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Review of the Department of Water's Approach to Determining Allocation Limits in the Manjimup Area

Commissioned Report for the ERA Inquiry into Water Resource Management and Planning Charges

By

Jonathan F. Thomas

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EXECUTIVE SUMMARY

Terms of Reference and Context

1. The Economic Regulation Authority requested Resource Economics Unit to undertake this case study of the Manjimup Area (Warren and Donnelly river basins) as part of its Inquiry into Water Resource Management and Planning Charges (the Inquiry). Of particular interest for the case study were the procedures, practices and costs incurred by the Department of Water (the Department) in its allocation planning function with respect to the Study Area, and whether these are justifiable in terms of the range of activities undertaken and their costs. This report does not comment on the Draft Warren-Donnelly Water Management and Allocation Plan, or on the arguments put forward in community submissions to the ERA's Inquiry. The Terms of Reference are attached.
2. To fulfil the consultancy Resource Economics Unit interviewed Departmental staff, who were entirely cooperative, and undertook desk research on recent publications, including: (i) Inquiry documents, (iii) submissions to the Inquiry from the Manjimup Area, and (ii) relevant hydrological and water resource management papers. See References.
3. The Department published a draft Water Management and Allocation Plan for the Warren-Donnelly area in June 2010, and will now enter a phase of public consultation (Government of Western Australia 2010a and 2010b). Allocation limits data quoted in this report have been updated in line with the draft Water Management and Allocation Plan.

Hydrology and Water Use in the Study Area

4. Average stream flows in the Study Area as a whole are very much in excess of diversions. Mean annual runoff of the Warren and Donnelly Rivers combined was 772,000 ML between 1975 and 1998. Total water use is expected to be around 35 ML in 2009-10. Of this, 85% is for irrigated farming, mainly for horticultural products, and approximately 5% is used for rural domestic and stock purposes.
5. While most of the Donnelly and much of the Warren catchments are forested there are parts where farm dam density is very high. In a few resource sub-management areas current use is very much higher than the allocation limit introduced in 2008. These areas are classed as "C4", or "overdeveloped". In 2008 the Department introduced a provisional cap on water use, with no new licenses being granted. Since 2008 an intensive review of allocation limits has been conducted, with emphasis on the ecological basis for sustainable yield estimation. This will lead to a new Warren-Donnelly Water Management and Allocation Plan, development of

which is well advanced. It appears likely that there will be some upward revisions of allocation limits in some parts of the study area as a result of this review.

Impacts of Farm Dams

6. Studies undertaken by SKM using the CHEAT model (SKM, 2008) concluded that the farm dams in the Upper Lefroy Brook Catchment are significantly affecting stream flow at the Channybearup Gauge. SKM estimates that annual flow is reduced by 22%, on average, with the largest volumetric reductions occurring during the months of April, May and June. The dams intercepted nearly all (~85%) of the low summer flows. Under natural conditions, only 24 days each year would have flow below 0.58ML/d, compared to the observed 79 days each year with the farm dams. Typically, low-flow spells are nearly twice as long and 50% more frequent due to farm dams.

Review of Departmental Procedures and Practices, and their Costs

7. The procedures and practices employed in the Department in setting allocation limits and developing allocation plans have been reviewed. In the consultant's opinion the Department's system for allocation planning gives priority to the areas that are most stressed, and therefore is much more cost-efficient than a system that treated all areas in the same depth of detail. Newly commissioned work is minimised through the system. The activities undertaken in plan preparation are appropriate and cost-efficient.
8. The costs directly incurred for production of the Warren-Donnelly Water Management (Allocation) Plan are identified. Also, the costs of wider-ranging work that is drawn upon in developing the Plan have been factored in, on a shared cost basis. The total "direct" cost of developing the Warren-Donnelly Allocation Plan over a three-year period ending in 2010-11 is estimated to be approximately $650,000. In addition there are department-wide costs that also support the allocation planning activity for Warren-Donnelly, including on-costs, resource assessment and water management. The work needed to estimate these costs and attribute them across Allocation Branch activities has not been completed by the Department at the time of this report. However, it seems unlikely that the total cost after factoring in "shared costs' will exceed $1 million. The cost excludes on-going licensing activities. It is unlikely that the new allocation plan will be repeated within the next ten years. Therefore, we have calculated the amortised value of $1.0 million over a ten-year period at 7.5% real discount rate. On an annualised basis for the applicable period of the new allocation plan the Department's cost amounts to $0.13 million per year. This level of cost is considered commensurate with the economic and environmental values at risk in the Warren-Donnelly basins.

Report to the Economic Regulation Authority on the Department of Water's Approach to Determining Allocation Limits in the Manjimup Area for the ERA Inquiry into Water Resource Management and Planning Charges

Introduction

The Current ERA Inquiry

The Economic Regulation Authority is conducting an Inquiry into Water Resource Management and Planning Charges (Economic Regulation Authority, 2009 a, 2009b, and 2009c). In accordance with its Terms of Reference, the Authority is to provide the Government with a range of options and recommendations for:

- The recovery of the water resource management and planning expenses incurred by the Department of Water (the Department), and
- The most appropriate regulatory arrangements for the setting of service standards for the water resources manager, the setting of charges and the subsequent recovery of those charges from water users.

ERAs Brief to REU

From submissions to the ERA Inquiry there has been a high level of community opposition to the suggestion that water resource management charges should be applied in the Manjimup area. The Department's approach and possible outcomes of the ERA's Inquiry have been questioned.

Work Undertaken to Address the Terms of Reference

To fulfil the consultancy Resource Economics Unit:

- interviewed Departmental staff (S. Worley, F. Bunny and N. Arrowsmith), who were entirely cooperative and supplied *inter alia* the latest draft of the Water Allocation Plan for Warren-Donnelly basins (Government of Western Australia 2010a), a draft report on the derivation of allocation limits (Government of Western Australia 2010b), and provisional estimates of the costs incurred by the Department in respect of water allocation planning for the Warren-Donnelly basins;
- interviewed Dr R. Silberstein (CSIRO) with respect to the recently-published South West Sustainable Yields project; and
- undertook desk research on relevant recent publications, including Inquiry documents and submissions to the Inquiry from the Manjimup Area.

Study Area

For the purposes of this case study, the Manjimup area has been taken to comprise two river basins, namely those of the Warren and Donnelly rivers. These cover a combined area of almost 6,100 km2.

The townships of Manjimup and Pemberton are located in the western portion of the Warren river basin. The Shire of Manjimup includes the Donnelly river basin, and the south western half of the Warren basin, but it extends outside of the Warren basin to the south east near Walpole. The area that falls outside of the Warren river basin is almost entirely forested.

The Warren basin extends from cleared farmland near Kojonup through mixed farming and forested areas to the south west near Pemberton. About 33 per cent of the basin is cleared farmland. Clearing controls were introduced in 1978 and increased rehabilitation has taken place since 1996 under the Salinity Action Plan.

The Donnelly River rises in poorly drained land to the north of Manjimup, with Manjimup Brook being the major tributary. It then flows in a south-westerly direction through Karri and Marri forest to reach the coastal heaths and sand dunes of the d'Entrecasteaux National Park before discharging to the Southern Ocean. The basin predominantly comprises State forest and national parks with about 11 per cent being cleared farmland. A substantial part of the cleared area is concentrated near Manjimup.

Figure 1: Map of the Donnelly and Warren river basins showing Department of Water "resource" areas

Water Resources

Flows

The Australian Water Resources Assessment (2000) produced estimates of the Study Area's water resource shown in Table 1. This data is based on the *Western Australia Water Assessment 2000* (Water and Rivers Commission (2002), which was undertaken as a part of the *Australian Water Resources Assessment* (Commonwealth of Australia, 2001). No groundwater resources were identified, this being an area dominated by low-yielding fractured rock aquifers. It is apparent from

Table 1 that average stream flows in the general region were very much in excess of diversions at the time of the National Land and Water Resources Audit in the year 2000.

There is substantial inter-annual variation in runoff. The coefficient of variation of runoff [(*)] is 0.44 for the Donnelly River and 0.46 for the Warren River, based on stream flow records since 1975 (* see Glossary). This indicates that the two rivers have very similar pattern of flows through the year. The period from 1996 to 2000 had historically high stream flows. Lower than average stream flows have been recorded since 2001.

Table 1: Surface water resources of the Warren and Donnelly River Basins (Australian Water Resources Assessment (2000)

Surface Water Management Area	Mean Annual Runoff (ML)	Sustainable Yield (ML)[1]	Developed Yield (ML)[2]	Diversion (ML)[3]	Basin Development Category
Warren River	441,000	207,142	31,220	8,781	C1
Donnelly River	331,000	90,520	10,440	1,632	C1
Total	772,000	297,662	41,660	10,413	

Notes: see Glossary for definitions of sustainable yield, developed yield and diversion.

Estimates of sustainable yields of unregulated catchments in the south west of the State were revised following a study in 2004 by SKM (described in Lang et al, 2008). The objective of this study was to estimate "Sustainable Diversion Limits", beyond which "there would be an unacceptable risk that additional diversions would degrade the environment". These estimates were used by the Department in setting revised provisional allocation limits for the Warren-Donnelly basins in 2008. Following more recent studies within the Department (Donohue et al, 2009) new allocation limits have been proposed in the Surface Water Allocation and Management Plan, June 2010. These have produced a moderate upwards revision in some sub-management areas within the two river basins.

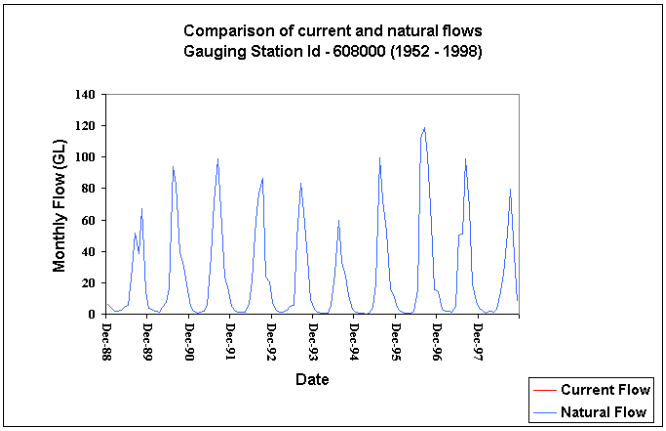
Water Quality

The two river basins differ greatly in terms of their water quality. The Warren River is brackish, with fresher water added through tributaries in the lower reaches. The Perup River, which joins the Warren about 20km south-east of Nannup is moderately saline. Wigarup River is marginal, while Lefroy Brook and Dombalrup Brook are fresh. The Warren basin is one of five "recovery catchments" in the south of WA, selected for action (mainly re-forestation) under the State Salinity Program. In the Donnelly basin, increased salinity is apparent from clearing in the upper part but downstream water resources are all fresh due to the relatively small amount of clearing and the contribution of fresh runoff from the higher rainfall parts of the basin.

Seasonality of Flows

Rainfall and stream flows are highly seasonal. Figure 2 shows average monthly flow for Surface Water Measurement Station 608000, which is positioned near the mouth of the Donnelly River. The graph is based on the historical record from Dec 1988 to Dec 1998 as monitoring regrettably ceased after the latter year. Peak flows are experienced in late winter-spring, while flow may cease altogether in the summer months, particularly February-March.

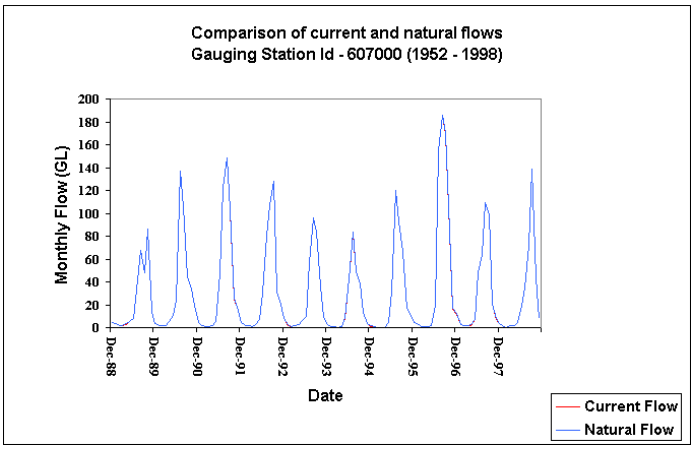
Figure 2: Seasonality of flows in the Donnelly River Basin



Source: Australian National Resource Atlas

A very similar seasonal pattern of flows is observable in the Warren River: see Figure 3. It is also notable that the flow in both rivers is very close to the natural level throughout the year.

Figure 3: Seasonality of flows in the Warren River Basin



Source: Australian National Resource Atlas

Potential Climate Change Scenarios

A recent study by CSIRO (CSIRO, 2010) has examined the impacts on runoff of four climate change scenarios for catchments in the South west of WA including the Donnelly and Warren river basins. Under CSIRO's climate change scenarios to the year 2030, and comparing with the historical climate (1975 to 2007) runoff is projected to decline by 12.5% (-10 GL) to 39% (-33 GL) in the Warren basin, and from 10% (-16 GL) to 35% (-56 GL) in the Donnelly basin. Percentage declines are somewhat smaller but still large if the comparison is made with recent (post 2000) climate.

The projected decline in rainfall and runoff is likely to impact self-supply irrigators and streams in national parks and nature reserves. Included in the CSIRO report (under Key Findings, p iv) is a statement "Projected growth in plantations and farm dams is expected to have a minimal impact on stream flows *relative to the effect of future climate*" *(in the south west of WA)*: our parenthesis . Discussion with CSIRO clarified this statement. It relates only to the *potential increment* in farm dam

use, which is compared with potential change in rainfall-runoff. The CSIRO statement should not be interpreted to mean that farm dams do not have a minimal impact on stream flows.

Agricultural Activity

Agriculture and forestry play an important role in the economy of Manjimup Shire. In 2006 significant industries, by percentage of total employment for persons aged 15 years and over and usually resident in Manjimup Statistical Local Area, were: Log Sawmilling and Timber Dressing 5.8%, Fruit and Tree Nut Growing 5.7%, Sheep, Beef Cattle and Grain Farming 5.3%, School Education 6.9%, and State Government Administration 4.5% (Australian Bureau of Statistics, 2006 Census).

Almost a half of agricultural businesses irrigate, as can be seen from Table 2.

Table 2: Agricultural statistics for the Manjimup Shire in 2005-06

Number of agricultural businesses	461
Number irrigating	212
Area of agricultural holdings (ha)	79,000
Area irrigated (000 ha)	4
Volume applied (ML)	12,356
Number of agricultural businesses	461

Source: 2006 ABS Agricultural Census

Water Use

The Donnelly and Warren river basins have been proclaimed under the Rights in Water and Irrigation Act, 1914. Total water allocation as at March 2010 plus an estimate of existing exempt use was approximately 36,000 ML, of which 8,459 ML was in the Donnelly basin and 27,798 was in the Warren basin (Department of Water pers. com.)

Table 3, showing the types of licensed use, has been taken from the WA Water Futures Study (Thomas, 2009). Water allocation (excluding licenses to store water) was 27,530 ML as at May 2009. Storage licenses are usually excluded in estimating water use (Thomas, 2009). However, in the Warren-Donnelly basins, separate licenses have been granted for "storage" and "use". For farm dams that are sometimes drawn down to near-empty the storage element is actually used (Department of Water pers. com.) Therefore, the data in Table 3 understate actual use, but are nevertheless useful in showing the types of uses.

Water use in the Study Area is dominated by irrigation using surface water, mostly for vegetable growing and perennial horticulture (including vineyards and orchards). In 2009 there were 510 licenses, and the average volume allocated was 54 ML. It is notable that the average volume licensed for irrigation activities is higher than the grand average: 119 ML/license for Pasture Irrigation, and 66 ML/license for Vegetables and Other Horticulture. All urban supplies - there were 47 licenses with a total allocation of 52 ML - were for the local towns, and no water was licensed for use in the Water Corporation's Integrated Water Supply System.

Table 3: Number of licenses and total allocations in the Warren and Donnelly river basins by user category, May 2009

	Use category	Number of Licenses	Total Allocation (KL)	Ave. Per License (KL)
1	Domestic	0	0	0
2	Parks & Recreation	8	110,000	13,750
3	Commercial & Institutional	3	29,000	9,667
4	General industry	4	25,000	6,250
5	Mining	0	0	0
6	Power Generation	1	0	0
7	Pasture irrigation	6	712,000	118,667
8	Perennial horticulture incl. orchards, vineyards etc	19	664,000	34,947
9	Vegetables & Other Horticulture	351	23,315,700	66,426
10	Rural domestic & stock	14	35,500	2,536
11	Rural -Other	57	200,000	3,509
12	Urban Water Supply	47	2,438,800	51,889
	Total	510	27,530,000	53,980

Note: Excludes licenses classified as "STOR", equals water storage

The Department reported that as at December 2009 there were 484 licensed farm dams in the Warren-Donnelly area of which 379 were located in the Warren river basin and 105 in the Donnelly river basin. These store 26.3 GL of flow in the Warren basin and 7.5 GL of flow in the Donnelly basin. The size of commercial dams ranges from around 50 ML to 600 ML, with about 86% storing between 50 ML and 300 ML. A few larger dams store up to 1,500 ML.

It has been conservatively projected that if economic activity in the Study Area follows expected trends, total water use could rise at an annual average rate of increase of around 1% to 2% /year. These growth rates are based respectively on expected trends in employment and value added in irrigated industries (Thomas, 2009).

Impacts of Farm Dams

SKM Studies

The impacts of farm dams on stream flows have been studied in two SKM projects (SKM 2007, 2008).

In the first study SKM estimated the impacts of farm dams in seven catchments in the south west of WA, including the Lefroy Brook, a tributary of the Warren River (SKM, 2007). Statistics for this river are given in Table 4.

A modelling software package CHEAT (SKM, 2004a) was used to estimate the effect of farm dams on surface water flows. This software is specifically designed to estimate farm dam impacts on downstream flows. It works by performing a water balance on each farm dam in a catchment on a daily time step. CHEAT is able to estimate the difference between flows into a farm dam and the

flows out of a dam by taking into account dam storage level, rainfall, evaporation, and demands. In order to run CHEAT, a range of inputs were required, including:

- gauged rainfall and evaporation data (from the Bureau of Meteorology);
- demand data such as typical patterns of irrigation and stock and domestic demand (from DoW);
- the different sizes of farm dams in each catchment (available from DoW based on data previously collected by SKM); and
- the gauged flow at the outlet of each catchment was required over a reasonable period of record (<20 years) so that model results were representative of long term conditions within each studied catchment.

Table 4: Statistics for the Lefroy Brook catchment area (SKM (2007)

Mean annual flow (ML/yr)	53,704
Mean annual flow per km^2 (ML/yr/ km^2)	150
Mean annual rainfall (mm)	1,136
Mean annual evaporation (mm)	1,139
Area (km^2)	358
Number of farm dams	665
Total dam volume (ML)	8,871
Farm dam density (ML/km^2)	27.2
Farm dam density (ML of storage/ML mean annual flow)	17%

Source: SKM (2007)

SKM found that, while the pattern of flows remained broadly similar to the natural flow, around 80% of flows are significantly reduced by farm dams (SKM, 2007). For example, average daily flow was reduced to 24% of the natural flow during February. For high flow conditions, the farm dams result in fewer flow events and shorter flow durations. There was a lag in the timing of early winter freshes. Late winter was an exception. At that time the impacted flow was slightly higher, being a maximum of 109.4% of the natural flow.

The degree of impact of farm dams was found to be significantly affected by the amount of annual rainfall, with the effect being greatest in drier years. The degree of impact only appeared to begin to lessen at an annual rainfall above approximately 1,300mm.

The second SKM report (SKM, 2008) examined a sub-catchment of the Lefroy Brook catchment. New modelling was undertaken. This differed from the 2007 work in the following ways:

- It focused on a smaller sub-catchment, namely the Upper Lefroy above Channybearup guage.
- Revised demand levels were used, based on new data provided by the Department of Water;
- 3 scenarios were run (rather than only 1), each with a different level of demand;
- Changes were made to the hydrological model, to improve the estimation of impacts. These included more accurate representation of: (i) the stream network; (ii) base flow interactions; and (iii) the catchment areas of individual dams; and
- The modelling period was lengthened by a year to cover Jan 1975 – April 2006.

This catchment of the Upper Lefroy above Channybearup Gauge (607002) has an area of 92 km^2 and has an average annual flow of 13,744 ML/year. Within this catchment there are 178 dams, with a total volume of 4,203ML. This corresponds to a farm dam density of 45.7 ML/km^2. Compared to previous modelling, this catchment is only a quarter of the size of the Lefroy catchment used in the 2007 report, and farm dam density is nearly twice as high. The Upper Lefroy Brook Catchment has an exceptionally high level of farm dam development, even if compared to states outside Western Australia. For example, SKM reported that only 2% of catchments in Victoria have a higher farm dam density.

SKM concluded that the farm dams in the Upper Lefroy Brook Catchment were significantly affecting stream flow at the Channybearup Gauge. Using the "Best Estimate" of demand levels, the following results were obtained:

- Annual flow was reduced by 22%, on average;
- The largest volumetric reductions occur during the months of April, May and June. For example, in April, $Flow_{Observed}$ = 4ML/d, but $Flow_{Simulated\ Natural}$ = 20ML/d, on average. In May, $Flow_{Observed}$ = 11 ML/d, but $Flow_{Simulated\ Natural}$ = 39ML/d, on average.
- The dams intercepted nearly all (~85%) of summer flows. Sensitivity testing of demand levels indicated that the demand level makes little difference to this result.
- Analysis of spells below 0.58ML/d indicated that, under natural conditions, only 24 days each year would be spent under this threshold, compared to the observed 79 days each year. Typically, spells were nearly twice as long and 50% more frequent due to farm dams. Demand level made no difference to this result.

SKM concluded from these last two points that it is the presence of the dams themselves, rather than withdrawals from them, that are causing impacts during summer. SKM suggested that the only ways to lessen the effect would be to remove or to install low flow bypasses on some dams. SKM recommended that further study be undertaken to examine strategies for implementation of low flow bypasses, to ensure that the right dams were to be targeted and the maximum benefit derived in terms of flow impacts.

The two SKM studies indicated to the Department that some surface water resources within the Warren-Donnelly area were at risk of over-allocation due to high levels of surface water use and particularly very high levels of on-channel infrastructure in some areas. In 2008 the Department therefore imposed a cap on the use of some highly developed resources in order to secure water supplies to existing licence holders and provide time to better assess water availability in these areas. The relevant sub-management areas were as follows:

Warren Basin

- Wilgarup
- Smithbrook
- Upper Lefroy
- Diamond Tree Gully
- Eastbrook
- Four Mile brook/Big Brook

Donnelly Basin

- Manjimup Brook/Yanmans Dixvale

CSIRO Sustainable Yields Study

CSIRO assessed the impact of farm dams on stream flow under a series of scenarios for climate change (CSIRO, 2010). The Upper Lefroy catchment in the Warren river basin was included as a particular case. In this study the current extent of farm dams was obtained from a combination of aerial orthophotographs and satellite imagery. Total farm dam storage capacity in the Upper Lefroy catchment was estimated to be 31% of mean annual flow. A future dam development scenario was developed using projections of industry growth potential from the WA Water Futures Study (Thomas, 2009). Irrigation growth rates were estimated to range from 23 to 55 per cent between 2009 and 2030, depending on economic assumptions. Mean monthly impacts of farm dams were derived for the 2030 farm development by scaling the current development level by the irrigation growth rate and interpolating between the mean monthly impacts of farm dams on natural flows for the adjacent higher and lower catchment development levels. These monthly 2030 farm dam development factors were then applied to the natural catchment stream flows to estimate the impact of 2030 farm development. However, where 2008 allocation limits had been reached (including sub-management areas in the Warren-Donnelly) the CSIRO study assumed that there would be no further irrigation development.

For the Busselton-Denmark region as a whole it was concluded that there is a potential for mean annual runoff to decline by around 1% as a result of increased storage capacity, for various climate-change scenarios. In the opinion of the CSIRO researchers the impact of farm dams is likely to be much smaller than potential variation due to their climate change scenarios. However, it should be emphasised that the CSIRO study considered "end of river" impacts for over 200 individual catchment areas in the south west of WA. This broad summary statement therefore hides more radical effects at smaller scales.

The CSIRO study also concluded that the area of plantations is unlikely to have significant effects on runoff in these catchments, due to the relatively small areas involved, and the better prospects for economic plantation forestry in the intermediate rainfall zone.

Research in the Department of Water

In the past two years the Department has elaborated on the previous work by consultants (SKM 2007 and 2008), focusing on the *ecologically sustainable yields* in the Warren-Donnelly basins (see Government of Western Australia, 2010b). To do this the Department considered:

- Ecologically sustainable yields (ESY) of rivers from environmental flow studies of south west rivers. Factors considered included summer low flows, fish passage, bankfull and flood flows, habitat type, seasonal inundation of habitat pools and channel morphology.
- A hydrological model that enables estimation of ESY for Warren-Donnelly streams
- Information on existing use
- An assessment of environmental risk and potential risk to water resource recovery (i.e. salinity) for the Warren basin

These activities are fully documented in Government of Western Australia (2010b).

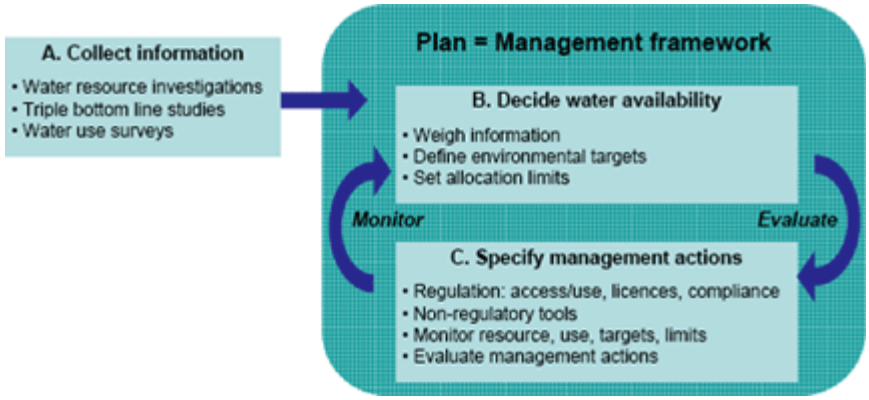
Allocation Planning in the Department

Allocation Planning Process

Figure 4 below shows the Department of Water's summary of its process for allocation planning. This includes specifying management actions relating to access, use and licensing.

In developing a Water Management (Allocation) Plan for an area, staff within the Department concentrate on steps B and C in Figure 4, drawing on whatever information is already available on (i) the resource (for example hydrology, in-situ needs, and potential climate effects) and (ii) the use/demand side, (including current levels of use, management capacity, potential future use and management needs for the future). The management responses corresponding to each category are therefore complex, and may include hydrological, social, environmental and economic appraisal.

Figure 4: The framework used by the Department of Water for development of allocation plans



In developing a Water Management (Allocation) Plan costs are also incurred in relation to (i) consultation/participation, (ii) the development of a process and methodology and (iii) project management.

Allocation Limits

The Department of Water's general approach to the setting of allocation limits (author's interpretation) is illustrated in Figure 5.

The Allocation Limit is the amount of water that is currently available for use, annually. This may be less than "Sustainable Yield", which is a notional estimate of the amount of water that *may* be available for use in future, recognising acceptable levels of stress and protection of key economic, social and environmental values. The difference between the Allocation Limit and Sustainable Yield is shown as a "Buffer" (author's term). The "Buffer" includes un-allocable water such as for stock and domestic use, and water that is reserved for future public water supply. The Department may also wish to keep this "Buffer" to allow for the possibility that new high-value uses may appear in future, or because there is uncertainty about the hydrological aspects, including the possibility of climate change. Allocation limits could be changed in future as knowledge of climate change improves. The key point of the diagram is that both Sustainable Yield and Allocation Limits are adjustable over time at the discretion of the Department.

Also shown is the "Divertible Yield" (see Glossary), which is the amount of water that could be economically diverted with existing and potential new infrastructure. This is likely to be higher than Sustainable Yield. However, it should be noted that this term is no longer used in the Department's allocation planning processes.

Most importantly, the Department sets allocation limits at the level of individual "Sub-Management Areas" or "Resource Areas". So, while there may be substantial stream flows over much of a basin, allocation limits may be used to constrain use in any Sub-Management/Resource Area where stream flows, environmental values, or downstream uses may be compromised. This is true in both the Donnelly and Warren basins.

Figure 5: Schematic of the treatment of allocation Limits

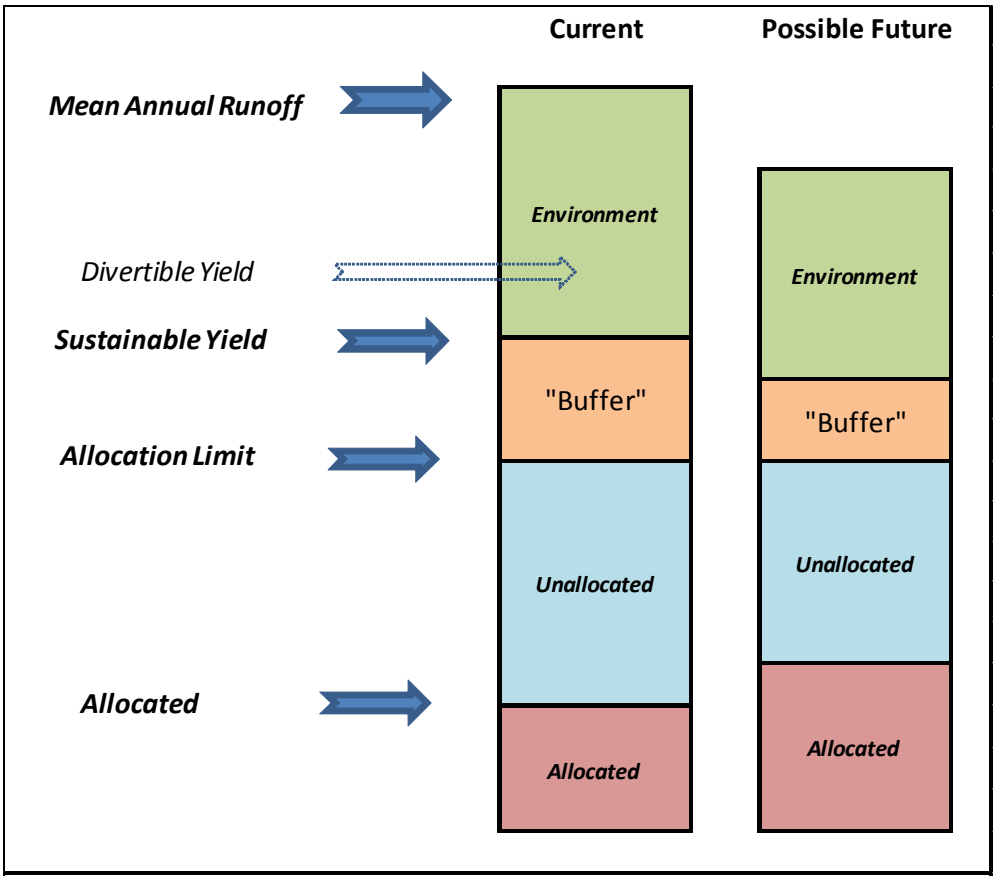


Table 5 shows allocation limits and allocations in each sub-management area in the Warren and Donnelly basins, as at May 2008. It is notable that several sub-management areas were substantially over-allocated in relation to the allocation limits introduced in May 2008. This does not mean that water was not physically there: only that irrigators were dipping into the environmental provision or "buffer".

Table 5: Allocation limits and allocations in sub-management areas within the Donnelly and Warren basins as at May 2008.

Sub-Management Area	May 2008 Allocation Limit (ML)	May 2008 Allocation (ML)	% Allocated	Classification
DONNELLY RIVER BASIN				
Manjimup Brook/Yanmahs/Dixvale	2,742	5,821	212	C4
Middle Donnelly	1,482	1,105	75	C3
Fly Brook	1,504	973	65	C2
Beedelup Brook	1,963	794	40	C2
Record Brook	381	125	33	C2
Upper Donnlly	2,363	370	16	C1
Barlee	5,484	0	0	C1
Carey Brook	1,544	0	0	C1
Lower Donnelly	14,758	0	0	C1
Total Donnelly River	32,221	9,188	29	
WARREN RIVER BASIN				
Wilgarup	3,760	6,151	164	C4
Smith brook	1,721	3,424	199	C4
Upper Lefroy	1,488	7,342	493	C4
Diamond Creek Gully	358	374	104	C4
Eastbrook	2,117	3,620	171	C4
Four Mile Brook/ Big Brook	1,880	3,858	205	C4
Lefroy Brook	2,400	2,262	94	C3
Perup	903	605	67	C2
Yerraminnup	454	9	2	C1
Treen Brook	3,097	1,021	33	C2
Lower Warren	9,084	312	3	C1
Dombakup Brook	3,536	131	4	C1
Upper Warren	6,119	1,082	18	C1
Quinninup Brook	1,120	352	31	C2
Tone River	4,657	50	1	C1
Unicup Lakes	404	0	0	C1
Total	43,098	30,593	71	
Combined Total	75,319	39,781	53	

The degree of detail that enters the Department of Water's assessment of its investment in water resources management and planning activities for a catchment depends on the classification of the particular water management area, in terms of the amount of stress it experiences. A four-fold classification is used to determine the level of assessment, as illustrated in Table 6.

Table 6: Catchment Classification System

Category	% Currently Allocated	Management Response
C1: Relatively low use, low risk to the environment and low consequences of short to medium term use	30% or less	R1: use is managed through ***RiWI Section 5C licenses***, up to the allocation limit provided that this has been reviewed and updated within the last ten years.
C2: Moderate development, or medium risks to assets and users, or medium consequences if use changes, or potential to jump quickly to high use.	Greater than 30%, and 70% or less	R2: use is managed through ***RiWI Section 5C licenses***, risk-based allocation limits to be assessed through an ***allocation plan using the most current investigation and assessment work*** (no new work, no new management regime).
C3: High level of use, or high risk or consequences if the level of use increases without improvements to management	Greater than 70%, and 100% or less	R3: As in R2, except that the required allocation plan requires ***newly commissioned investigation and assessment***; water availability optimised and *in situ* values protected through ***a specified water management regime***.
C4: Over-developed	Greater than 100%	R4: recovery approach as specified in an R2 or R3-type plan. May include cap on use, targeted compliance and efficiency strategy or an active recovery program.

While the percentages of allocation limits shown in the second column of Table 6 are precise, they are used in essentially a qualitative sense to guide Departmental activities.

The "Management Responses" corresponding to each classification level require successively higher levels of investigation and assessment. The greater is the ratio of current water allocation to the Allocation Limit in that area, the higher is the level of assessment required. Generally, higher levels of assessment lead to higher costs being incurred by the Department. This system means that the Department's allocation planning function concentrates its investigation and assessment effort on C3 or C4 sub-management areas. In some cases it may be necessary to investigate impacts on C1 or C2 areas in order to assess downstream impacts of use in a particular C3 or C4 area. Investigations of C3 or C4 areas may also involve an assessment of ecological impacts of use, as well as hydrological modelling.

Finally in setting allocation limits the department is increasingly taking account of catchment land use. This particularly refers to catchments that are almost entirely forested, and where there is no intention to allow new diversions. Accordingly, downward revisions of the allocation limits for sub-management areas such as the Lower Donnelly and Lower Warren (see Table 5), and other forested areas in Warren-Donnelly may be expected in future.

The number of Warren/Donnelly sub-management areas in each category is shown in Table 7. While the level of allocation is moderate for the two basins as a whole, there were seven sub-management areas that fell into category C4. In these areas an R4 response was required, and a cap on water use was introduced by re-setting allocation limits to the then existing level of use.

Table 7: Number of sub-management areas in each category in the Warren-Donnelly river basins.

	Warren	Donnelly	Combined Total
C1	6	4	10
C2	3	3	6
C3	1	1	2
C4	6	1	7
Total	16	9	25

Water Allocation Plan for Warren-Donnelly

An Allocation Plan for surface water resources in the Warren-Donnelly area has been developed by the Department of Water, and released for public comment in June 2010. The plan is based on a study of the hydrology, ecology, dam storage and current levels of water use. For allocation planning and licensing purposes, the Department has divided the area into 25 surface water resources (see Figure 1), which are based on hydrological catchment boundaries.

Following from the work summarised earlier in this report, the Water Allocation Plan proposes changes to allocation limits shown in Table 8.

Table 8: Aggregate allocation limits as at May 2008 and proposed in June 2010

Basin	Allocation Limits as at May 2008	Draft Allocation Limits June 2010	Difference
Warren	43,098	47,730	4,632
Donnelly: developed resources (1)	3,842	12,713	8,871
Donnelly: undeveloped resources	32,221	2,187	-30,034
Combined Totals	79,161	62,630	-16,531
Warren plus Donnelly developed sources	46,940	60,443	13,503

Note (1): the developed resources are Upper Donnelly, Middle Donnelly and Manjimup

Costs Incurred by the Department

Overall Costs

The Department has an expected budget for 2009-10 of $93.6 million. This is the budget estimate for Total Cost of Services, as given in the State Budget Papers 2009-10. The total budget for the department has been declining. It was $108.8 million in 2007-08, and $101.4 million in 2008-09 (actual as given in the State Budget Papers 2009-10).

The total cost of the *Water Use, Allocation and Optimisation* section in 2009-10 is $47.5 million. This includes revenue of $4.0 million, mainly comprising Commonwealth payments under the former National Heritage Trust and the National Action Plan for Salinity and Water Quality. The latter have been steadily declining since 2007-08, when they amounted to $9.5 million.

Activities Undertaken

Each year the Department schedules its allocation planning work according to State-wide priorities. For the year 2009-10 the following commitments were identified.

Allocation Planning Projects

- Commonwealth funding commitments (Water Smart and National Water Commission GAP projects)
- Water Reform allocation plans
- Seven RiWI Allocation Plans required under transitioning to water reform: to be released for public comment. This included the Warren-Donnelly Water Management (Allocation) Plan.
- RiWI plans to be finalised, including statement of response, and released
- Other RiWI planning projects, (subject to capacity)
- Input to source planning and service provider licenses and operating strategies
- Related projects

Allocation Planning Program Elements

- Planning support systems (including GIS, DWAID, water reform, water accounting)
- Specific reviews of allocation limits
- Reviewing and further developing processes for allocation planning (including risk-base decision making, input to monitoring review, Quality Assurance and peer reviews)
- Policy development (including EWR/EWP Policy #5 and related policies, licensing policy, guidelines for impact assessment, planning components of legislation, climate and planning, consumptive pools, managing over-allocation, indigenous access, risk assignment)
- Partnership projects
- Implementation and evaluation of 11 water allocation plans, of which the Warren-Donnelly Allocation Plan is one.

Branch Activities

- Reporting (e.g. Commonwealth and Ministerial conditions, Key performance Indicators, Corporate Executive Plan status)
- Program management and support responsibilities

It is beyond the scope of this brief to assess the appropriateness of all these elements in the Allocation Branch business agenda. Nevertheless, it can be seen that development of the plan for Warren-Donnelly is just one activity amongst many that the Allocation Planning branch has to undertake.

Costs of planning for the Warren-Donnelly

The Department of Water has undertaken investigations at various levels, yielding information and allocation decisions for the Manjimup Study Area:

- Water allocation and planning studies undertaken specifically for the Manjimup Region. The whole of the costs associated with these activities, are attributable to the Manjimup Study Area, and are termed "direct costs".
- State-wide or regional assessments that include the Manjimup Study Area as a component of a wider study. Some proportion of the costs of these studies may be attributed as a cost to the Manjimup Study Area, and are referred to below as "shared costs".

Direct Costs

The Department provided the following information on costs of the Warren-Donnelly water Allocation Plan, in response to a format suggested by the consultant.

Table 9: Estimated costs of the Warren-=Donnelly Allocation Plan

	2008-09 ($)	2009-10 (to 10/052010) ($)	Total 2008-10 (to 10/052010) ($)
Branch general [1]	30,403	18,020	48,423
Regional and allocation planning [2]	29, 459	108, 779	138,238
Environmental Water Provision [3]	114, 647	145,590	260,237
Total	174,510	272, 591	447,101

Notes:

1. Branch general are the in-branch overheads such as systems (DWAID), branch leadership, GIS, licensing support, process etc which apply over all plans
2. Regional and allocation planning cost is the cost of both central and regional staff who have directly contributed to the plan
3. Environmental water provisions is staff time directly to determined EWRs and EWPs.

The estimates are offered with the following provisos:

- The Department is still finalising its costings for ERA, (due 31 May 2010).
- The figures below will differ from the costs to be provided to ERA because (i) the Department has not included on-costs, as it is still finalising the attribution of on

costs to activities on an FTE basis; (ii) resource assessment and measurement costs which contribute to allocation planning are not included.; and (iii) the Department was not able to allocate a proportional share of some work to the Warren Donnelly, as it does not have the figures.

It is estimated that plan will be completed in a total of three years. This implies that the estimated direct cost for the completed plan will be in the order of $670,652 plus a share of Department-wide costs for (i) on-costs, (ii) resource assessment and measurement, and (iii) miscellaneous other costs.

Shared Costs

At the time of writing the Department was unable to supply estimates of Department-wide costs that could be attributed on a share basis to Warren-Donnelly. This will be done by end may 2010 as part of the Department's support for another ERA consultancy. It is considered unlikely that these additional costs would exceed $330,000. Therefore, for illustrative purposes the total cost over three years for allocation planning and implementation for the Warren-Donnelly has been taken as $1.0 million.

Discussion and Conclusions

A key question mentioned in the Terms of Reference is whether the Department's allocation planning effort is appropriate. Two ways of approaching this are through:

- a qualitative assessment of whether the Department's effort has been commensurate with the hydrological and environmental issues manifest in the sub-management areas having a high density of farm dams. In other words, could allocation decisions have been reached with less effort, or conversely are they questionable because more investigation is needed?
- to compare the costs incurred by the Department for allocation planning in Warren-Donnelly with the economic values at risk in the absence of planning

Qualitative Evaluation

A qualitative evaluation needs to begin with the recent history of water management in Warren-Donnelly, as described above. In summary, the Warren River was proclaimed in 1959 under the Rights in Water and Irrigation Act (1914), and the Donnelly River in 1968. Proclamation was prompted by increasing demand for water from agricultural developments in the area. Since proclamation, there has been an acceleration of on-stream dams in the cleared areas of the Warren and Donnelly systems. Being aware of the growing demands on surface water resources in Warren-Donnelly and other south west catchments, the Department of Water commissioned SKM (SKM 2007) to assess the impacts of farm dams in seven catchments. The level of dam development was found to be very high in a number of resource areas within the Warren-Donnelly basins. In response, the Department of Water introduced new allocation limits in 2008. The new limits were set equal to sustainable yields as estimated by SKM (2007), and water use was capped at the 2008 level until it, the Department, was in a position to make a more thorough determination of appropriate allocation limits. Firstly, SKM was commissioned to undertake more detailed work on the impacts of farms dams on stream flow in the Upper Lefroy catchment (SKM 2008). This provided a detailed test of the

more broadly-based conclusions of SKM (2007). Second, the Department undertook additional work on the hydrological and aquatic ecology of all Warren-Donnelly catchments, thus developing evidence-based arguments supporting a revised level of allocation limits to protect downstream users and aquatic environmental values (Donohue et al, 2009). As with any hydrological study the analyses were probabilistic in nature.

The sequence of investigations described above is justifiable. Departmental resources devoted to the task had to be multi-disciplinary. New hydrological work was required. Existing knowledge of the aquatic ecology had to be synthesised and related to hydrological conditions. While this report falls short of a full scientific review, it can be said that the personnel involved have been of a very high calibre and the work shows every sign of thoroughness. Moreover, it is difficult to see how a sound decision on new allocation limits could have been reached without the comprehensive assessment that was undertaken. In particular it was important to examine the whole of the two basins, rather than just the most highly developed parts.

Economic Evaluation

Brennan (2006) estimated economic values for horticulture in the south west region. The value of water in irrigated uses was estimated as the expected stream of income that can be derived from access to physical resources at a particular location, after all cash, labour and capital costs are accounted for. The value associated with access to water was taken as the difference between the residual profit, earned from access to land and water, and the income that would be earned using dryland agriculture, which is determined by the value of land on dryland farms. Applying this approach based on gross margin budgets from the Department of Agriculture, and estimates of labour requirements, capital investment costs, and assessment of product price risk, Brennan calculated an annual return to water for potatoes of $745 per ML, and for carrots of $345 per ML. Perennial fruits were estimated to return an annual value to water of $512 per ML for apples and $211 for stone fruits. Reflecting the importance of potato growing in the region, a value of $500 per ML was selected to represent horticulture in the south west. This value was similar to an earlier study by Economic Consulting Services (2005).

Using the figure of $500/ML an indicative economic value of irrigation water in the Warren-Donnelly basins based on current use would be around $13 million/yr. Some part of this use value could be at risk from poor hydrological management. The annual value of all costs incurred by the Department in water allocation planning for the Warren-Donnelly basins has been estimated by the author to be $ 0.133 million/yr (i.e $1 million annualised over 10 years using a 7% real discount rate, assuming that the new Warren-Donnelly Surface water Allocation plan will have a lifetime of ten years). A half of these costs has been assumed to be for public interest purposes, notably environmental protection, implying that the cost of departmental activities undertaken in the interest of protecting flows for irrigators is approximately $ 0.065 million/yr. It is therefore concluded on the basis of these approximations that: (i) the costs that could potentially be incorporated in to license fees would form a small part of the value of water to farms, and (ii) there is a strong prima facie case for judging the Department's allocation planning activities to have a highly favourable benefit-cost ratio. While it is stressed that the figures given here are approximations, it would require very substantial changes in assumptions to invalidate this conclusion.

An alternative way of examining the net economic benefits or costs of the Department's allocation planning activities is to make the (in the author's view) reasonable assumption that, in the absence of any further investigations after the SKM (2008) report, allocation limits would have had to be pegged at the 2008 level for precautionary reasons. Subsequent investigations have led to an upward revision of the allocation limits. The investigations post 2008 have supported a recommendation to increase allocation limits by 13,505 ML in the Warren basin and developed parts of the Donnelly basin. Assuming a use value for horticultural irrigation water of $500/ML this implies an incremental water value of $6.75 million/yr, assuming that all future use would be for horticulture. Therefore, the costs of investigations since 2008 are evidently much smaller than the water "created" by the revised allocation.

Summary

Our overall conclusion is that a minimum critical effort is required to properly assess allocation limits in general, and for the Warren-Donnelly basins in particular. In making allocation decisions for the Warren-Donnelly basins due regard has to be given to:

- Aggregate and seasonal effects of on-stream and off-stream dams
- the impacts of land uses on flows
- ecological implications of altered flow, including the resilience of ecosystems to changes in natural flow: see Government of Western Australia Department of Water (2010b)

In the opinion of the consultant the Department's efforts in allocation planning for the Warren-Donnelly basins have been commensurate with the C3 and C4 classifications of some sub-management areas.

Wherever possible, reference has been made to existing information. Consultants have been used in a cost-effective way. Additional in-house work has added scientific rigour in areas not previously covered by the consultants.

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Glossary

Coefficient of Variation: the coefficient of variation is the standard deviation of runoff divided by the mean runoff and expressed as a percentage. It is a useful way of comparing variability across rivers with widely differing total stream flow. A large value of the coefficient indicates a wider spread of flow values. The standard deviation is a statistical measure of the range of observed values. The mean plus or minus two standard deviations usually covers most (perhaps 95%) of the range of observed values.

Ecological Sustainable Yield: in principle the same as Sustainable Yield (see below). Inclusion of the word "Ecological" serves to underline the point that the estimate has been based on an explicit hydrological-ecological analysis, rather than on a notional figure.

Sustainable Diversion Limits: the limit of water diversion beyond which there would be an unacceptable risk that additional abstractions would degrade the environment (definition given in SKM, 2004)

Sustainable Yield: the limit on potentially divertible surface water that is allowed to be diverted after taking account of environmental values and making provision for environmental water needs.

Developed Yield: the volume of surface water that can be diverted for use with existing infrastructure, expressed as an annual average. Developed yield represents the portion of the Divertible Yield that is currently available for use".

Diversion: the volume of surface water diverted for use from the resources of a river basin for supply to both within-basin and external consumers.

Divertible Yield: the volume of surface water that could be diverted using existing and potential new infrastructure, expressed as an annual average. The divertible yield is generally higher than the sustainable yield

Terms of Reference

Terms of Reference for Consultant Advice on the Department of Water's Approach to Determining Allocation Limits in the Manjimup Area for the ERA Inquiry into Water Resource Management and Planning Charges

The Economic Regulation Authority (**Authority**) is conducting an inquiry on behalf of the Western Australian Government into water resource management and planning charges. The Terms of Reference for the inquiry are provided in **Attachment A**.

The Authority published a Draft Report on 3 December 2009 and a Final Report is due by 29 October 2010. The Draft Report identified a number of functions carried out by the Department of Water (**Department**) for which the Authority considers it would be appropriate to recover costs from parties for whom the services are provided. These activities are listed in **Attachment B**.

The Authority has carried out a process review of the listed activities, to establish how the Department carries out these functions, and has recently engaged consultants to examine the effectiveness and efficiency of the Department of Water in providing its services.

The Authority would like to further assess whether the Department is undertaking unnecessary work when determining allocation limits and water availability. To help answer this question, the Authority would like advice on a specific case study, the Warren-Donnelly catchments in the vicinity of Manjimup (the Study Area). The Department of Water is currently developing a water allocation plan for the area, which is due to be released for public comment around June 2010.

The aim of this consultancy is to examine the work that the Department is doing and has done to establish water allocation limits in the Study Area. This would include, for example, work done to determine environmental water requirements, assessment of the impacts of farm dams, hydrological and hydrogeological studies, monitoring, demand projections, and stakeholder engagement.[1] The aim of this study would be to assess whether each of these activities / pieces of work are appropriate and can be justified.

Objectives of the Case Study

Description

- Describe the general principles used by the Department to assess environmental water requirements and water allocation limits and what procedural guidelines are followed.
- Describe the rationale behind the Department's use of the four-fold (C1-C4) classification in determining the level of assessment, and for the percentage allocation limits used to define the four categories.

[1] Thus, in terms of the activities listed in Attachment B, the focus of this study is the activities which contribute to allocation planning; i.e. Allocation Planning; Environmental Water Planning; Groundwater and Surface Water Assessment, Investigation and Review; and Water Measurement and Information.

- Describe the key water resource management and planning issues in the Study Area.
- Describe the hydrological basis for relating irrigation use to stream flows for the Study Area, including seasonal requirements for environmental flows and the impact of farm dams.
- Determine what methods are being used to assess allocation limits in the Study Area.

Tasks to be Undertaken

- Consultant to become familiar with Inquiry documents and in particular submissions from within the Study Area.
- Obtain relevant published and Department-sourced information about water resources management and allocation planning issues in the Study Area.
- Consult with relevant staff of the Department of Water.

Comment and Advice

- Comment on the procedures used by the Department in determining environmental water requirements and water allocation limits within the Study Area.
- Comment on the hydrological basis for determining the environmental flows in the Study Area.
- Comment on the appropriateness of the allocation limits determined by the Department for the Study Area and the classification of water resources in the area (C1 to C4).
- Advise on the amount of effort that the Department should put into the assessment of environmental water requirements and water allocation limits in the Study Area, and whether current efforts are excessive or insufficient.

Output and Timetable

A final report on the consultant's findings should be delivered to the Authority by 14 May 2010.

The Authority normally publishes consultant reports for its inquiries on the Authority website. The publication of this report would be delayed until after the Department's water allocation plan for the area has been released by the Department.

In the event that the allocation plan differs markedly from the assumptions on which the consultant report has been based, the Authority may seek additional advice from the consultant to revise the report in the light of any new information.

Attachment A

INQUIRY INTO WATER RESOURCE MANAGEMENT AND PLANNING CHARGES – TERMS OF REFERENCE

I, TROY BUSWELL, Treasurer, pursuant to section 32(1) of the Economic Regulation Authority Act 2003, request that the Economic Regulation Authority (ERA) undertake an inquiry and provide the Government with a range of options and recommendations for:

- the recovery of the planning and management expenses incurred by the Department of Water for the sustainable management of the State's water resources; and
- the most appropriate regulatory arrangements for the setting of service standards for the resource manager, the setting of the charges and the subsequent recovery of those charges from water users.

The options are to include:

- the implementation impacts for various types of users, including a sensitivity analysis on capacity to pay assumptions; and
- opportunities for implementation under both the existing legislative responsibilities of the Department of Water as well as those specified by the National Water Initiative.

In doing so, the Authority is requested to consider and develop findings on:

- the tasks or activities undertaken in the efficient management of the State's water resources, by the Department of Water, that would appropriately be recovered from water users;
- the most appropriate level (or percentage) of cost recovery from water users; and
- the most appropriate allocation of costs between licence holders and other water users (licensed entitlement or actual use).

In developing its recommendations, the Authority will have regard to:

- the Government's social, economic and environmental policy objectives;
- the Government's obligations as a signatory to the National Water Initiative Intergovernmental Agreement; and
- any relevant pricing principles arising from the 1994 Council of Australian Governments water reform agreement and the National Water Initiative.

The Authority will release an issues paper as soon as possible after receiving the reference. The paper is to facilitate public consultation on the basis of invitations for written submissions from industry, government and all other stakeholder groups, including the general community.

A draft report is to be available for further public consultation on the basis of invitations for written submissions.

The ERA will complete a final report no later than nine months after receiving the Terms of Reference.

TROY BUSWELL MLA
TREASURER, MINISTER FOR COMMERCE;
SCIENCE AND INNOVATION; HOUSING AND WORKS

The Treasurer has approved an extension, to 29 October 2010, for the Authority to deliver the final report for its inquiry into water resource management and planning charges.

Attachment B

LIST OF THE DEPARTMENT OF WATER'S WATER RESOURCE MANAGEMENT AND PLANNING FUNCTIONS AND ACTIVITIES FOR COST RECOVERY

1) Assess, Allocate and Licence Water Resources
    - Licensing, Compliance and Enforcement
    - Allocation Planning **
    - Environmental Water Planning **
    - Groundwater and Surface Water Assessment, Investigation and Review **
    - Water Measurement and Information **
2) Water Metering
3) Urban Drainage, Assessment and Land-Use Coordination
4) Water Source Protection
5) Executive and Corporate Services (where allocated to the above activities)

** *Note: These activities, not licence assessment, are the focus of this consultancy.*