	15.46
				Municip	ality totals				
Industrial Total				4		Industrial Total Pric	es		\$1,202,900
Residential Total			42	20		Residential Total Pr	ices		\$102,202,254
Commercial Total				6		Commercial Total P	rices		\$1,076,000
National Parks, etc Total				1		National Parks, etc	Total Prices		\$40,000
Primary Production Total				65		Primary Production	Total Prices		\$44,410,002
Sport/Hrtge/Cultural Tota	I			1		Sport/Hrtge/Cultura	I Total Prices		\$936,650
All Sales Total			49	97		All Sales Total			\$149,867.806

				Strathbo	ogie Shir	e			
			Anal	ysis of prop	erty sales f	or 2012			
Land Use	No of Sales	Mean Sales Price (\$)	Median Sales Price (\$)	Median Price per Unit Area	Median Block size	Price-Iı (base i 2011	ndices s 100)	Mean Block size	Mean Price per Unit Area
Commercial				(\$/\$M)	(SM)		2007	(SM)	(\$/\$M)
Dev Site	1	362500	362500	362.50	1000.00	185 90<	ND	1000.00	362.50
Guest/BackPack Unsp	4	271250	285000	3 21	75000.00	ND	ND	85891.75	3.16
Hotel/Motel Unsp	1	380000	380000	91.37	4159.00	ND	ND	4159.00	91.37
Mixed Use Unsp	1	160000	160000	367.82	435.00	22.22<	71 11<	435.00	367.82
Playhouse/Theatre	1	90000	90000	86.12	1045.00	ND	ND	1045.00	86.12
Pub/Tavern/Club Unsp	2	480000	480000	252.50	2701.50	ND	ND	2701.50	177.68
Restaurant	1	775000	775000	1293.82	599.00	ND	244 87<	599.00	1293.82
Retail Sale Occ Unsp	1	362500	362500	362.50	1000.00	185.90<	ND	1000.00	362.50
Community Services	•			(\$/SM)	(SM)			(SM)	(\$/SM)
Church. Temple. etc.	1	150000	150000	41.19	3642.00	65.22<	ND	3642.00	41.19
Industrial				(\$/SM)	(SM)			(SM)	(\$/SM)
Factory Unsp	2	246500	246500	29.92	16000.00	129.74<	ND	16000.00	15.41
Warehouse Unspec	1	380000	380000	54.81	6933.00	ND	447.06<	6933.00	54.81
Infrastruc&Utilities				(\$/SM)	(SM)			(SM)	(\$/SM)
BusInterchangeCentre	1	232500	232500	294.68	789.00	ND	ND	789.00	294.68
ReservedRoads/Unused	1	12000	12000	0.15	81400.00	ND	ND	81400.00	0.15
Primary Production				(\$/SM)	(SM)			(SM)	(\$/SM)
Livestock – Dairy	1	1175000	1175000	0.59	1993000.00	344.93<	453.67<	1993000.00	0.59
Livestock – Sheep	2	670000	670000	0.22	2798500.00	317.09<	239.29<	2798500.00	0.24
MixedFarm no impr	6	505916	346000	0.74	470100.00	123.57<	105.65<	764903.67	0.66
MixedFarm&GrazUnsp	64	518796	397150	0.59	485000.00	ND	112.67<	978674.41	0.53
Orchard Plantations	1	550000	550000	3.02	182115.00	ND	ND	182115.00	3.02
Poultry broiler	1	1450000	1450000	12.28	118054.00	ND	72.50<	118054.00	12.28
Vineyard	4	355805	357500	0.37	562102.00	114.62<	42.06<	741051.00	0.48
Residential				(\$/SM)	(SM)			(SM)	(\$/SM)
Detached Home (new)	2	275000	275000	376.81	724.00	107.99<	68.75<	724.00	379.83
Detached Home Unsp	76	228679	220000	207.17	959.50	ND	135.80<	984.64	232.71
Detached Home(exist)	65	231474	220000	213.08	1009.00	115.79<	102.33<	1277.08	178.99
MisImpRuralLand Unsp	1	40000	40000	4.00	10000.00	ND	ND	10000.00	4.00
Res/Rural Lstyle	33	395393	300000	40.00	10000.00	98.68<	96.77<	30499.30	12.96
Single Strata Unsp	8	157125	160000	482.50	330.00	ND	57.97<	2737.25	57.54
Strata Unit/Flat Uns	11	221181	160000	762.12	395.50	91.43<	74.42<	395.50	720.61
Townhouse	3	230000	230000	NA	NA	141.98<	83.64<	NA	NA
Vac Res A	41	104560	88000	104.22	844.50	112.82<	106.02<	969.23	109.82
Vac Res B	13	72961	75000	24.07	2700.00	144.23<	115.38<	2639.15	27.65
Vac Res/Rural Lstyle	32	113390	90000	2.01	33375.00	104.44<	75.31<	51900.22	2.18
				Municin	ality totals				
Community Services Tota					anty totals	Community Sonvice	Total Prices		\$150,000
Residential Total	A1			85		Residential Total Pri	Ces		\$130,000
Commercial Total				12		Commercial Total P	ices		\$4,175,001
Industrial Total				3		Industrial Total Price	S		\$873.000
Infrastruc&Utilities Total				2		Infrastruc&Utilities 1	otal Prices		\$244,500
Primary Production Total				79		Primary Production	Total Prices		\$42,176,728

All Sales Total

382

All Sales Total

\$42,176,728 \$106,926,716

Land Lysis of property sales for 2012         Metha bits         Metha Bick         Metha Bick         Metha Bick         Proceedings         Metha Bick         Metha Bick         Proceedings         Metha Bick         Proceedings         Proceedings <th c<="" th=""><th></th><th></th><th></th><th>Gr</th><th>eater She</th><th>pparton</th><th>City</th><th></th><th></th><th></th></th>	<th></th> <th></th> <th></th> <th>Gr</th> <th>eater She</th> <th>pparton</th> <th>City</th> <th></th> <th></th> <th></th>				Gr	eater She	pparton	City			
Land Use         Meen bins Base         Meen bins Prof (m)         Meen bins (m)         Meen b				Analy	ysis of prop	erty sales f	or 2012				
Connectal         Cell         Open Sectal	Land Use	No of Sales	Mean Sales Price (\$)	Median Sales Price (\$)	Median Price per Unit Area	Median Block size	Price-lı (base i	ndices is 100)	Mean Block size	N	
ConstructionalUUBANUBANUUBANUUBANConstructionalSS15000228.5997.00N.NN.NN.D977.50BiscianCS70000S141.52977.50N.DN.D977.50977.50MichanCS70000S141.62977.50N.DN.D977.50MichanS449303S50000S44.441172.00157.4847.50Nimoni Los IrritonalTS20200S24.5444.65.00N.DN.D44.65.00Nimoni Los IrritonalTS20200S24.5444.65.00N.DN.D42.65.00Nimoni Los IrritonalS40.50S42.4467.03N.DN.D42.65.00Nimoni Los IrritonalS40.50S42.4467.03N.DN.D42.65.00Nimoni Los IrritonalS40.50S40.54N.DN.D49.0049.00Real Scip CortinalS40.50S40.54N.DN.D97.0097.0097.00N.D197.00Real Scip CortinalS40.50S40.55N.DN.DS40.50N.D197.0097.0097.0010.0010.0010.0010.0010.00Real Scip CortinalS40.50S40.50S40.50N.DN.D197.0010.0010.0010.0010.0010.0010.0010.0010.0010.0010.0010.0010.0010.0010.0010.0010.0010.0010.0010.00			( )		·		2011	2007			
Concurs (Sinital 0)         1         150000         22.8.3         697.000         NO         NO         697.00           Hest Site         1         70000         70010         114.4.2         617.400         ND         NO         697.00           Medical Class (Japa)         1         70000         70010         114.4.2         617.400         ND         NO         617.00           Maced Lase Unap         4         339525         355530         659.89         448.00         ND         ND         647.00           National Concept         1         120000         120000         244.50         MAR         ND         ND         647.00           National Concept         2         366000         368.00         ND         ND         ND         677.00           National Concept         2         366000         368.00         ND         ND         677.00         977.00         977.00         977.00         101.74         273.29         1172.00         360.00         101.74         273.29         1172.00         360.00         100.77         273.29         1172.00         360.00         100.77         273.29         1172.00         360.00         100.777.00         100.77         100.77 </td <td>Commercial</td> <td></td> <td></td> <td></td> <td>(\$/SM)</td> <td>(SM)</td> <td></td> <td></td> <td>(SM)</td> <td></td>	Commercial				(\$/SM)	(SM)			(SM)		
bp: bits         3         115.000         34.400         34.46         977.50         127.360         107.35         977.50           None:Singing         3         43333         500.000         544.48         1130.00         157.464         778.57×         1130.00           None:Use Units         5         779.00         179.160         24.48.00         Null         Null         44.88.00         Null         Null         50.85.00         Null         Null         50.85.00         Null         Null         50.85.00         Null         50.85.00         NULl         38.000         S0.41.10         S0.85.00         NULl         S0.85.00         NULl         S0.85.00         NULl         S0.85.00         NULl	Com Land (Struct 0)	1	1500000	1500000	228.31	6570.00	ND	ND	6570.00		
ikada iSbugs         1         7000         7100         7100         7100         7170         7170         7170         7170           Made iSbugs         3         300000         644.46         71720         717.30         71730           Minet isbu Ursp         4         388.25         355.25         825.89         455.00         717.30         717.30           National Co-Ursp         1         712000         724.50         717.50         717.50         717.50         717.50           Real Sige Our Ursp         3         1551000         348.500         368.48         717.50         7	Dev Site	3	1851696	451000	364.16	9171.50	121.89<	101.35<	9171.50		
Mied.Lisp	Health Clinic Unsp	1	700000	700000	1134.52	617.00	ND	ND	617.00		
Minetia (bit lue lung)4391/25392/25825 PB4495.0047.8°67.3°47.10Nationa (Co lung)1120000224.904405.00NONONO22250.00PalaTaservillo lung2348500598.865707.05NONO22250.00PalaTaservillo lung316161064461.00904.41917.15917.1611.3.5°917.10PalaTaservillo lung1298000297.5297.20144.77223.32°1172.00Sing1298000297.5297.50NONONO93.00Control55.5998.5068.1771.9593.0070.9770.07Child Celle lung1900009000075.9770.07NONONO203.50Palatony Sances68.4449.89523.56117.00.0038.6133.5917700.00Palatony Usage8444.64749.89523.56110.37.421.75.734.67.7Palatony Usage968.400.00.0090.23.567.6038.6133.5917700.00Palatony Usage968.400.00.0090.23.567.6038.6133.5917700.00Palatony Usage99.64.2411.9611.9611.9611.9611.96Palatony Usage99.60.009.32.5610.37.412.75.622.85.00Palatony Usage99.69.0010.35.767.6038.6113	Medical/Surgery	3	493333	500000	544.46	1102.00	157.48<	178.57<	1113.00		
Netoda i Co / Neta         1         19200410         1274 50         4448.00         ND         ND         4408.00           Natorai Co / Neta         2         1486.00         1420.419         652.08         2225.00         ND         ND         ND         STO.50           Pita / Sprom Co Lo / Imp         2         185.168         4550.00         064.84         171.50         171.60         171.50           Read Signe Convert         2         82850         258.50         171.82         171.80         171.80         171.80           Serv AptiVitu (Imp)         1         280000         2717.32         97.00         ND         ND         187.00           Serv AptiVitu (Imp)         1         280000         2717.32         97.00         ND         ND         283.00           Cohe Corris (Imp)         1         280000         171.32         179.00         305.81         305.80         292.51.7           Patory (Imp)         1         90000         262.43         292.61.07         179.00         293.51         293.51         293.51         293.51         293.51         293.51         293.51         293.51         293.51         293.51         293.51         293.51         293.51         293.51<	Mixed Use Unsp	4	389125	363250	829.69	458.00	45.32<	67.39<	471.00		
Ninking Ninking PickTaleern(Using)1100N00N002225.00Real Sign Oct Uring345450056.865700.50N00N00S700.50Real Sign Oct Uring3656450542500344.13171.50121.42*171.51Sign Oct Uring1269000277.3297.00N40N00N70N00Sing0553.56255.06255.000.0089.17*156.5353.00Commung Sarrices	National Co Rest	1	1210000	1210000	274.50	4408.00	ND	ND	4408.00		
pin arrawn Chia Urag         2         348000         968 86         9700.50         ND         ND         ND         9700.50           Rehit Sige Octo Urag         3         135106         945000         349.27         1192.30         107.74         223.28*         107.30         107.30           Stop         3         353000         25500         273.07         ND         ND         P70.01           Stop         3         353000         25500         273.07         ND         ND         970.01           Chin Centru Urag         1         350000         258.20         128.97         2883.00         ND         ND         9700.00           Frantry         1         990000         258.2         17800.00         114.32×         205.57         4395.17           Frantry         1         990000         268.2         1780.00         114.32×         205.57         4395.00           Frantry         1         990000         202.44         208.00         ND         14000.00         ND         14000.00           Warehouse Urage         1         10550         100.50         133.4         14000.00         ND         ND         19900.00           Warehouse Urage	National Co Unsp	1	12303419	12303419	552.96	22250.00	ND	ND	22250.00		
Real Sign Cot Unage         3         191590         9241 Sizen Sign Cot Unage         1917 50          1917 50 <th< td=""><td>Pub/Tavern/Club Unsp</td><td>2</td><td>3485000</td><td>3485000</td><td>508.86</td><td>5700.50</td><td>ND</td><td>ND</td><td>5700.50</td><td></td></th<>	Pub/Tavern/Club Unsp	2	3485000	3485000	508.86	5700.50	ND	ND	5700.50		
Real BlueBhowm         2         95200         9442,7         1972.00         107.7         25.03/e         197.00           Serv ActUL Upap         3         552080         953.39         933.00         ND         ND         950.00           Sinp O         3         55000         159.97         289.00         ND         ND         983.00           Chi Contro Urap         1         55000         159.97         289.00         ND         ND         983.00           Fachary Urap         6         440474         403260         20.66         300.90         119.95         20.57.5         20.57.5         3265.07           Fachary Urap         6         440474         403260         20.65.6         120.72.5         127.08         2855.00           WarafousaeUnape         5         64.020         800.000         202.43         67.00         80.01         32.02.17         127.08         2855.00           WarafousaeUnape         5         180.50         180.50         90.00         90.00         90.00         90.00         90.00         90.00         90.00         90.00         90.00         90.00         90.00         90.00         90.00         90.00         90.00         90.00	Retail Sgle Occ Unsp	3	1851696	451000	364.16	9171.50	121.89<	101.35<	9171.50		
Serve ph/Linking         1         28800         2773 20         97.00         ND         ND         97.00           Sing         3         55280         25530         95.30         95.30         95.30         95.30           Community Services         (SM)         (SM)         (SM)         (SM)         (SM)         (SM)           Indicersity         1         30000         55.62         (SM)         SM         10.30         201.57×         436.517×           Factory         6         444007         40000         50.56         235.80         30.86.60         114.32×         201.57×         436.517×           Warnhouse Unspin         6         94420         200000         222.43         2004.00         ND         ND         MD         MD           Warnhouse Unspin         1         1550         90.000         222.43         2004.000         ND         ND         100.00           Warnhouse Unspin         1         1805         160.90         190.700         ND         ND         100.00           CarrCore 250m Unspin         449860         250.70         168.00         168.07         69.67         67.74         68.07×         67.828.50         100.00         1	Retail Store/Showrm	2	582500	582500	349.27	1672.00	104.77<	253.26<	1672.00		
Shop3Sizee2935.00983.30983.30987.7*91 5.0*983.00Child Curite Urap1550003500012.29 772033.00NDND2083.00Diradzariat5800055.2217800.00S5.8217800.00S5.8217800.002083.01Fachery Urap19900002055.8517800.00S5.8217800.00100.23201.07×201.	Serv Apt/Unit Unsp	1	269000	269000	2773.20	97.00	ND	ND	97.00		
Cammuny Services         (HSM)         (BM)         (BM)         (BM)           Inducerity         1         35000         12.927         2.93.00         ND         ND         269.00           Factory         1         90000         55.82         17.90.00         33.95.50         114.32*         2201.57*         3425.17           Factory Unsp         6         449.07         440550         233.68         33.95.50         114.32*         2201.57*         3425.17           Factory Unsp         5         954.200         60000         202.43         2.904.60         ND         233.24*         3739.60           Warehouse Kingae         5         954.200         60000         202.43         2.904.60         ND         233.24*         3739.60           Marentose Kingae         5         954.200         5.05.9         1786.00         ND         ND         180.00.00           Marentose Kingae         1         183.93         152.24         1400.00.0         ND         180.00         140.92         420.30         140.92         453.70         140.42         140.00.00         ND         180.00         140.92         453.70         140.42         140.00.00         ND         180.00         140.	Shop	3	532666	258500	563.59	363.00	86.17<	91.50<	363.00		
Child Cetter Unsp         1         35000         35000         129.97         2033.09         ND         ND         2693.00           Indury         1         960000         960000         55.82         1780.00         306.44         335.69         1780.00           Factory Unp         6         464047         435550         233.88         50         114.324         201.67         335.69         1178.00           Warehouse Unspec         5         664280         600000         203.24         2085.00         ND         233.24         3738.60           Warehouse Unspec         5         664280         600000         203.25         877.00         50.61         87.80         (5M)           Warehouse Unspec         5         664280         600000         0.35         13.44         14000.00         ND         H300.00           Warehouse Unspec         5         468660         420000         0.37         68860.00         ND         ND         19400.00           Unspec         5         468660         420000         0.37         68867.00         95.02         87.76         689.70         689.72         87.760.70         69.02         87.76         689.70.00         11114         1	Community Services				(\$/SM)	(SM)			(SM)		
Industrial(BSM)(BM)(BM)(BM)Factory1900065 6217080.00335.95114.32×201.57×17900.00Factory127000100.562265.00114.32×201.57×170002425.37Ind Lev Silve5944200900000202.43204.40ND233.243738.60Warehouse Chrose6944200900000202.43204.40ND233.243738.60Interstruc GUIInte116535010.2414400.00NDND14000.00Mater Utambifishtut118535010.2414400.00NDND14000.00GentCiny 2701 Uray54366020000.536580.0085.02×87.50×87.60×Livestox - Dany1240033000000.53518477.0050.00×11.11×518477.00Livestox - Dany12400302560001.57153300.00NDND183300.00Masd Tam Inpr102750032560001.57153300.00NDND183300.00Masd Tam Inpr240330440000.54656.5125.7165837.0102.94Livestox - Dany1.2240330447507.60144760.0156.5126.7165837.0Livestox - Dany1.2440350447507.60144760.0163.2485.051760.24Livestox - Dany1.24403504475007.60144760.0 <td< td=""><td>Child Centre Unsp</td><td>1</td><td>350000</td><td>350000</td><td>129.97</td><td>2693.00</td><td>ND</td><td>ND</td><td>2693.00</td><td></td></td<>	Child Centre Unsp	1	350000	350000	129.97	2693.00	ND	ND	2693.00		
Factory         1         990000         990000         55.62         17780.00         308.41         335.59.4         1780.00           Factory Unype         0         44407         438.50         233.56         316.52         117.05.7         324.51.7           Ind be Site         1         270000         270000         202.43         288.50         117.05.7         324.51.7           Warehouse/Hourse/Hou	Industrial				(\$/SM)	(SM)			(SM)		
Factory Unsp         6         448047         433850         233.80         2328.50         114.32*         20.15*         3225.17           ind Dav.Sile         1         270000         270000         100.58         2207.3*         127.08         2208.50           Warehusse Unspec         5         644290         600000         202.43         2994.00         ND         232.24         3779.90           Intrastruc dUllities         (#SM)         (SM)         (SM)         (SM)           SubtrandaRual Road         1         155350         13.24         14000.0         ND         ND         1800.00           Primary Production         (#SM)         (SM)         ND         ND         1987.00           CentCrop 2010 Unp.0         5         456960         42000         0.57         668800.00         95.02*         87.50*         514246.00           Livestock - Barly         2         300000         0.53         51477.00         50.00*         111.1*         518477.00           Livestock - Steep         1         256000         1.57         165300.00         ND         ND         163300.00           MixedFamaRoTanzUnp.0         43         37900         1.56         65.54.5*         5	Factory	1	990000	990000	55.62	17800.00	308.41<	335.59<	17800.00		
Ind Dev Sile         1         270000         270000         100.56         288.00         120.73*         127.06*         288.80           Warehouse/Nonvoon         4         8763731         1022000         303.25         876.00         ND         53.24*         373.86           Marehouse/Nonvoon         4         8763731         1022000         303.25         876.00         36.81*         5.40*         1798.00           Intsutcatand.Paral Read         1         18550         18550         18550         1824         14000.00         ND         ND         14000.00           Water/ubtand.Paral         7         18950         13.24         14000.00         ND         ND         1807.00           Intary Producton         (\$458)         (\$80)         5         684280.00         28.57*         673282.50           Uvestock - Daiy         12         440333         440000         0.87         68580.00         ND         ND         ND         10         16330.00           Weeder/arm No Incor         10         21727         440500         0.33         62229.20         55.647         59.55*         67328.50           Weeder/arm No Incor         13         338606         315000         4313 <td>Factory Unsp</td> <td>6</td> <td>446047</td> <td>493850</td> <td>233.56</td> <td>3266.50</td> <td>114.32&lt;</td> <td>201.57&lt;</td> <td>3425.17</td> <td></td>	Factory Unsp	6	446047	493850	233.56	3266.50	114.32<	201.57<	3425.17		
Wate losse binspec         5         664280         600000         20.243         29.400         ND         23.244         3738.60           Mater losse binspect         (19.80)         30.252         67.800         30.614         5.400         175.000           Mater losse binspect         (19.80)         18.550         18.324         14.000.00         ND         ND         1890.000           Value loss binspect         (19.80)         1887.00         ND         ND         1897.00           Primary Production         (18.90)         4.896.00         0.05         55.62         87.50.0         614242.00           GentCorp 201 long         5         4.896.00         0.67         65856.00         55.62         87.50.0         614242.00           Losstock - Dariy         12         440033         440000         0.67         16330.00         ND         ND         16330.00           MusedFarm Charry         10         217627         1445000         0.10         453471.00         56.84         59.65.7         59.86.7         59.86.7         59.86.7         59.86.7         59.86.7         59.86.7         59.86.7         59.86.7         59.86.7         59.86.7         59.86.7         59.86.7         59.86.7         59	Ind Dev Site	1	270000	270000	100.56	2685.00	120.73<	127.06<	2685.00		
Waterbuse/Shownom         4         8763761         102500         30.2.5         67.0.0         36.1         5.40         1796.00           Suburban/Retuile Raad         1         168330         119550         13.3.4         14000.00         ND         ND         14000.00           Pinary Production         (9.8%)         (9.8%)         (8%)         (8%)         (8%)           GenCrop -20na Ungp         5         489660         420000         0.57         68960.00         95.02         87.50         814248.00           Livestock - Dairy         12         440333         440000         0.677         696470.00         95.00         111.11         151877.00           Livestock - Dairy         12         440333         440000         0.67         696477.00         95.66         125.71         698370.00           Livestock - Dairy         12         440330         447000         0.10         45941.00         55.87         59.67         153.00         0.01         164394.00         16330.00         ND         ND         16330.00           Mixed/Farm Inip         48         377156         315000         0.13         652540         128.00         828790.40           Orchard Plantations         5 <td>Warehouse Unspec</td> <td>5</td> <td>664280</td> <td>600000</td> <td>202.43</td> <td>2964.00</td> <td>ND</td> <td>233.24&lt;</td> <td>3739.60</td> <td></td>	Warehouse Unspec	5	664280	600000	202.43	2964.00	ND	233.24<	3739.60		
InfrastruckUtilities         (\$\$\$\$)         (\$\$\$\$)         (\$\$\$\$)         (\$\$\$\$)           ValaetArbanDistribut         1         18550         182530         124 4         14000.00         ND         ND         180700           Primary Praduction         (\$\$\$\$\$)         124 4         14000.00         95.02         \$7.50         8184245.00           GenCrop 2010 lungs         5         489660         200000         0.57         688600.00         95.02         \$7.50         8184245.00           Livestock - Beef         2         300000         0.53         518477.00         95.65         125.71         68937.00           Livestock - Sheep         1         256000         1.57         163300.00         ND         ND         163300.00           MixedFamR GrankGrauthang         8         37755         315000         0.11         44780.00         69.87         59.57         59.57         59.57           Residential         5         440333         440030         0.11         44780.00         69.87         69.50         174034.80           Residential         1         25600         233750         324.66         730.00         ND         78.44         780.75           Detached Home (new) <td>Warehouse/Showroom</td> <td>4</td> <td>8763761</td> <td>1025000</td> <td>303.25</td> <td>676.00</td> <td>36.61&lt;</td> <td>5.40&lt;</td> <td>1796.00</td> <td></td>	Warehouse/Showroom	4	8763761	1025000	303.25	676.00	36.61<	5.40<	1796.00		
SuburbankTuril Road         1         195350         13.24         14000.00         ND         ND         14000.00           Write Likensionstrukt         1         1055         1055         0.09         19970.00         ND         ND         14000.00           Primary Production         5         4498400         42000         0.57         688800.00         95.02         87.50         814248.00           Livestock - Beeff         2         300000         0.30         514477.00         50.00         111.11         518477.00           Livestock - Sheep         1         246000         256000         1.57         163300.00         ND         ND         10         9330.00           MixedFarm Ro Impr         10         2.17227         145000         7.00         14478.00         6.55.7         59.55         125.71         69.837.00           Orchard Planations         5         44730.00         7.00         14478.00         69.85         92.56         717024.80           Detached Home (new)         13         338006         315000         73.00         78.44         780.75           Detached Home (new)         18         2.45899         2.31750         322.40         ND         A23.73	Infrastruc&Utilities				(\$/SM)	(SM)			(SM)		
Meter/chan/bishtbut         1         1805         1805         0.09         ND         ND         ND         18970.00           Primary Production         (SN)         (SN)         (SN)         (SN)         (SN)         (SN)           Livestock - Beef         2         300000         0.57         65867.00         95.62         87.50         814244.00           Livestock - Dairy         12         440333         440000         0.57         669475.00         95.65         122.71         689370.00           Livestock - Sheep         1         25600         1.57         163300.00         ND         ND         163300.00           MixedFarmACirazUnsp         48         377156         31600         0.31         627292.00         555.40         126.00         628790.40           Orthard Plantstions         5         440350         47550         7.60         114780.00         69.87         89.50         174034.80           Patached Home (new)         13         338606         31500         49131         80550         102.94         96.60         924.70           Detached Home (new)         13         33860         31500         14131         80550         102.94         98.60         924.70<	Suburban&Rural Road	1	185350	185350	13.24	14000.00	ND	ND	14000.00		
Primary Production         (\$M\$)         (\$M)         (\$M)           GenCrop 20h Unsp.         5         489660         42000         0.5.3         518477.00         50.02         87.50         814248.00           Livestock - Beef         2         300000         0.5.3         518477.00         50.00         111.11         518477.00           Livestock - Dairy         12         44033         440000         0.67         668670.00         95.65         125.71         668970.00           Livestock - Sheep         1         225000         225000         1.7         193300.00         ND         ND         103300.00           MixedFarm&GrazUnsp         48         377156         315000         0.31         652722.00         555.40         122.00         82870.40           Orchard Plantalions         5         4405500         447500         7.60         147470.00         69.87         89.50         174034.80           Detached Home (new)         13         338606         31500         491.31         805.50         102.94         95.60         924.70           Detached Home (new)         18         246699         23370         344.80         70.00         104.24         97.06         88.87	WaterUrbanDistribut	1	1805	1805	0.09	19870.00	ND	ND	19870.00		
Lensitox +       Bell       490600       0.57       00800.00       95.02*       87.90*       81.428.00         Livestox - Dairy       12       440333       440000       0.67       606475.00       95.66*       125.71*       8689370.00         Livestox - Dairy       12       440333       440000       0.67       606475.00       95.66*       125.71*       8689370.00         Livestox - Sheep       1       256000       1.57       163300.00       ND       ND       163300.00         MixedFarm ScrazUnsp       48       377.156       315000       0.31       627.92.00       555.40*       128.00*       827.90.40         Orchard Plantations       5       4403500       447500       7.60       144.78.00       69.87*       89.50*       174.034.80         Residentia       (SM)       (SM)       (SM)       (SM)       (SM)       924.70         Detached Home (ensit)       13       338606       315000       491.31       805.50       102.94*       95.60*       924.70         Detached Home (exist)       442       252238       239750       481.30       722.00       104.24*       97.06*       86.897         Residentia       1       1540000       18.5	Primary Production		400000	100000	(\$/SM)	(SM)	05.00		(SM)		
Livestok - Beef       2       30000       0.53       518477.00       50.04       11.11*       518477.00         Livestok - Sheep       1       25600       16.57       163300.00       ND       ND       163300.00         MixedFarm no impr       10       217627       145000       0.10       459410.00       55.64       125.71       653370.00         MixedFarm Karzulnsp       440353       440000       0.10       459410.00       55.64       125.01       679262.50         MixedFarm Karzulnsp       48       377156       315000       0.31       627292.00       55.44       125.00       629270.40         Orchard Plantations       5       440350       447500       7.60       14478.00       68.87       89.50       174034.80         Cestondel Home (new)       13       338005       315000       491.31       805.50       102.94       95.60       924.70         Detached Home (new)       13       338005       315000       491.31       805.50       102.94       95.60       924.70         Detached Home (new)       18       252238       233750       324.68       73.00       ND       76.44       760.75         Detached Home (exist)       442       <	GenCrop >20ha Unsp	5	489660	420000	0.57	688600.00	95.02<	87.50<	814248.00		
Livestok - Daily       12       44033       44000       0.077       60647:0.0       95.054       122,712       668370.00         MixedFarm no impr       10       225600       25600       0.17       16330.00       ND       ND       668370.00         MixedFarm No impr       10       217627       145000       0.10       459410.00       55.87       59.57       578262.50         MixedFarm No impr       10       217627       145000       0.11       627292.00       555.404       128.00       628270.40         Orchard Plantations       5       4403500       447500       768       14478.00       69.87       89.50       172.403.480         Residential       (SM)       (SM)       (SM)       (SM)       (SM)       68.97         Detached Home (new)       13       338005       315000       491.31       80.505       10.294       95.60       924.70         Detached Home (new)       18       245699       233750       324.468       720.00       ND       452.94       80241.00         Res Dev Site       1       154000       18.50       8241.00       ND       40.52.94       82341.00         Res Investiment Fialt       4       195750       <	Livestock – Beet	2	300000	300000	0.53	518477.00	50.00<	111.11<	518477.00		
Livestopr         1         20000         1.50         10.5300.00         ND         ND         ND         ND3         ND3         ND3           MixedFarm&GrazUnsp         48         377156         315000         0.31         62222.00         555.40         126.00         828790.40           Orchard Plantations         5         4403500         447500         7.60         144780.00         56.87         59.262.50           Residentia         (KSM)         (SM)         (SM)         (SM)         (SM)         (SM)           Detached Home (new)         13         338606         315000         491.31         805.50         102.94         95.60         924.70           Detached Home (new)         18         245099         233750         324.66         730.00         ND         75.44         70.75           Detached Home (new)         18         245099         233750         4324.100         ND         452.94         83241.00           Res provisite         1         1540000         154.000         NA         NA         23.73         ND         NA           Res/Reville         1         1500000         NA         NA         23.73         ND         NA	Livestock – Dairy	12	440333	440000	0.67	606475.00	95.65<	125.71<	689370.00		
Mixe6 <sup>2</sup> arm no imp         10         21/22         143000         0.0         439410.00         53.81/4         59.51/6         59.51/6	Livestock – Sheep	1	256000	256000	1.57	163300.00	ND	ND	163300.00		
Mixed-armsQra20x19p         44         3 / 1000         0.1         62/292.00         503.40         126.00         629.90.40           Orchard Plantations         5         4403500         447500         7.60         144780.00         69.87         89.50<	MixedFarm no impr	10	21/62/	145000	0.10	459410.00	55.87<	59.57<	579262.50		
Charter Plantations         5         44/3500         44/3500         7.40         7.	MixedFarm&GrazUnsp	48	377156	315000	0.31	627292.00	555.40<	126.00<	828790.40		
Kesilenital         (SM)         (SM)         (SM)         (SM)         (SM)           Detached Home (uny)         13         338606         315000         491.31         805.50         102.94         95.60         924.70           Detached Home (uny)         148         245699         233750         324.66         730.00         ND         78.44         780.75           Detached Home(exist)         442         252238         239750         491.30         722.00         104.24         97.06         886.97           Res Investment Flat         4         195750         210000         NA         NA         233362.18           Res/Rural Lstyle         84         377332         340299         42.38         10000.00         95.19<		5	4403500	447500	(\$(014)	144780.00	69.87<	89.50<	174034.80		
Detached Home Unsw         13         336000         316000         316000         191.3         003.30         102.34-         93.80-         93.80-         93.80-           Detached Home Unsw         188         245699         233750         324.66         730.00         ND         78.44-         780.75           Detached Home (exist)         442         25233         239750         481.30         722.00         104.24-         97.06-         868.97           Res Dev Site         1         1540000         1540000         NA         NA         23.73-         ND         NA           Res Investment Flait         4         195750         210000         NA         NA         23.73-         ND         NA           Res/Rural Lstyle         84         377332         340299         42.38         1000.00         ND         21.39-         1590.00           Retire Village Compl         1         1500000         NA         NA         ND         ND         NA           Single Strata Unity/Flat Uns         19         242500         172000         1321.43         140.00         75.11         96.63-         140.00           Vac Res A         227         10956         107500         160.40<	Residential	10	229606	215000	(\$/SWI)	(SM)	102.04~	05 00 4	(SM)		
Detached Homie Onisp         field         24-069         233-03         24-060         1/3-00         fteld         1/3-44         1/0-13           Detached Homie(xist)         442         252238         239750         481.30         722.00         104.24         97.06         888.97           Res Dev Site         1         1540000         18.50         83241.00         ND         452.94         83241.00           Res Investment Flat         4         195750         210000         NA         NA         23.73         ND         NA           Res/Rural Lstyle         84         377332         340299         42.38         1000.00         95.19         103.12         33362.18           ResLandWithImprovemt         1         77000         77000         48.43         1590.00         ND         ND         NA           Retire Village Compl         1         1500000         NA         NA         NA         21.39         1590.00           Retire Village Unit         2         285500         285500         NA         NA         21.32         173.03         NA           Single Strata Unit/Flat Uns         19         242500         172000         1321.43         140.00         75.11		100	245600	233750	324.66	730.00	ND	95.60<	780.75		
Detached HolingeNsty         H42         Lock of         H42         Lock of         H42         100         000000           Res Dev Site         1         1540000         16500         83241.00         ND         452.94         83241.00           Res Investment Flat         4         195750         210000         NA         NA         23.73         ND         NA           Res Investment Flat         4         195750         210000         NA         NA         23.73         ND         NA           Res Investment Flat         4         195750         210000         NA         NA         23.73         ND         NA           Res Investment Flat         1         77000         48.43         1590.00         ND         21.39         1590.00           Res Investment Flat         1         17000         77000         48.43         1590.00         ND         21.39         1590.00         NA           Retire Village Compl         1         1500000         95.19         320.00         ND         104.44         317.00         NA           Single Strata Unit/Flat Uns         19         242500         172000         1321.43         140.00         75.11         96.63         14	Detached Home(exist)	100	252238	239750	481 30	730.00	104.24<	78.44<	868.97		
Res Investment Fial       1       100000       NA       NA       21.03       100.04       0000       NA         Res Investment Fial       4       19750       210000       NA       NA       23.73       ND       NA         Res Investment Fial       4       37732       340299       42.38       10000.00       95.19       103.12       33362.18         Res Investment Fial       1       77000       48.43       1590.00       ND       21.39       1590.00         Retire Village Compl       1       150000       NA       NA       ND       ND       NA         Single Stata Unsp       17       199705       188000       492.19       320.00       ND       104.44       317.00         Strata Unit/Flat Unsp       19       242500       172000       1321.43       140.00       75.11       96.63       140.00         Townhouse       36       233041       235000       883.33       300.00       138.24       115.06       316.69         Vac Res A       227       110956       107500       160.40       745.00       106.44       93.48       789.73         Vac Res // Rural Lstyle       30       227723       151000       20.52	Res Dev Site	442	1540000	1540000	18 50	83241.00	ND	97.00<	83241.00		
No.       Int.	Res Investment Flat	1	195750	210000	NA	NA	23 73<	452.94 ND	NA		
ReskandWithImprovemt       1       77000       77000       48.43       1590.00       ND       21.39       1500.00         Retire Village Compl       1       1500000       NA       NA       ND       ND       ND       NA         Retire Village Compl       1       1500000       NA       NA       NA       ND       ND       NA         Single Strata Unsp       17       199705       188000       492.19       320.00       ND       104.44       317.00         Strata Unit/Flat Uns       19       242500       172000       1321.43       140.00       75.11       96.63       140.00         Townhouse       36       233041       235000       883.33       300.00       138.24       115.06       316.69         Vac Res A       227       110956       107500       160.40       745.00       106.44       93.48       789.73         Vac Res B       19       160236       155000       68.65       2695.00       164.89       114.18       2792.37         Vac Res/Rural Lstyle       30       227723       151000       20.52       10057.50       105.23       125.83       32432.60         Industrial Total       17       I	Res/Rural Lstyle	84	377332	340299	42.38	10000.00	95 19<	103 12<	33362 18	_	
Retire Village Compl         1         11000         110000         NA         NA         ND         ND         NA           Retire Village Compl         1         1500000         NA         NA         NA         ND         ND         NA           Retire Village Unit         2         285500         285500         NA         NA         A         221.32         173.03         NA           Single Strata Unit/Flat Uns         19         242500         172000         1321.43         140.00         75.11         96.63         140.00           Townhouse         36         233041         235000         883.33         300.00         138.24         115.06         316.69           Vac Res A         227         110956         107500         160.40         745.00         106.44         93.48         789.73           Vac Res B         19         160236         155000         68.65         2695.00         164.89         114.18         2792.37           Vac Res /Rural Lstyle         30         227723         151000         20.52         10057.50         105.23         125.83         32432.60           Industrial Total         17         Industrial Total Prices         125.83		1	77000	77000	48.43	1590.00	ND	21 30<	1590.00		
Net in Higge Online       1 <th1< th="">       1       <th1< th=""></th1<></th1<>	Retire Village Compl	1	1500000	1500000	NA	NA	ND	ND	NA		
India Finds of the second strate       International finance       International finance       International finance         Single Strate Unity/Flat Uns       19       242500       172000       1321.43       140.00       75.11       96.63       140.00         Townhouse       36       233041       235000       883.33       300.00       138.24       115.06       316.69         Vac Res A       227       110956       107500       160.40       745.00       106.44       93.48       789.73         Vac Res B       19       160236       155000       68.65       2695.00       164.89       114.18       2792.37         Vac Res/Rural Lstyle       30       227723       151000       20.52       10057.50       105.23       125.83       32432.60         Funder Unity Field Prices         Community Services Total       71       Industrial Total Prices         Industrial Total       17       Industrial Total Prices       1	Retire Village Unit	2	285500	285500	NA	NA	221.32<	173 03<	NA		
Strata Unit/Flat Uns       19       242500       172000       1321.43       140.00       75.11       96.63       140.00         Townhouse       36       233041       235000       883.33       300.00       138.24       115.06       316.69         Vac Res A       227       110956       107500       160.40       745.00       106.44       93.48       789.73         Vac Res B       19       160236       155000       68.65       2695.00       164.89       114.18       2792.37         Vac Res/Rural Lstyle       30       227723       151000       20.52       10057.50       105.23       125.83       32432.60         Municipality totals         Community Services Total       1       Industrial Total Prices       32432.60         Industrial Total       17       Industrial Total Prices       32432.60         Infrastruc&Utilities Total       17       Industrial Total Prices       1         Infrastruc&Utilities Total       1       1.084       Residential Total Prices         Infrastruc&Utilities Total       1.084       Residential Total Prices       1         Commercial Total       25       Commercial Total Prices       1         Primary Production Total	Single Strata Unsp	17	199705	188000	492 19	320.00	ND	104 44<	317.00		
Order Ontry Reform         10         11000         1100000         1100000         1100000         1100000         1100000         1100000         1100000         11000000         1100000000000         1100000000000000000000000000000000000	Strata Unit/Elat Uns	10	242500	172000	1321 43	140.00	75 11<	96.63<	140.00		
Vac Res A227110956107500160.40745.00106.4493.48789.73Vac Res B1916023615500068.652695.00164.89114.182792.37Vac Res/Rural Lstyle3022772315100020.5210057.50105.23125.8332432.60Municipality totalsCommunity Services TotalPricesIndustrial Total1Community Services Total PricesIndustrial Total17Industrial Total PricesInfrastruc&Utilities Total12Infrastruc&Utilities Total PricesResidential Total1,084Residential Total PricesCommercial Total25Commercial Total PricesPrimary Production Total83Primary Production Total Prices	Townhouse	36	233041	235000	883.33	300.00	138.24<	115.06<	316.69		
Vac Res B1916023615500068.652695.00164.89114.182792.37Vac Res/Rural Lstyle3022772315100020.5210057.50105.23125.8332432.60Municipality totalsCommunity Services Total11 <td>Vac Res A</td> <td>227</td> <td>110956</td> <td>107500</td> <td>160 40</td> <td>745.00</td> <td>106.44&lt;</td> <td>93.48&lt;</td> <td>789 73</td> <td></td>	Vac Res A	227	110956	107500	160 40	745.00	106.44<	93.48<	789 73		
Vac Res/Rural Lstyle3022772315100020.5210057.50105.03125.8332432.60Municipality totalsCommunity Services Total1Community Services Total PricesIndustrial Total17Industrial Total PricesInfrastruc&Utilities Total2Infrastruc&Utilities Total PricesResidential Total1,084Residential Total PricesCommercial Total25Commercial Total PricesPrimary Production Total83Primary Production Total Prices	Vac Res B	19	160236	155000	68 65	2695.00	164.89<	114 18<	2792 37		
International for the formation of the form	Vac Res/Rural Lstyle	30	227723	151000	20.52	10057 50	105.23<	125.83<	32432.60		
MUNICIPAIITY totalsCommunity Services TotalIndustrial TotalIndustrial TotalInfrastruc&Utilities TotalResidential Total1,084Residential Total PricesCommercial Total2Primary Production Total83Primary Production Total	The restrict Estyle		22.720		20.02		100.20	120.00	02102.00		
Community Services Total1Community Services Total PricesIndustrial Total17Industrial Total PricesInfrastruc&Utilities Total2Infrastruc&Utilities Total PricesResidential Total1,084Residential Total PricesCommercial Total25Commercial Total PricesPrimary Production Total83Primary Production Total Prices					Municip	ality totals					
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Infrastruce/offinities fotal     2     Infrastruce/offinities fotal Prices       Residential Total     1,084     Residential Total Prices       Commercial Total     25     Commercial Total Prices       Primary Production Total     83     Primary Production Total Prices					2		Industrial Total Price	es Lotal Dricco			
Commercial Total     25     Commercial Total Prices       Primary Production Total     83     Primary Production Total Prices	Residential Total			1.00	۲ R4		Residential Total Dri	I UTAL PLICES			
Primary Production Total     83     Primary Production Total Prices	Commercial Total			1,00	25		Commercial Total P	rices			
	Primary Production Total			{	33		Primary Production	Total Prices			

1,212

All Sales Total

#### Mean Price per Unit Area

(\$/SM)	
228.31	
290.85	
1134.52	
443.25	
730.01	
274.50	
552.96	
611.35	
290.85	
348.39	
2773.20	
564.74	
(\$/SM)	
129.97	
(\$/SM)	
55.62	
130.23	
100.56	
6422.61	
(\$/\$M)	
(\$/SIVI) 13.24	
0.09	
(\$/SM)	
0.60	
0.58	
0.64	
1.57	
0.38	
0.46	
25.30	
(\$/SM)	
388.11	
314.85	
290.99	
18.50	
NA	
11.31	
48.43	
NA	
NA	
614.09	
1321.43	
812.85	
140.23	
57.38	
7.02	

#### \$350,000

\$42,312,727 \$187,155 \$249,705,032 \$39,862,099 \$50,885,606 \$383,302,619

All Sales Total

				Campas	spe Shire	•			
			Anal	ysis of prop	erty sales f	or 2012			
Land Use	No of Sales	Mean Sales Price (\$)	Median Sales Price (\$)	Median Price per Unit Area	Median Block size	Price-lı (base i 2011	ndices s 100)	Mean Block size	Mean Price per Unit Area
				(\$ (014)	(014)		2007	(014)	(\$(0.04))
Commercial	4	46000	46000	(\$/SM)	(SM)	ND	0.40.4	(SM)	(\$/SM)
Mixed Use Shop		40000	750000	400.00	1529.00	245.00~	0.13<	2911.90	400.00
Nixed Use Ulisp	5	905000	250000	121.49	2059.00	245.90	100.20<	2011.00	121.49
Pub/Tavern/Club Unsp	1	250000	250000	121.40	2056.00	ND	ND	2000.00	121.40
Retail Store/Snowrm	3	3760000	1430000	407.70	180.00		189.72<	19703.00	239.44
Shop	2	220000	220000	1321.79	109.30	63.50<	47.77<	109.30	1100.95
Strata/Subdiv Office	1	200000	266000	12.0E	10240.00	160 71 4	ND	10240.00	12.05
	1	450000	450000	43.95	10240.00	100.715	ND	10240.00	43.95
	4	E245E0	E24550	(\$/SIVI)	(SM)	ND	ND	(SM)	(\$/SWI)
	1	534550	534550	20.70	19960.00	100.00.4	ND	19960.00	20.70
Factory Unsp	4	269750	95000	15.34	3955.50	102.395	66.18<	00143.00	4.49
Ind Dev Site	1	726000	726000	358.70	2024.00	325.50<	342.86<	2024.00	358.70
Warehouse Unspec	3	351666	305000	108.58	4418.00	ND	ND	4418.00	108.08
Infrastruc&Utilities		75000	75000	(\$/SM)	(SM)	ND		(SM)	(\$/SM)
Airport Hangar Build	1	75000	75000	145.07	517.00	ND	ND	517.00	145.07
Suburban&Rural Road	1	4692	4692	0.48	9680.00	ND	ND	9680.00	0.48
WaterUrbanDistribut	1	281	281	0.01	20420.00	ND	ND	20420.00	0.01
Primary Production		40.4050	005005	(\$/SM)	(SM)	100 50		(SM)	(\$/SM)
GenCrop >20ha Unsp	8	434356	325625	0.74	577700.00	138.56<	62.02<	722615.00	0.60
Livestock – Beet	8	463526	414356	0.48	1557050.00	182.13<	90.08<	1579696.75	0.29
Livestock – Dairy	30	413074	378500	0.55	4/3/50.00	101.08<	161.75<	628690.50	0.66
MixedFarm + impr	1	315000	315000	0.62	511900.00	ND	41.81<	511900.00	0.62
MixedFarm no impr	12	259068	275000	0.32	764414.00	130.95<	107.84<	807261.75	0.32
MixedFarm&GrazUnsp	102	355976	258000	0.39	631100.00	75.75<	129.53<	809880.27	0.44
Orchard Plantations	1	660000	660000	8.89	74200.00	264.00<	ND	74200.00	8.89
Residential				(\$/SM)	(SM)			(SM)	(\$/SM)
Detached Home (new)	4	355000	362500	344.78	817.50	164.77<	130.63<	842.25	421.49
Detached Home Unsp	149	262951	235000	424.28	766.00	ND	97.92<	887.57	292.54
Detached Home(exist)	223	244082	233000	194.20	811.00	105.91<	105.91<	994.58	246.36
MisImpRuralLand Unsp	3	161000	165000	2.41	82100.00	ND	ND	114966.67	1.40
Res Investment Flat	5	182400	172000	NA	NA	38.39<	ND	NA	NA
Res Land (\$0)	2	229000	229000	225.84	1014.00	ND	ND	1014.00	225.84
Res/Rural Lstyle	138	421046	365500	25.88	20000.00	133.64<	110.76<	47323.06	8.90
ResLandWithImprovemt	4	166750	101000	76.40	10497.00	56.50<	20.61<	25665.50	6.50
Retire Village Unit	1	82000	82000	NA	NA	31.15<	43.16<	NA	NA
Single Strata Unsp	21	259197	229000	685.63	334.00	ND	143.13<	847.00	411.10
Strata Unit/Flat Uns	19	245526	250000	1112.06	293.50	116.28<	129.87<	293.50	924.19
Townhouse	17	220970	220000	672.80	314.50	120.55<	88.00<	314.50	673.29
Vac Res A	58	102271	97500	110.35	802.00	97.50<	88.64<	870.80	121.72
Vac Res B	12	135208	127500	82.60	3018.00	159.38<	231.82<	2941.58	45.96
Vac Res/Rural Lstyle	62	96394	87500	2.65	26290.00	81.40<	53.03<	61240.66	1.57
Sport/Hrtge/Cultural				(\$/SM)	(SM)			(SM)	(\$/SM)
Gymnasium/Health	1	402500	402500	1150.00	350.00	ND	ND	350.00	1150.00
				Municip	ality totals				
Commercial Total				14		Commercial Total P	rices		\$17,280,000
Industrial Total				9		Industrial Total Price	es		\$3,394,550
Infrastruc&Utilities Total				3		Infrastruc&Utilities	Total Prices		\$79,973
Primary Production Total			10	62		Primary Production	Total Prices		\$59,968,694
Residential Total			7	18		Residential Total Pr	ces		\$183,131,806
Sport/Hrtge/Cultural Total				1		Sport/Hrtge/Cultural	Total Prices		\$402,500
All Sales Total			90	7		All Sales Total			\$264,257,523

Appendix B Holmes and Sackett Report Extract







#### CONTENTS

- 02 Editorial Can profitability guide reasearch?
- 04 Useful life of a drench How can it be prolonged?
- 08 Pasture economics 101 Back to basics
- 12 Sharefarming vs. leasing Where do the profits lie?
- 15 Succession planning Issues faced in implementation

# **ON FARM**

YOUR FARM PROFIT IS OUR PRIORITY A HOLMES SACKETT PUBLICATION ISSUE 129 DEC 2010 / JAN 2011



DSE per hectare for two years, increased to 9 DSE per hectare in the third year, and further increased to 12 DSE per hectare by the fourth year, where it remains. Validation of the magnitude of this production increase is based on trial work from the central tablelands.

The increase in production over the longer term is reasonably modest at 50% relative to the existing pasture. This leads to an increase in gross margin (at \$25/DSE) of \$100 per hectare. The cost of achieving the additional production equates to approximately \$100 per hectare. Additional on-going costs of \$10 per hectare have been applied to account for the additional phosphorus required to maintain the higher stocking rate.

The peak cumulative debt of \$330 per hectare occurs at the end of year 4. Livestock purchases account for approximately 70% of the total additional costs with the cost of phosphorus accounting for the remaining 30%.

#### Pasture establishment

The main production assumptions in the analysis include a marginal decrease in stocking rate of 4 DSE per hectare in year 1, no change in year 2 and a marginal increase of 8 DSE per hectare in year 3. The reduction in stocking rate in year 1 and gradual increase in year 2, relative to the existing



Graph 1: The cost of pasture establishment is \$420 per hectare

pasture, accounts for the need to nurture the new pasture. Full production is assumed to occur in year 3.

The analysis assumes that the cost of establishing the pasture is \$420 per hectare. Included in this cost is starter fertiliser, seed, sowing, chemicals, lime and contracting (Graph 1). This accounts for all of the costs prior to, and during the establishment phase of the pasture. Other costs incurred in an investment in a new pasture include the cost of foregone production during the establishment phase and the cost of additional livestock required to stock the pasture.

The marginal cashflow implications during the early stages of pasture establishment are shown in Graph 2. Consider that the projections are all relative to the existing pasture running 8 DSE per hectare. The positive livestock return shown in year 1 occurs due to the sale of 4 DSE per hectare in the first year of the pasture to reduce the stocking rate during the establishment phase. Livestock sales and purchases have been valued at \$85 per DSE. In years 2, 3 and 4 livestock purchases are necessary, thus the net cashflow is negative.

The livestock gross margin follows the change in livestock numbers (DSE per hectare) over the first four years of the investment. Gross margins of \$25 per DSE have been assumed. The additional gross margin of \$200 per hectare seen in year 4 continues for the 30 year life of the pasture.

Graph 2: Expenses exceed income in the first four years of the pasture phase



**Appendix C** Rapid Appraisal Method (RAM) For Floodplain Management



Natural Resources and Environment

AGRICOLTORE RESOURCES CONSERVATION LAND MANAGEMENT

### RAPID APPRAISAL METHOD (RAM) FOR FLOODPLAIN MANAGEMENT

MAY 2000



This Rapid Appraisal Method for Floodplain Management has been prepared for the Department of Natural Resources and Environment by Read Sturgess and Associates, Consulting Economists and has been funded under the Victorian Government's Floodplain Management Reform Program.

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of Victoria

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For further information please contact the Department of Natural Resources and Environment, Floodplain Management Unit, telephone (03) 941 24073.

avoidance of some costs as well. Harvesting and marketing costs would be avoided and if the time of inundation fell somewhere subsequent to planting but still significantly prior to harvest time, then some growing costs would also be avoided.

We have determined the typical time of planting and harvest for most crops and estimated the net costs associated with a loss of crop production, for month of inundation. For example, the gross proceeds from sale of a tobacco crop would be approximately \$3,000 per hectare, but if a flood occurred, say, three months prior to harvest time, then growing, harvest and marketing costs of about \$1,000 per hectare would be avoided. Hence, the net costs of damage would be \$2,000 per hectare for a flood three months prior to harvest.

The damages for a range of crop types are presented in Table 3-7 and Table 3-8 and these represent the damages according to month of inundation. Only the expected average damages for the year need to be used. Our analysis of models of varying levels of complexity (see Appendix 3) has revealed that, for areas with a substantial amount of inundated crops, it has proved important to take account of the likely distribution of flooding throughout the year. The expected average damages for the year (bottom line of Table 3-7 and Table 3-8) are calculated as the damages in each month multiplied by the relative probability of floods in each of those months. In many cases, horticultural enterprises represent a relatively small proportion of total area of crops inundated and it would suffice to use simply the 'other horticulture' estimate for all horticultural crops. However, where damages to horticultural crop should be considered separately.

#### Clean-up

As well as damages to crops/pastures, flooding will generally require expenditure to repair erosion, repair fences and/or to remove debris, rocks or silt deposits from fields and/or to replace soil. These should be added to the damages to crops/pastures.

Of the pasture enterprises included for the Myrtleford and Swan Hill survey samples, the average costs for repairs to fences and/or soil renovation were \$25 per hectare. Of the horticultural enterprises included for the Myrtleford and Swan Hill survey samples, the average costs for repairs to fences and/or soil renovation were \$350 per hectare.

The following clean-up costs are recommended (and have been used in case studies presented here):

Pastures and broadacre crops in floodway areas	\$25 per hectare
Pastures and broadacre crops for low velocity flood events (typically across floodplain beyond the defined floodway)	\$10 per hectare
Horticultural enterprises	\$350 per hectare

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2	Seamus Hoban	Adam Briggs	On file	Joe Lane	On file	12/09/14		
3	Seamus Hoban	Adam Briggs	On file	Joe Lane	On file	04/11/14		
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6	Seamus Hoban	Adam Briggs	On file	Joe Lane	On file	05/12/14		

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