Water Act 1989

Steels, Pauls and Dixons Creeks
Water Supply Protection Area
Stream Flow Management Plan 2007

Victoria
The Place To Be

MelbourneWater®

Water Supply Protection Area
Stream Flow Management Plan 2007

Preface

Throughout Victoria Stream Flow Management Plans (SFMP) are being prepared to better manage the surface water resources of particular catchments. The plans are prepared for the benefit of water users and the general community and they aim to improve the environmental health of waterways in these catchments.

The preparation of this SFMP commenced in March 2004 by a consultative committee established by Melbourne Water, which has the surface water licensing responsibilities in the Yarra River catchment.

The consultative committee, consisting of the following people, have developed this SFMP following extensive discussions and consideration of technical work, and in response to public submissions.

Steels, Pauls and Dixons Creeks Stream Flow Management Plan consultative committee members

Mr Jim Viggers	Licensed water user
Mr Bernard Priestly	Licensed water user
Mr Gavan Oakley	Licensed water user
Mr Brian Mullens	Licensed water user
Mr Graeme Miller (Chair)	Licensed water user
Mr Paul Sinclair	Environment Victoria
Ms Sarah Lamshed	Melbourne Water

These members were appointed by the Minister for Water under section 29 of the *Water Act 1989*. These appointments were made following nomination by the Port Phillip and Westernport Catchment Management Authority and in consultation with Melbourne Water and the Victorian Farmers' Federation.

Steels, Pauls and Dixons Creeks Stream Flow Management Plan ex officio observers

Ms Susanna Finger	Environment Protection Authority
Mr Ian Morgans	Port Phillip and Westernport Catchment Management Authority
Mr Bill O'Connor	Department of Sustainability and Environment
Mr Owen Gooding	Shire of Yarra Ranges
Ms Christine Hughes	Melbourne Water
Ms Jenny Barnett	Environment Victoria

Past members of the consultative committee:

Mr Jamie Ewert	Melbourne Water

This Plan is prepared in two parts. The first part is the Explanatory Memorandum which provides the background for the development of the Plan and explains the reasons why the various recommendations have been made. The second part is the SFMP itself, which is written in line with the legal requirements of the *Water Act 1989.*

Glossary and Acronyms

All-year licence: A licence that allows harvesting of water from a waterway at any time during the year.

Catchment dam: A dam that is not located on a waterway and which captures rainfall and run-off from the catchment.

Cap: An upper limit placed on licence allocations.

Commercial use: Water used for irrigation of produce to sell and for industrial uses such as cooling or dairy washing.

Domestic and stock licence (D&S): A licence to take water from a waterway for use in and around a house or for watering of stock, but not for commercial purposes.

Environmental flow: A pattern of streamflows that maintains or improves aquatic ecosystems and their habitats by mimicking the size and timing of natural flows.

Ephemeral: A seasonal waterway where flows are usually intermittent. This means that the river or creek often ceases to flow during dry periods.

Flow regime: The range of flows throughout the year which may include low flows, flood events, high flows, cease to flow.

Fresh: Streamflow peaks occurring after rain. These peaks partially fill the river or creek channel for a number of days. They 'freshen' the river or creek by providing water to flush the system and rejuvenate the aquatic life.

Natural flow: The flow that would exist if there was no harvesting of water by dams or direct extraction. Natural flows are estimated by adding an approximation of the water taken out of the catchment back onto the flows that are recorded at a stream gauge.

Macroinvertebrate: Animal species without a backbone that can be seen with the naked eye. Macroinvertebrates are commonly used as a measure of stream health.

Median: The middle number of a set of numbers, such that half the results are greater than the median and half are less than the median.

ML: Megalitre, one million litres. Approximately the size of an Olympic swimming pool.

Off-stream dam: A storage that is not located on a waterway but is filled with water pumped from a waterway.

On-stream dam: A storage that is located on a waterway.

Reliability of supply: A percentage chance of being able to fully obtain a volume of water in any year.

Sleeper licence: Licence held but not utilised.

Stream Flow Tender: Means the process by which the State Government invested with licence holders to implement environmental flows (refer to Appendix 2 for more details).

Winter-fill licence: Licence to fill on or off-stream dams during the winter-fill period. The licence is limited to the volume of the storage.

Winter-fill period: The wetter months of the year when flows are high enough to allow additional water to be harvested over and above extraction by all-year licence holders. (July-Nov inclusive)

1 Background

1.1 What is a Stream Flow Management Plan?

The object of a SFMP is to manage the water resources of the area in an equitable manner so as to ensure the long-term sustainability of those resources. It is developed by a consultative committee which represents all relevant interests in the area.

A SFMP defines the total amount of water in a catchment and describes how it will be shared between the environment and water users.

It aims to recognise the needs of licensed water users while maintaining or improving waterway health by protecting a portion of the total stream flows for the environment. Providing sufficient environmental flows to maintain river health is a key component of ensuring the long-term sustainability of the water resource.

In preparing a plan, community involvement is necessary to ensure that community needs and aspirations are fully understood and that essential background knowledge is considered.

1.2 Stream Flow Management Plans in the Yarra Basin

This SFMP has been prepared as part of Melbourne Water's program for managing priority catchments throughout the Yarra River basin. Plans have already been completed for Diamond Creek, Hoddles Creek and Plenty River catchments. This program will see new plans developed for other priority tributary catchments in the basin, and existing plans reviewed as required.

2 Development of the Plan

2.1 How is a Stream Flow Management Plan developed?

A committee consisting of Steels, Pauls and Dixons creek water users, representatives of environmental interests, the Shire of Yarra Ranges, Melbourne Water and other government agencies has developed this SFMP. A full list of members is given on page 3.

Using advice from numerous scientific and other studies (listed in the References section), the committee identified improvements that could be made in the management of water licences and negotiated a series of recommendations that aim to both balance water user reliability of supply and maximise environmental benefits.

2.2 Consultation and information available during the development of the plan

The development of the Steels, Pauls and Dixons Creek SFMP involved significant consultation to ensure that the rules are relevant to local stakeholders and conditions. Stakeholders have been informed and involved during the development of the SFMP through the following activities and planned communication.

- Water user survey and property visit
- Consultative committee membership – including local water users, relevant authorities, interest groups
- Consultative committee meetings
- Letters to licensed water users – describing the process and encouraging involvement
- Media releases
- An open day information session (during consultation phase)
- Licensed water user meeting and presentation of draft plan (during consultation phase).

The consultative committee published a draft Plan in August 2005 for the consideration of water users and the broader community. A total of 19 submissions were received. The consultative committee considered the issues raised by the community submissions, and amended the Plan in response. A summary of the committee's response to the submissions is provided in Appendix 1.

2.3 Technical Audit Panel Review

A Technical Audit Panel (TAP) was established by the then Minister for Environment and Conservation, Sherryl Garbutt, in June 2002 to review the Stream Flow Management Plans (SFMPs) and Groundwater Management Plans (GMPs) that have been prepared or are being prepared across Victoria. The main purpose of the reviews is to answer two fundamental questions:

- Was the information and methodology used the best available at the time?
- Has the assessment of risks (to the environment and to security of supply) been properly done?

The TAP found that the technical studies are valid for use in the development of a SFMP, recognising the limitations imposed by the limited amount of streamflow data. Recommendations may need to be re-assessed once further data exists with respect to flow patterns.

The full TAP review of Steels, Pauls and Dixons Creek technical studies can be found in Appendix 2.

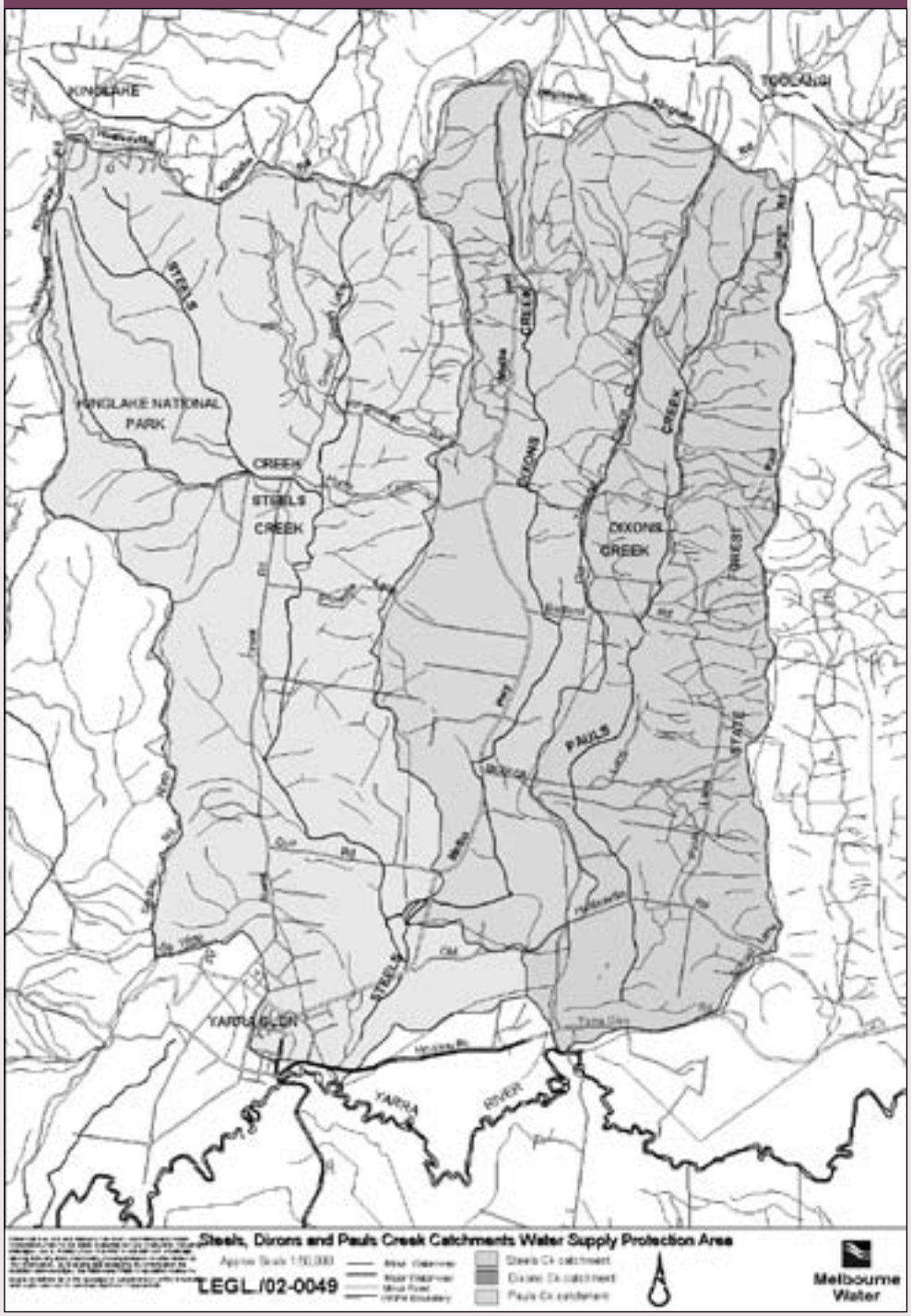
3 The Steels, Pauls and Dixons Creek Catchment

3.1 Water Supply Protection Area

This SFMP applies to the catchments of the Steels, Pauls and Dixons creeks. In accordance with the *Water Act 1989,* Section 27, Melbourne Water advertised the Water Supply Protection Area for the Steels, Pauls and Dixons Creeks in August 2002. After receiving public submissions, the Minister for Water declared the Steels, Pauls and Dixons creek catchments a Water Supply Protection Area in December 2002.

This SFMP applies to the surface waters of the Water Supply Protection Area, which is shown in figure 1 below.

Figure 1 **Steels, Pauls and Dixons Creeks Water Supply Protection Area**



3.2 Catchment Description

The Steels, Pauls and Dixons creek catchments lie approximately 70 kilometres north east of Melbourne near the town of Yarra Glen and drain a combined catchment area covering 127 square kilometres.

Steels Creek rises on the slopes of Mount Slide in the Kinglake National Park and flows in a generally southerly direction through the Steels Creek community to the Yarra River just upstream of Yarra Glen. The upper tributaries of Steels Creek include the Jehosophat, Pinchgut, Dry, Full and Plenty creeks, which drain the southerly aspects of the Kinglake National Park around Mount Jerusalem and Mount Beggary. The upper reaches of the catchment are in a near natural state, with very little farm dam development.

Dixons Creek is the main tributary of Steels Creek and joins just before it flows into the Yarra River upstream of Yarra Glen. It flows in a parallel valley to the Steels Creek, with the confluence approximately three kilometres upstream of the Yarra River. Like Steels Creek the upper reaches of Dixons Creek are in a near natural state.

Photograph by Tarmo A. Raadik

The middle and lower parts of the catchment have been extensively cleared for grazing with an increasing number of properties being used for viticulture. The lower reaches of both the Steels and Dixons Creeks have been substantially realigned to allow for improved drainage and increased productivity on nearby farms.

The Pauls Creek catchment rises in Toolangi State Forest near Toolangi and flows due south until the confluence with the Yarra River near Tarrawarra. There are no tributaries of any size that feed into Pauls Creek. The lower reaches of Pauls Creek have not been realigned like the Steels and Dixons Creeks however, the area has been extensively cleared, with grazing and viticulture the dominant industries.

3.3 Environmental Values

The environmental condition or health of a river or creek is a product of many factors. Land use within the catchment area, the presence of native streamside vegetation, the level of change from its natural state, water quality and water use all affect stream health.

The component of river health addressed within the scope of the Stream Flow Management Plans is the flow regime. While Stream Flow Management Plans recognise other issues and make recommendations where relevant and necessary they do not specifically deal with these other issues.

The flow regime in a river or creek is the range of flows that occur within the waterway over all seasons. The flow components may include high flows such as floods, very low flows and zero flow events and medium freshening flows that follow periods of dry. All components of the flow regime are important to stream health, with local flora and fauna having become reliant on and adapted to particular flow components.

Small native migratory fish within the Yarra River system (including the Steels, Pauls and Dixons Creeks) require flushing flows to trigger migrations. Sediment that accumulates on the streambed during the dry periods is flushed downstream by higher flows, deep pools are replenished by fresh water and the silt is removed. A fish survey undertaken in 2005 found 12 species of fish in the Steels, Pauls and Dixons creeks. Five of these are native (one of which is considered introduced) and seven exotic species.

With the aid of Melbourne Water a number of landholders are actively rehabilitating sections of the streamside through the Stream Frontage Management Program. Willow removal and the replanting of native vegetation will help to increase environmental values within the Steels, Pauls and Dixons creek catchment.

4 Water use within the catchment

4.1 Licensed water allocations

Licences are required to take and use water from a waterway for irrigation and commercial purposes and in some instances for domestic and stock use. Melbourne Water has the delegated responsibility under the *Water Act 1989* to issue and manage licences.

Licences within the Steels, Pauls and Dixons creek catchments are issued as

- all-year pumping licences for domestic and stock
- winter-fill during the winter-fill period
- on-stream dam harvesting during the winter-fill period
- irrigation or commercial use farm dams.

Winter-fill licences are issued for the purposes of filling dams by pumping from the waterway during the high-flow period. Water stored in dams can be used at any time of the year, which provides a higher reliability of supply to water users.

Amendments to the *Water Act 1989* enabled a person to obtain a registration licence for water taken from a spring, soak or dam that was used for irrigation or commercial purposes in any year within a 10-year period prior to 4 April 2002.

Farm dams that were licensed or registered are permitted to take water in any month of the year in recognition of their operation prior to the changes to legislation. Landholders who registered their water use cannot transfer the water off their property. However a registration licence can be converted to a standard all-year licence at any time. A standard all-year licence incurs an annual fee and may be transferred.

New farm dams are required to be constructed to enable them to comply with licence conditions and restrictions.

In the Steels, Pauls and Dixons Creeks catchment there are 91 licences including domestic and stock, irrigation and commercial use licences that take water during any month of the year with a total allocation of 1684 ML per year (Table 1).

Table 1 **Summary of licensed diversions at January 2005**

	Winterfill licences (ML)	All-year Domestic and Stock licences (ML)	Registered Farm Dams (ML)	Total licensed Allocation (ML)
Steels Creek catchment	320		173.8	493.8
Pauls Creek catchment	167		238	405
Dixons Creek catchment	209	2	574.2	785.2
Total	**696**	**2**	**986**	**1684**

A survey of licence holders in 2001 revealed that while a number of licences were currently inactive, all licence holders indicated that they considered their licence as an important asset for both property value, and future security of water supply. A number of properties were found to be only using a small proportion of their licensed volume; this was attributed to irrigation efficiencies since the licence was granted or from properties having an alternative water source.

4.2 Water use not requiring a licence

Water for domestic and stock use can be taken from a waterway without a licence, if the waterway flows through a person's property or the waterway immediately borders a person's property. If a crown frontage or property owned by someone else exists between a person's land and the waterway, a licence for domestic and stock use is required.

Water can also be collected in a farm dam without a licence provided the water is not used for any irrigation or commercial purpose, for example, a farm dam used for aesthetic, stock or domestic purposes. The collection of reuse water, within allowable volumes, and the collection of rainwater from a roof, are also exempt from any licensing requirements.

4.3 Current licence management arrangements

Water may be diverted in accordance with licence conditions that typically specify a maximum daily rate of diversion, an annual volume and an area. Historically licences have been managed to an irrigated area but are now managed to a metered volume.

Historically during drought periods, Melbourne Water enforced the Drought Response Plan for Licensed Water Users to protect a minimum flow of 245ML/day in the Yarra River at Warrandyte. Water restrictions were historically applied throughout the Yarra basin, regardless of the flow in individual catchments. Restrictions of this type were implemented in the Steels, Pauls and Dixons catchments in 1998/99 and 2002/03. In 2003/04 Melbourne Water set catchment specific restriction levels for the Steels, Pauls and Dixons catchment as a part of the Drought Response Plan review.
These catchment specific levels replace the 245ML/day in the Yarra River at Warrandyte. Ban levels for the winter-fill period are currently set at 5ML/day in Pauls Creek and 7ML/day in Steels and Dixons Creeks. There are no all-year commercial or irrigation licences, therefore summer ban levels do not apply.

Melbourne Water has not issued all-year licences for many years, except for domestic and stock purposes or under a transfer arrangement. New winter-fill licences have been available based on an assessment of the impacts on other water users and the environment in accordance with the *Water Act 1989.*
The release of the Victorian Government's *Our Water, Our Future* action plan in 2004 introduced a moratorium on the issue of any new entitlements within the Yarra basin, including the catchments of Steels, Pauls and Dixons Creeks, with the Yarra basin considered by the Government to be fully allocated. An environmental water reserve for the Yarra basin will be set by capping the consumption of water in the catchment however, the exact nature of the cap is yet to be determined. The moratorium on the issue of new diversions applies until this environmental water reserve is implemented.

Water can also be purchased temporarily or permanently from other licence holders via the Transferable Water Entitlement process described in the *Water Act 1989.* These transfers are not affected by the moratorium.

5 Determining Environmental Flows

5.1 Stream flow in Steels, Pauls and Dixons Creeks

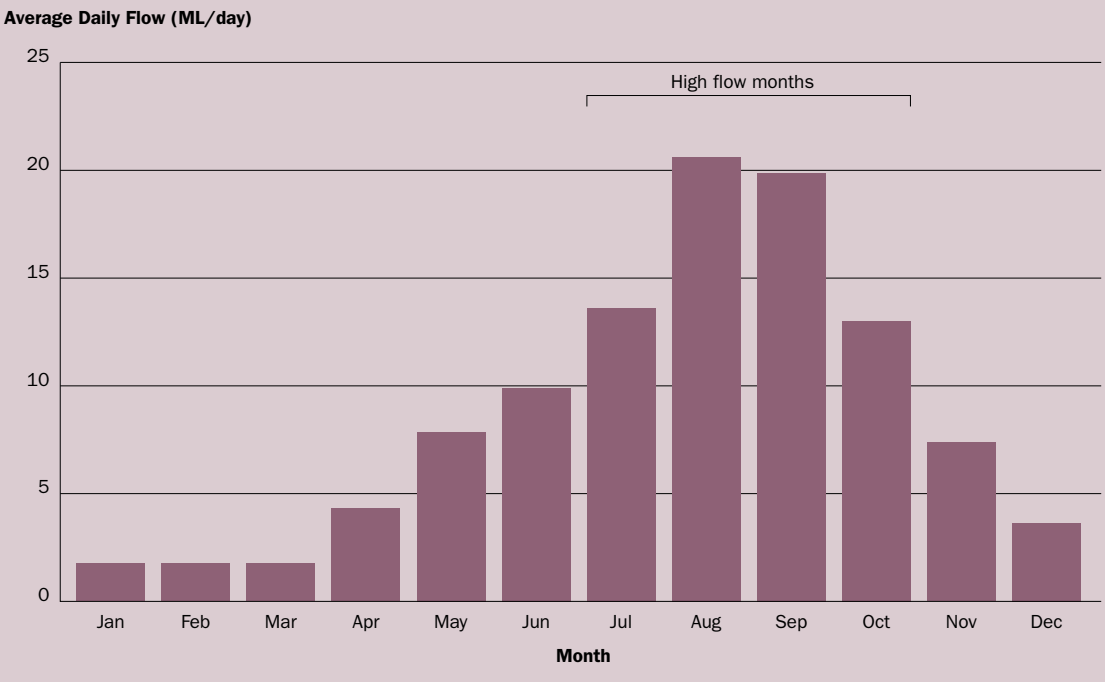
The Steels, Pauls and Dixons Creeks are ephemeral streams with low or non-existent flows during the summer months (Jan-Mar). During cease to flow periods habitat is limited to remnant pools as shallower stream sections dry out. Often summer rainfall events refresh streamflow for short periods of time. There are two streamflow gauging stations within the catchments. One of these is located just upstream of where Pauls Creek meets the Yarra River and the other is located just upstream of where Steels Creek meets the Yarra River but below the confluence with Dixons Creek. Gauge data from these stations is only available from April 1998 to the present, which represents a period of extremely low-flow drought conditions.

Daily streamflows were generated by consultants Sinclair Knight Merz using the HYDROLOG rainfall-runoff computer model. This computer model estimated daily stream flows based on recorded rainfall and assumed run off. The model results were checked for accuracy against existing stream flow data and the model adjusted if required.

Modelling outputs showed that streamflow is highest in August in the Steels, Pauls and Dixons Creek catchments, with averages around 21.0ML/day at the Steels/Dixons Creek gauge, and 9.0ML/day in Pauls Creek (SKM 2003). The average annual flow from the Steels/Dixons Creek is approximately 3270ML/year, and the Pauls Creek is approximately 1430ML/year (SKM 2003).

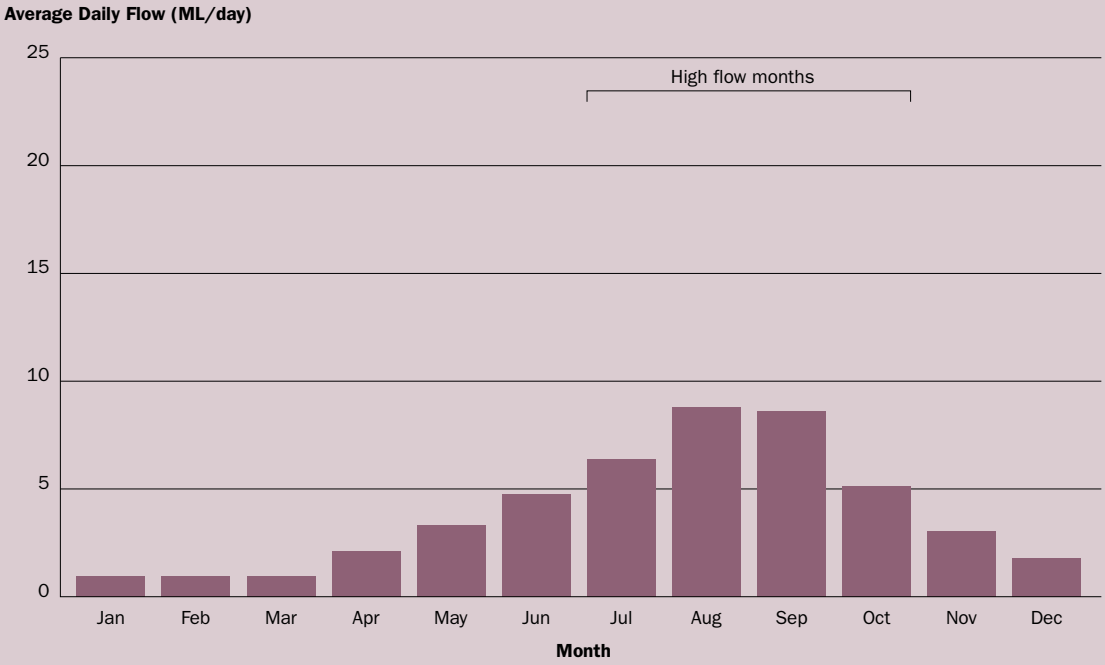
Figures 2 & 3 show the average flows that occur throughout the year from the SKM modelling described above, and show that the 'wettest' months are July to October, with flows declining during the remaining months. Note that these results appear to be optimistic as the average flows in summer are estimated to be <1.0ML/day. Nonetheless, the results are included to highlight the seasonal changes in flow.

Figure 2 Average daily flows (ML/d) per month for the Steels Creek (includes Dixons Creek flow) (SKM 2003)



NB: based on estimated current level of development flows of the period 1965 to 2001.

Figure 3 Average daily flow (ML/d) per month for the Pauls Creek (SKM 2003)



NB: based on estimated current level of development flows of the period 1965 to 2001.

5.2 Current flows compared to natural flows

A hydrologic model was developed to represent the flows and diversions in the catchments, and to assess the impacts on water user reliability of supply under several flow scenarios. The model provided an opportunity to estimate the change between natural conditions and those currently in the catchment. The modelling has found that current practices in the Steels, Pauls and Dixons creeks catchment has resulted in a significant reduction in flows compared with natural conditions, which is represented in Figure 4 below.

Figure 4 Average monthly flows (ML/month) under current conditions and natural flows

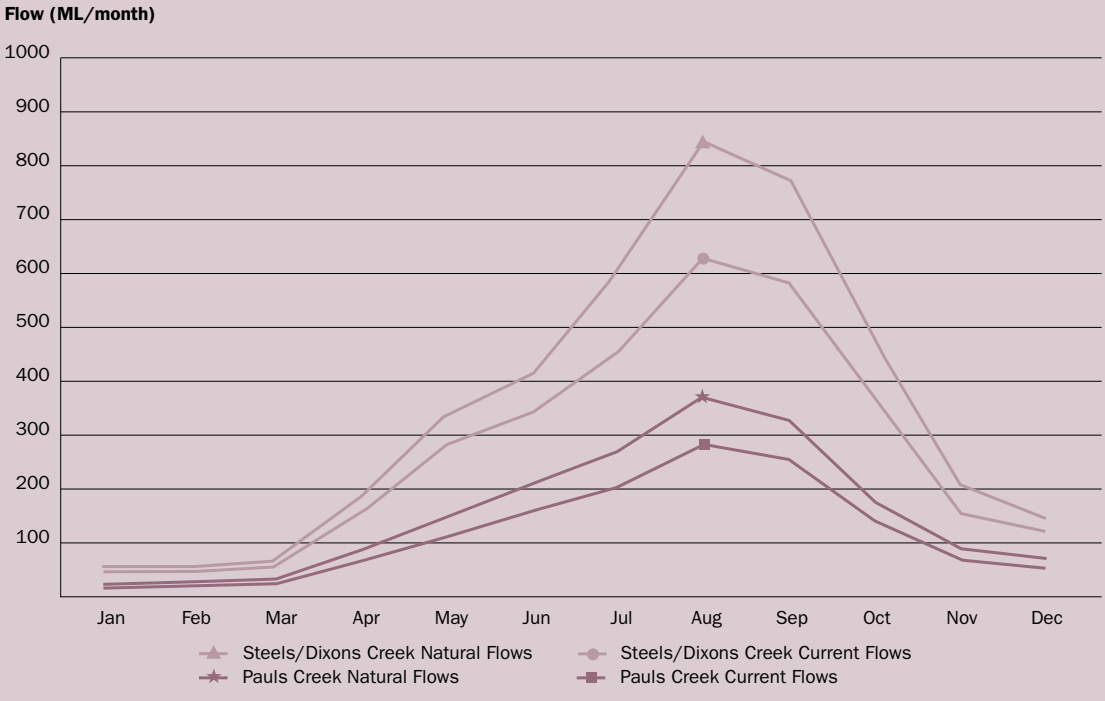


Table 2 shows the change to high, median and low natural flows with the impact of current user demands.

Table 2 **Natural and Current flows in the Steels, Pauls and Dixons Creek system**

	Steels Creek (including Dixons Creek)			Pauls Creek		
	Natural Monthly Flow (ML/month)	Current Monthly Flow (ML/month)	% Reduction in Flow	Natural Monthly Flow (ML/month)	Current Monthly Flow (ML/month)	% Reduction in Flow
Low Flows[1]	25.3	19.6	22.6	5.4	4.1	23.1
Median Flows[2]	130	106	17.9	51	39	23.3
High Flows[3]	920	757	17.7	455	360	20.8

Current flows in this table are those modelled using a hydrological model as discussed above to extend the limited stream flow record from the existing gauges. The effects of current harvesting practices are included in the current flow figures. For the purpose of this analysis natural flows are modelled, and represent the flows that would have occurred if there were no water harvesting activities occurring in the catchment.

1. Low flows are those exceeded 80% of the time (ie. the flow is at least this much 80% of the time). Low flows are common and often occur even during dry periods.
2. Median flows are those that occur 50% of the time (ie. half of recorded flows are greater and half are lesser). These are usually larger flows that do not overtop the banks and periodically flush the creek.
3. High flows are those exceeded 10% of the time. These are rare flows, like floods that overtop the banks of the river or creek, rejuvenating floodplains and maintaining the rivers course.

5.3 Environmental values

An Aquatic Fauna Assessment of the Steels, Pauls and Dixons Creeks was completed in March 2005 by the Freshwater Ecology Unit at the Arthur Rylah Institute for Environmental Research. The study was commissioned by Melbourne Water to assess the current condition or health of the aquatic fauna and to identify those factors that impact most upon these systems. Surveys were conducted at 10 sites within the catchment with each site sampled on 3 or 4 occasions, with the results describing the species abundance and diversity. In addition environmental condition and "naturalness" of aquatic fauna populations and the relative abundance of exotic species was assessed at each site.

The survey provided results indicating that 12 species of freshwater fish were found with seven species of exotic fish recorded. The native fish species were Mountain Galaxias, Common Galaxias, Southern Pygmy Perch, Western Carp Gudgeon (introduced – a native species translocated outside of its natural range, ie. not native to this catchment), Short Finned Eel and Crustacea including Common Yabby, Freshwater Shrimp and Granular Burrowing Crayfish.

The general health of aquatic fauna populations at the survey sites was considered poor to moderate with sites along Pauls Creek considered the most degraded. Dixons Creek was rated as poor to moderate health and Steels Creek rated as moderate to good health.

In summary, the study provided a list of recommendations for future improvement to the health of the Steels, Pauls and Dixons Creeks. The recommendations were as follows:

- Undertake improvement of environmental flows for each catchment
- Assess the potential impact of groundwater abstraction in headwater areas within the catchments, and in adjacent catchments, to groundwater inflows to streams within these catchments
- Undertake improvements to water quality in each catchment
- Assess the presence and distribution of potential aquatic refuge sites in each system
- Identify additional physical barriers to fish movement, assess their significance, and install fishways if appropriate
- Undertake improvement to the quality of instream habitats in each catchment
- Improve protection of instream and riparian zones through restricting cattle access, and fencing and replanting riparian margins

Anecdotal evidence collected during the aquatic fauna assessment by the Arthur Rylah Institute suggested that River Blackfish might have been found in Dixons Creek up to about 6 years ago. The anecdotal evidence and scientific opinion included in the report suggested that they were originally present in the lower to mid reaches of both the Steels and Dixons Creeks and possibly in the lower reaches of Pauls Creek. River Blackfish are still present in the Yarra River both upstream and downstream of the junction with Steels Creek, including some nearby tributaries.

Historically, the lowland reaches were swampy marshes which have been cleared for farm development and are now channelised. Accordingly, the mid to lower reaches of these creeks now provide marginal habitat for both fish and macro-invertebrate communities. The specific hydrology of these creeks and the changed land use

in the region over the last twenty years together with climate change now seem to be contributing factors to the ephemeral nature of these creeks. Compared with other species that move considerable distances and will opportunistically use available habitat, River Blackfish prefer permanent rivers or creeks and are thought to be non-migratory with a small home-range (Koehn and O'Connor, 1990).

The committee noted that no River Blackfish were recorded during the aquatic fauna assessment by the Arthur Rylah Institute nor in any previous sampling of these creeks (Raadik, 2005).

One of the main requirements for fish such as the Mountain Galaxias is the provision of refuge habitat to maintain populations during low flow or cease to flow periods. In creeks such as the Steels, Pauls and Dixons, providing a suitable low-flow regime is achieved by determining a suitable cease to divert flow, below which diversions for commercial and irrigation use are not permitted. This means that when diversion pumping is permitted, there is sufficient habitat available throughout the entire reach to ensure suitable habitat for fish species.

Another requirement of fish species is to allow for the redistribution of populations after low-flow or cease to flow periods. Freshes during the spring/summer period allow movement between refuge habitats and also help to maintain water quality in pools. Macro invertebrate sampling in the catchments in the past has shown that the number of key families present in the waterways does not meet compliance with EPA guidelines. Most of the sites sampled did not meet the requirements for the minimum number of total families expected (SPDEFTP 2003A). The committee recognised that these guidelines are limiting and not necessarily appropriate as they refer to healthy, permanently flowing waterways, and do not adequately recognise ephemeral waterways such as the Steels, Pauls and Dixons Creeks.

In their Issues Paper, the Environmental Flows Technical Panel suggested that the low ecological values could also be influenced by the ephemeral nature of the creeks. Ephemeral systems often have low levels of dissolved oxygen and therefore, support taxa which have a tolerance to low oxygen levels. These results reflect a different type of ecosystem – an ephemeral ecosystem compared with one that flows permanently.

5.4 Environmental flows

The Environmental Flows Technical Panel performed an independent study of the distribution and habitat availability of aquatic animals in the Steels, Pauls and Dixons Creeks. The study set environmental objectives, with a final report recommending an environmental flow regime to protect the key flow related environmental values in each of the creeks. Table 3 below summarises the environmental objectives.

Table 3 **Recommended environmental objectives for the Steels, Pauls and Dixons Creek system proposed by the Environmental Technical Expert Panel (SPDEFTP 2003A)**

Maintain or restore self-sustaining populations of Mountain Galaxias, Flat-headed Gudgeon and Southern Pygmy Perch
Maintain or restore self-sustaining populations of River Blackfish
Maintain or restore self-sustaining populations of Common Galaxias
Maintain or restore natural invertebrate community
Maintain or restore in-stream vegetation community
Rehabilitate Riparian Forest bench and bank vegetation community
Maintain geomorphic river and channel form

During an environmental flow study various components of the flow regime may be assessed for their importance to the flow dependent flora and fauna and stream processes within the system. An environmental flow study may consider the timing, frequency, duration and magnitude of flows required to sustain the aquatic environment in ideal circumstances.

Environmental flows were determined by surveying key sites along the creeks to measure fish habitat availability during a range of flows. The surveys included the assessment of available habitat at these flows such as snags, rocky substrate or aquatic vegetation to meet the above objectives and allowed accurate pictures to be developed of the shape of the creek bed and banks. Available habitat is considered critical in sustaining areas for shelter, food gathering and reproduction within a river or creek. This study was undertaken using the best available method in 2003.

A hydraulic model was then built, which took these surveyed cross-sections and estimated the water depths at different flows (eg. the depth of water when the creek is flowing at 15.0ML/day). These depths were then compared with the known depth requirements of various fish species taken from the scientific literature. This is based on the assumption that fish and other aquatic species will be sustained if a minimum degree of habitat is available. (SPDEFTP 2003B)

Based on the biodiversity processes for small-bodied fish and River Blackfish described in Section 5.3 above, the Environmental Flows Technical Panel determined the depths required to ensure habitat availability and localised fish movement between these habitats.

Table 4 below summarises the flow objectives for sustainable fish populations proposed by the Environmental Flow Technical Panel (SPDEFTP 2003A). With the aid of a hydraulic model, these objectives were translated into flow requirements throughout the year, as seen in Table 5.

Table 4 **Recommended minimum environmental flows for sustainable fish populations proposed by the Environmental Flow Technical Panel (SPDEFTP 2003A)**

Biodiversity Process	Flow Process	Flow objective
Maintain or restore population of small bodied fish	Habitat availability	Low Flow (depth > 0.2m)
	Localised fish movement between habitats	Low Flow freshes (depth > 0.12m over shallowest point)
Maintain or restore population of River Blackfish	Habitat availability	Low Flow (depth > 0.4m)
	Localised fish movement between habitats	Low Flow freshes (depth > 0.2m over shallowest point)

Table 5 **Recommended minimum environmental flows in the Steels, Pauls and Dixons Creek system proposed by the Environmental Flow Technical Panel (SPDEFTP 2003B)**

Location	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Pauls Creek	Cease to divert flow 15.0 ML/d											
					High flow fresh > 150.0 ML/d							
					High flow fresh > 520.0 ML/d							
Dixons Creek	Cease to divert flow 15.0 ML/d											
					High flow fresh > 50.0 ML/d							
					High flow fresh > 500.0 ML/d							
					High flow fresh > 1250.0 ML/d							
Steels Creek	Cease to divert flow 5.0 ML/d				Cease to divert flow 15.0 ML/d							Ctd flow 5.0 ML/d
	Low flow fresh > 15.0 ML/d				High flow fresh > 700.0 ML/d							Low flow fresh 15.0 ML/d
					High flow fresh > 2500.0 ML/d							

During the development of this SFMP, the committee debated the environmental objectives, including the State Environment Protection Policy (SEPP) objective to have Blackfish, Tupong, Grayling, Spotted Galaxias and Common Galaxias of appropriate size present in streams and within the natural range of these species (EPA 1999). Following discussion of these recommendations, it was suggested that the 15.0ML/day cease to divert flow was high for these creeks.

The committee noted the ephemeral nature of the catchments and the relative lack of in-stream habitat. This indicates that this original Blackfish objective was perhaps not as appropriate as several of the other environmental objectives, especially as there are no scientific records of Blackfish in these creeks, although anecdotal advice suggests that Blackfish have been caught in the past. The cease to divert flow of 15.0ML/day was also expected to impact heavily on licence users ability to access and obtain their water entitlements. The environmental flow assessment by the EFTP was never finalised as the frequency and duration of the flow recommendations could not be assessed with the limited stream flow data that was available at the time.

Accordingly, the committee requested that the environmental flow requirements of the Steels, Pauls and Dixons Creek catchments were re-evaluated without the Blackfish objective, as Blackfish require substantially greater water depths than other species. Given the significant impact of a 15.0ML/day cease to divert flow on the reliability of irrigation licences; the fact that no Blackfish had been recorded in the catchment during very recent fish surveys; and the known preference of the species to inhabit more permanently flowing creek systems, it was agreed that the proposed objective for Blackfish should be revised to: *Maintain existing populations of Blackfish by maintaining existing pool habitats.*

This revised objective, in conjunction with the other objectives proposed by the SPDEFTP (2003A) formed the agreed ecological objectives for the plan (DSE, 2004). This revision of the Blackfish objective was supported by Tim Doeg and David Crook who were members of the original technical panel that conducted the environmental flow assessment (Doeg 2004; Tim Doeg and David Crook pers comm.) The implication of this revision to the objectives was that the water depths required to provide habitat and movement for smaller bodied fish (eg galaxias) was lower and therefore, the revised cease to divert flow was less than the originally proposed 15 ML/day. Refer to Table 4 for the water depth requirements of different fish species.

Detailed modelling of the implications from changing the water depths at each environmental flow site was undertaken to compare a range of environmental flows against different habitat and movement options. For the Steels and Dixons Creeks it can be seen that small-bodied fish movement and habitat is generally achieved at depths of 0.2 metres, which equates to a stream flow of 5.0ML/day (Figures 5 & 6 long section/water depths). These long sections demonstrate that deeper pools, represented by the peaks on the graph, are still maintained with depths of at least 40cm. These pools would provide habitat for Blackfish as well as small-bodied fish habitat and movement. The importance of these pools is to provide refuge for any Blackfish that are in the system until such time as stream flows flush the creek and reconnect the pools to allow more extended movement.

For Pauls Creek, the long sections demonstrate that even at the originally recommended cease to divert flow level of 15.0ML/day, the depths of 40cm required by Blackfish are not achieved (Figure 7). And in this creek, a cease to divert flow level of 5.0 ML adequately allows for small bodied fish movement at a water depth of 0.12m and is borderline at providing Blackfish movement/small bodied fish habitat at a water depth of 0.2m. It was felt that 5.0ML/day in the Pauls Creek was a borderline cease to divert option but was proposed as an acceptable option to maintain consistency and ease of management across the three creeks. It was strongly suggested that monitoring be undertaken over the course of the SFMP to confirm that a cease to divert level of 5.0ML/day is adequate for small-bodied fish habitat and movement, especially in Pauls Creek.

Figure 5 Dixons Creek Water depths at various flow rates showing ecologically important depths

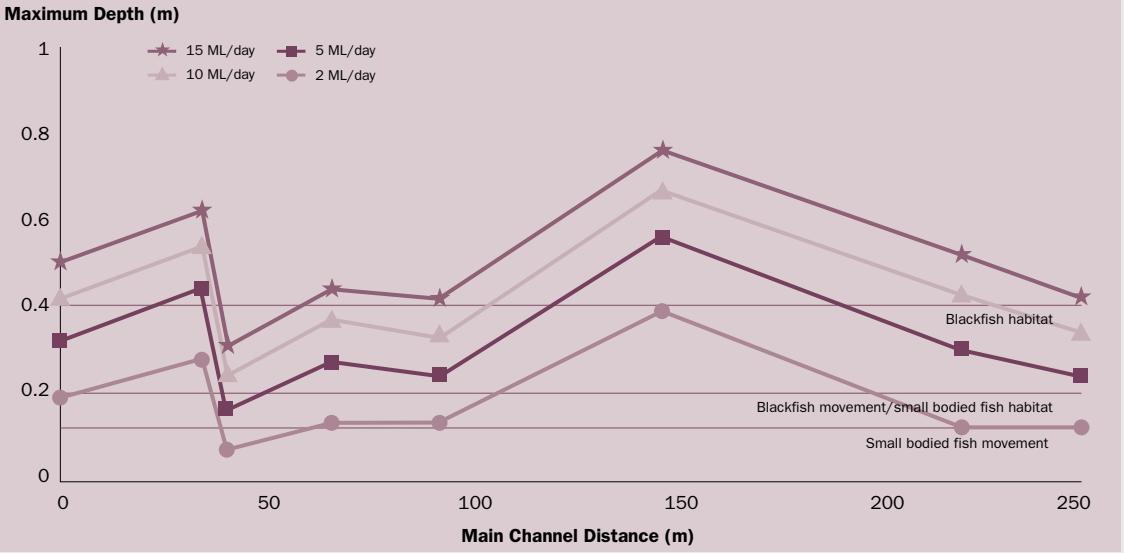


Figure 6 Steels Creek Water depths at various flow rates showing ecologically important depths

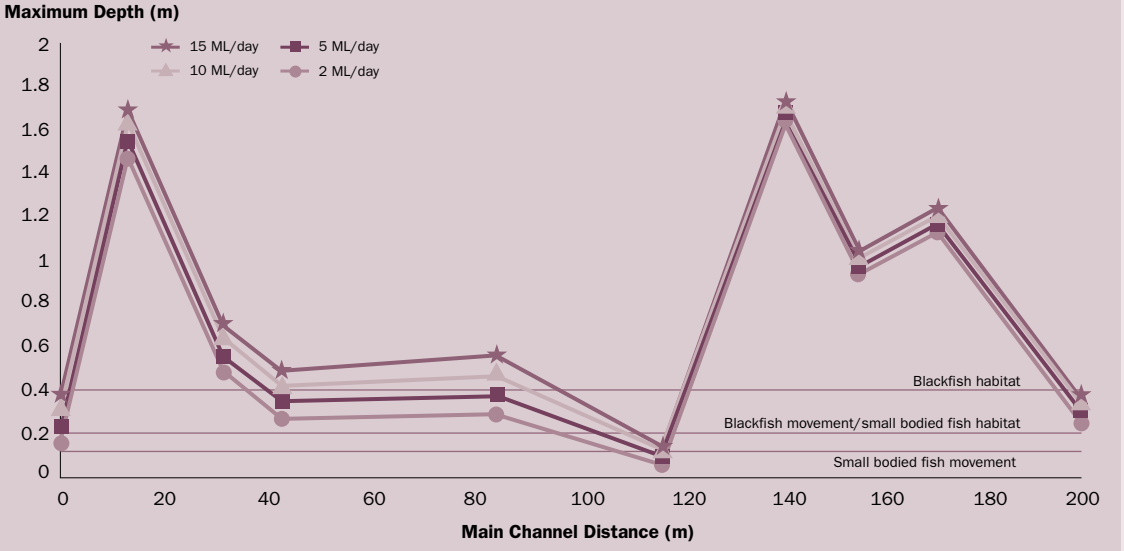
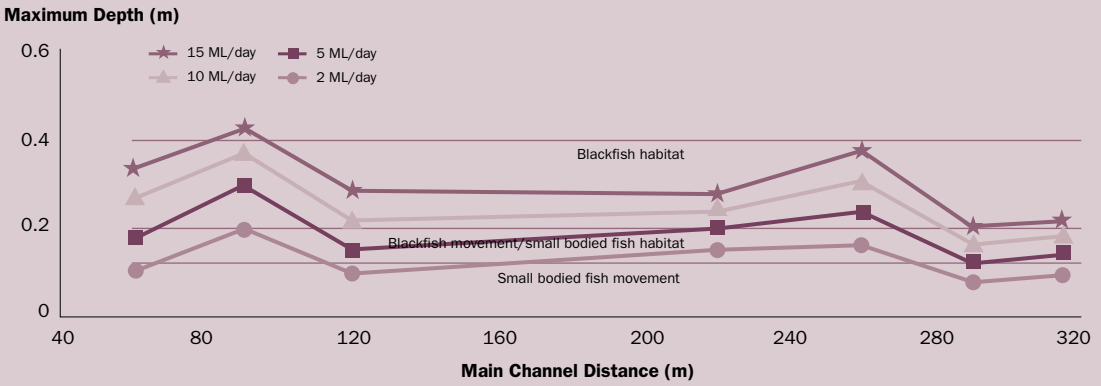


Figure 7 Pauls Creek Water depths at various flow rates showing ecologically important depths



The re-assessment of the flow requirements without the River Blackfish objective had a significant impact on the environmental flow recommendations in the Steels, Pauls and Dixons Creeks catchment. Without the modified River Blackfish objective, it was recommended that the winter-fill cease to divert level for all the creeks should be 5.0ML/day. (Pers. Coms. Tim Doeg & Dave Crook, 2004)

The Committee recommends the following environmental flows for the Steels, Pauls and Dixons Creeks:

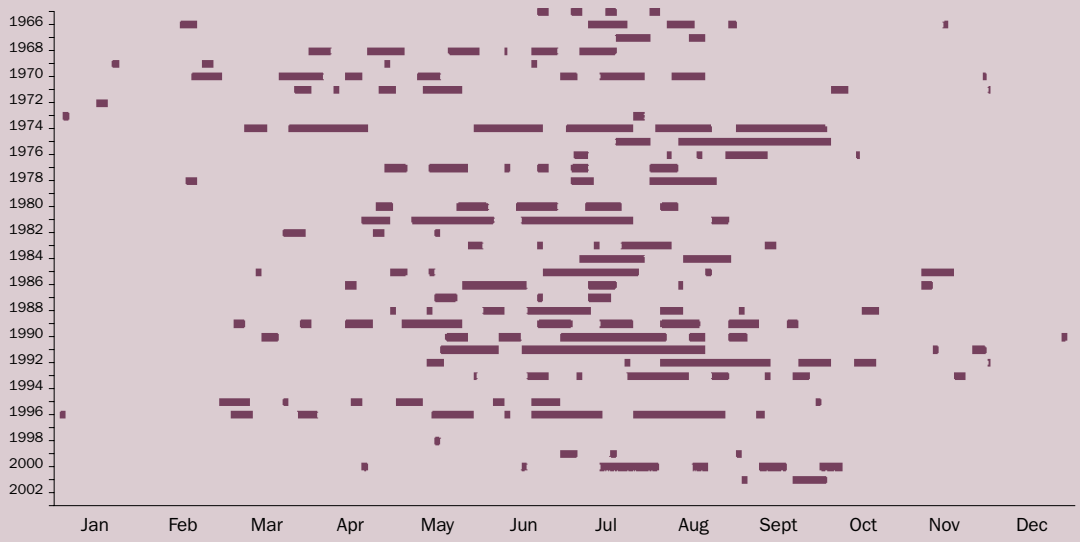
The cease to divert level be set at 5.0ML/day, subject to evaluation by Melbourne Water over the next five years. This evaluation must include:

- *A study on fish migration opportunities (ie. adequate water depths to allow movement) by fish specialists to ensure that 5.0ML/day is suitable for fish migration. This includes checking the adequacy of the resulting flow regime for opportunity of fish movement between pools.*
- *A study on the health of pools (ie. water quality) to ensure fish can be sustained during low flows.*

The Environmental Flows Technical Panel also recommended low flow freshes to refresh water quality in pools, flush deposited sediment from habitat substrates and to allow recolonisation by fish to areas at times when the cease to divert flows does not allow fish passage as described above. While specific volumes were not recommended, the final report by the panel suggested that the recommend environmental flow of 15.0ML/day should adequately perform this function. Considering the re-evaluation of the minimum environmental flow for the creeks down to 5.0ML/day, it was highlighted as important to ensure that these low flow freshes still occur to allow for fish passage between low flow periods. There are no all-year commerical or irrigation licences, so low flow freshes will be preserved.

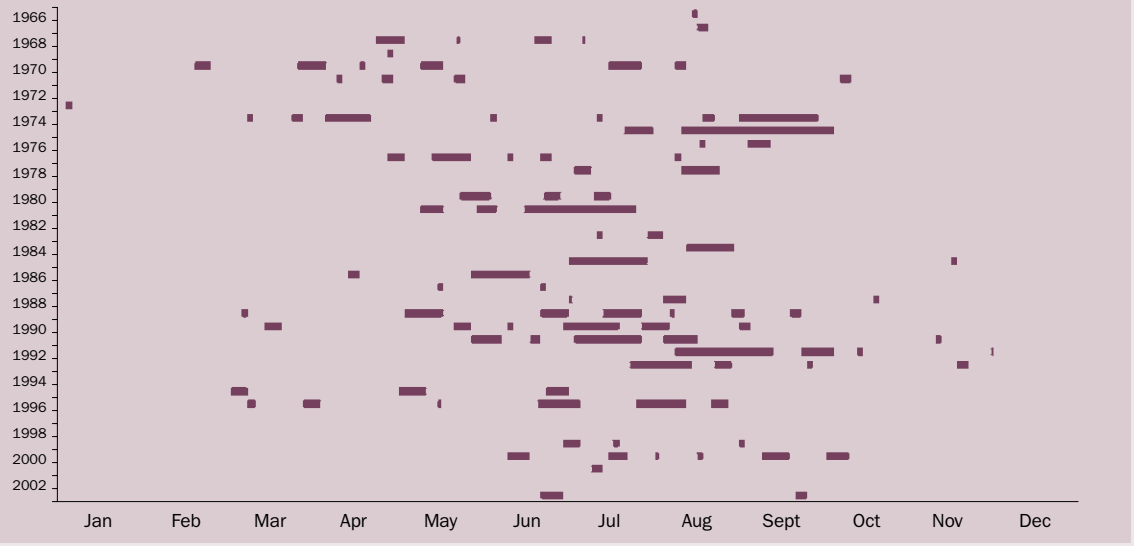
To demonstrate this point, Figure 8 presents a chart commonly referred to as a spells analysis and highlights the frequency with which flows exceeded 15.0ML/day in Pauls Creek from 1964-2004. Years are represented horizontally with blocks on the same horizontal line representing the days of that year when flow exceeded 15.0ML/day. This shows that flows above 15.0ML/day do occur, but were rare during the recent drought from 1998-2004. Figures 8 and 9 have been created using modelled flow data and incorporate a 5.0ML/day minimum environmental flow.

Figure 8 Distribution of Low Flow Freshes (>15ML/day) for Pauls Creek



High-flow freshes were also recommended for Steels and Dixons Creeks to maintain the bank and bench vegetation. These freshes also provide natural disturbances that are important for maintaining channel form and biodiversity and were recommended based on the current channel structure (SPDEFTP 2003A). For Dixons Creek the high-flow fresh recommended to inundate the low-level benches was 50.0ML/day. This is represented below in Figure 9, which illustrates the frequency that high-flow freshes exceeded 50.0ML/day in Steels and Dixons Creeks from 1964-2004.

Figure 9 Distribution of Flushes >50ML/day for Steels/Dixons Creek



The flows that occur in the Steels, Pauls and Dixons Creeks during the summer months are largely protected by licence conditions that do not permit pumping between the months of December to June. One small domestic and stock licence is an exception to this plus a limited number of properties with creek frontages that are entitled to extract water for domestic and stock purposes without requiring a licence. In addition, there are a significant number of farm dams that collect rainfall run off during the summer months. These dams exacerbate the ephemeral nature of the catchments by capturing rainfall runoff that would otherwise feed into the creeks and create the first flushes in summer and autumn.

5.5 Issues associated with implementing Environmental Flows

The derivation of minimum environmental flows for the Steels, Pauls and Dixons Creeks has been outlined above. However, two issues arise with monitoring of the proposed flow levels in the catchments. Licence holders are currently managed by two streamflow gauges, one located on Pauls Creek, and the other on Steels/Dixons Creek, with the flows from both Steels and Dixons Creeks being recorded by one gauge. The problem exists during periods of high flow in the Yarra River, when both of the gauges are influenced by water that backs up from the Yarra resulting in unreliable high flow readings.

Due to the unreliable readings from these gauges and to ensure compliance with the new licence conditions and minimum environmental flows for each creek, the committee recommends that the two existing gauges be relocated to more suitable locations, and that a third, new gauge is installed at the lower end of Dixons Creek. The committee propose that the cost of relocating the existing gauges will be borne by the licensing authority. In addition, the committee proposes that the cost of installing the new gauge is to be borne by all stakeholders within the Yarra catchment as the provision of more accurate streamflow data and compliance with licence entitlements is considered to be a benefit for the greater community.

In order for useful correlation to be performed between the existing gauges and the proposed new gauges, the existing gauges would need to remain in place for a period of time.

As it's not possible to record 5.0 ML/day in each of the Steels and the Dixons Creeks, prior to the installation of new gauges, the committee proposes that licences continue to be managed to the Drought Response Plan for Licensed Water Users. Accordingly, the relevant ban levels for the winter-fill period will be set at 5.0 ML/day at the Pauls Creek gauge and 7.0 ML/day at the Steels Creek gauge, until such time as the new gauge is operational.

6 What the Plan contains

6.1 Object of the Plan

The *Water Act 1989* states:

"The object of a management plan is to make sure that the water resources of the relevant water supply protection area are managed in an equitable manner and so as to ensure the long-term sustainability of those resources."

In addition to this general objective, the committee has identified further objectives specific for the Steels, Pauls and Dixons Catchment. These objectives were developed following an analysis of the specific flow related issues facing the catchment including the ephemeral nature of the streams, the current water use, land use practices, and fish populations expected to be present:

a) Recommend stream flows that follow natural seasonal flow patterns and do not dry up any more frequently than would reasonably occur

b) Establish simple local trading rules

c) Adopt rules that adapt to longer term changes in water availability

d) Recommend suitable monitoring of stream flows and water usage

e) Set water access conditions that allow fair sharing of water between users

f) Prohibit new development that would diminish water availability beyond cap levels

g) Set caps on water allocation

h) Water allocations in the Steels, Pauls and Dixon Creeks Catchments to be managed such that beneficial uses of these waterways and their tributaries are protected.

The SFMP objectives and targets are consistent with broad objectives set for the catchment by the Victorian Government and the Port Phillip Catchment and Land Protection Board including the State Environment Protection Policy, (Waters of Victoria) Schedule F7 (Waters of the Yarra Catchment) 1999, and the Port Phillip and Westernport Regional Catchment Strategy 2002.

6.2 Administration and Enforcement

Melbourne Water has the duty of enforcing and administering this SFMP.

It is responsible for ensuring that:

> The metering and monitoring program is undertaken;
> Licence holders comply with rosters, restrictions and licence conditions;
> Licences are issued with the appropriate licence conditions; and
> Illegal water use does not occur.

6.3 Prohibitions on granting new licences

In 2004 the Victorian Government released an action plan titled *Our Water, Our Future* which set the policy direction for stressed rivers such as the Yarra. The Government set a moratorium on the issue of new entitlements anywhere within the basin, including the Steels, Pauls and Dixons Creeks catchment, until such time as an environmental water reserve is determined. This SFMP recommends a maximum volume of water rights (licences) that may be allocated for use within the catchments.

While government policy prohibits increasing the maximum volume taken within the Yarra basin, it still allows for rights to be redistributed. Accordingly, the right to take water can be bought and sold between irrigators and transferred so long as the total volume allocated is not exceeded. Melbourne Water has set trading rules that guide water transfers within the basin to ensure that prior to approving a trade an assessment of the impact on both the environment and other users is undertaken.

This section outlines the maximum volumes that can be taken within the Steels, Pauls and Dixons Creeks catchment, subject to the trading rules outlined in this SFMP (section 6.4).

All-year licence allocation limit

Under Melbourne Water policy, no new all-year diversion licences have been issued in the Yarra River basin for many years. This policy was put in place to protect waterways from further stress during the summer/autumn low flow period. This Stream Flow Management Plan is consistent with the established Melbourne Water and Victorian Government policy and effectively caps further allocations during the low flow period. All-year licences can, however, be transferred subject to the prescriptions in the SFMP and normal diversion licensing policies and guidelines.

Only one low-consumptive all-year domestic and stock diversion licence of 2.0ML exists in the Steels Pauls and Dixons Creeks catchment. However, there are a number of registered farm dams that are technically all-year licences. In future, new licences will only be issued as winter-fill, with the need for adequate off-stream storage required to ensure licence holders have sufficient water for use outside of the winter-fill period.

If an all-year licence is relinquished or revoked, the volume will not be issued as a new all-year licence, except if a site-specific assessment can determine that water is available and will not impact on either the environment or any other users.

As there will be no new all-year licences, the issue of an all-year licence will only occur when a water user surrenders an all-year farm dam registration licence to obtain a standard all-year farm dam licence. All licences, other than registration licences, are issued for a period of 12 months, and renewed annually.

The allocation limit for all-year licences is set at the current level of commitment being 988.0ML. The volume of farm dams that were registered or licensed by 1 July 2003 is to be included in the all-year licence allocation limit.

Existing farm dams must be included in this volume as:

> Their historic volume of use and operation is recognised under the *Water Act 1989.*

> They have not been designed with the capacity to pass flows during the prescriptive periods (ie. they cannot operate to winter-fill licence conditions) and therefore have historically collected water throughout the year.

People requiring stock and domestic water for new developments could access water by constructing a stock and domestic farm dam, through trading or through reticulated supplies, where available. The SFMP does not contain any requirements in relation to domestic and stock dams on multi lot subdivisions if these dams are not on waterways and do not take water from a waterway.

Recommendation 1.
The committee recommends an allocation limit on all-year licence allocations. The allocation limit (cap) will be equal to the current volume of licence entitlements, which is 988 ML plus the volume of any existing farm dams still to be registered or licensed.

Winter-fill licence allocation limit

The committee discussed the winter-fill period in some detail and agreed that to help protect autumn flushes for native fish migration and breeding, and to better align with the actual high-flow period, the winter-fill period should be changed from 1 May- 31 October, to 1 July- 30 November.

The environmental flow study emphasised that freshes occurring naturally during May to July are important trigger flows for fish spawning and are also critical for improving water quality in deep pools. Licensed water users indicated that July is an important month for water harvesting but June is not so critical, therefore it was agreed that the winter-fill months could be moved back a month to include the period 1 July to 30 November.

The committee discussed the volume of water harvested by farm dams in the catchment on a number of occasions and agreed that no further allocations could be made due to the 'cap' prohibiting new licences and that allowing the transfer of water into the catchment in excess of the current level would reduce existing water user reliability of supply and add to the environmental risk. The majority of the committee therefore agreed to set the winter-fill allocation cap at the current level.

The committee considered the option to set an annual cap at a level lower than existing allocations so that water being traded out of the catchment would reduce the cap until it reached a chosen figure. The options presented for choosing an annual volume included the Modelled Average Annual Supply Under Full Development (1345ML-year) and the Sustainable Diversion Limit (1008ML-year). It was felt this allocation limit would aim to allow a relatively high reliability of supply whilst also protecting instream values and processes during the winter-fill period. However, after careful consideration the majority of the committee felt they didn't want water to be traded out from the catchment and unable to return.

The recommendation to cap the catchment at the existing level for both all-year and winter-fill licences was made on the understanding that additional work will be undertaken within the five-year review period to refine water use demand.

Accordingly, the committee agreed to set the allocation limit for the winter-fill period at 696.0ML, which reflects the current allocation.

Recommendation 2.
The committee recommends that the winter-fill (high flow) period is 01 July to 30 November.

Recommendation 3.
The committee recommends an allocation limit (cap) on winter-fill licence allocations. The cap will be equal to the current volume of winter-fill licence entitlements which is 696 ML.

6.4 Trading Licences

The *Water Act 1989* allows licences to be transferred following approval of an application by Melbourne Water. Licences can be transferred on the sale of a property to which the licence relates but they can also be transferred to the owners of other land. Licences can be transferred permanently or temporarily and will only be approved where it is deemed that sufficient water is available to supply the licence at the new location without any adverse effect that the allocation or use of water may have on existing users or on the environment.

The SFMP enables the development of specific local rules relating to licence transfers. Water transfers aim to promote efficiency and assist farmers with moving water over time to highest value uses. Water trading provides access to water in areas where no more new licences are being issued. However, water transfers also have the potential to increase the overall water use within the catchment, as unused licences become active.

Under this SFMP, rules relating to the transfer of licences from one location to another have been recommended to ensure that additional development can occur without adversely affecting existing water users or the environment.

Transfer of farm dam licences can also occur. Commercial or irrigation dams which have their entire volume transferred will become stock and domestic dams. Commercial use will not be permitted from these dams unless a new or transferred licence is obtained. Permanent and temporary trading will be monitored by the use of meters.

The issues considered in developing specific transfer rules for Steels, Pauls and Dixons Creek included:

- The need to keep the rules simple
- Recognising the allocation cap and the potential for this cap to become over-allocated through transfers
- Protecting reliability of supply when licences are transferred
- Equity in trading: between the environment and extractive water users and between licence holders
- Catchment hydrological characteristics.

Transfers can only occur if there is an allocation available within the licence allocation limit.

It was proposed that potential transfers of entitlements upstream within the catchment should not be permitted, however downstream transfers should be permitted. The *Water Act 1989* outlines considerations for assessing transfer of entitlements either upstream or downstream.

The committee considered trading rules that were set for other SFMPs completed by Melbourne Water and reviewed the general Melbourne Water trading rules established for the entire Yarra basin. After some discussion the trading rules recommended by the committee included the following:

Recommendation 4.
The committee recommends a licence cannot be transferred upstream into the catchments of the Steels, Pauls and Dixons Creeks.

Recommendation 5.
The committee recommends a licence cannot be transferred between the catchments of the Steels, Pauls or Dixons Creeks.

Recommendation 6.
The committee recommends the maximum volume of a transferred licence will be determined by Melbourne Water after considering the water available at the new location, the water needs of existing licence holders and the environment at that location.

Recommendation 7.
The committee recommends that Melbourne Water may or may not alter the licence conditions of a transferred licence depending on whether the location of the licence changes as a result of the transfer. In other words, a licence that is transferred from one person to another but is still being used at the same location may not need to have its conditions changed.

6.5 New Dams

A licence is required to harvest water for commercial or irrigation purposes in a dam, regardless of whether it is on or off a waterway. However under the SFMP, no new dams on waterways may be licensed as the environmental impacts are too great.

6.6 Metering

Effective water resource management relies upon information about water usage patterns and volumes. This information can be collected by metering extractions. Melbourne Water must install meters to measure any water taken under licence.

Farm dam registration licences do not pay an annual fee and so there is no opportunity to recover the cost of installing meters on these licence holders. These licences may continue to be monitored using an area-based condition that describes a maximum area on which water can be applied until such time that meters can be practically fitted. Meters should firstly be installed on registered dams greater than 10ML in volume or those for which the licensee wishes to exceed their licensed area.

New licences for water either pumped from the waterway or collected in farm dams will be metered at the applicant's cost. There is no intention to meter all stock and domestic use in the Steels, Pauls and Dixons Creeks Catchment.

It is proposed to remove the licence area constraints following the installation of meters to enable licensed water users to efficiently maximise use of their entitlement and allow trading.

The introduction of meters has a number of benefits to both irrigators and Melbourne Water. Melbourne Water will be required to maintain each meter and keep records of any maintenance. Meters will be read at least once annually for all-year licences and at the start and end of the winter-fill season for winter-fill licences.

6.7 Maintaining Environmental Flows

One of the aims of the SFMP is to protect the catchment's environmental values, primarily by ensuring that the pattern of stream flows stays as close to natural as possible, even after the extraction of water has occurred. In brief, this is achieved by:

Table 6 **Maintaining environmental flows**

Protecting...	**By...**
High flows	Capping the total volume of licences, although realistically water users have little impact on high flows.
Medium flows	Capping the volume that can be taken on any single day between 1 July and 30 November.
Low flows	Setting minimum flows that trigger bans on water extraction – based on average and instantaneous stream flows.

The obligation for protecting environmental flows is twofold. Licensees have an obligation as a condition of their licence (Schedule 3), and Melbourne Water has an obligation to ensure, to the best of its ability, that the licensees fulfil these licence conditions (Clause 15).

Protecting Low -flows

An independent review of the environmental condition of the catchment recommended a series of minimum environmental flows that should be protected, based on an understanding of the flow needs of different fish species and the measured depth at a range of different flows. These were re-assessed following the adjustment of the environmental objective for Blackfish (see section 5.4 Environmental Flows).

Table 7 **Recommended minimum environmental flows in the Steels, Pauls and Dixons Creeks catchment**

Location	Minimum Flow (ML/day)
Steels Creek Gauge	5
Pauls Creek Gauge	5
Dixons Creek Gauge	5

Recommendation 8.

The consultative committee recommends a minimum environmental flow for the winter-fill period of 5.0ML/day or natural in each of the Steels, Pauls and Dixons Creeks. Bans on taking water will be introduced when flows fall below this instantaneous level and bans will be removed when the seven-day average flows rise above this level.

The stream flow monitoring gauges located on Steels and Pauls creeks are currently the only locations available to measure environmental flows. As described in Section 5.5, new gauge locations for monitoring environmental flows have been recommended by the committee, and should be implemented as soon as practicable.

The implications of implementing the environmental flows on water users described in Table 7 above were estimated using flows from the REALM model (SKM 2002) and counting the number of days each year when a ban on water extraction would have applied. The assessment was completed using the recorded stream flow data from the Steels Creek and Pauls Creek gauges between 1998 and 2004.

The assessment showed that in practically every year of this drought period bans on water extraction would have applied as flows during the winter-fill period were quite often below the recommended minimum environmental flow levels as described above. It should be noted that this period was particularly dry.

Based on historical gauge data, an environmental flow of 5.0ML/day during these months from 1 July to 30 November would have resulted in the bans shown in Table 8 below. The winter-fill period lasts for 152 days, so the table highlights the low reliability of supply in the catchments. Most of these bans would have lasted for several weeks each, although some would have been as short as one day. In the particularly dry years of 2002 and 2004, bans would have applied for the majority of the winter-fill period.

Table 8 **Historical ban analysis in the Steels, Pauls and Dixons Creek system**

	Ban Flow	Number of winter-fill ban days						
		1998	1999	2000	2001	2002	2003	2004
Steels & Dixons Creek	5 ML/day	88	95	11	84	144	68	103
	15 ML/day	120	115	57	130	152	115	123
Pauls Creek	5 ML/day	140	121	67	131	152	91	133
	15 ML/day	152	140	92	145	152	125	146

The extraction of water must cease whenever the instantaneous stream flows drop below 5.0 ML/day at the Steels, Dixons or Pauls Creek gauges.

Melbourne Water must therefore do its best to ensure that the extraction of water by licence holders does not cause flows in the Steels, Dixons or Pauls Creeks to drop below these environmental flow levels. In addition to the ban levels described above, further measures to protect flows during low flow periods have been recommended. A roster will be developed by Melbourne Water in consultation with licenced water users. The roster will allow equitable sharing of the available water, and will reduce ecological risk during low flow periods. An initial roster will be developed within the first 18 months of the life of the plan.

Protecting Medium Flows

Medium flows generally refer to the stream flow peaks that naturally occur after rain. These peaks may last for a number of days and can occur throughout the year. These medium flows provide important flushing mechanisms for the creeks, especially after long dry periods, by flushing out stagnant water and connecting pools that may have become isolated refuges for aquatic animals. They also help to flush accumulated vegetation and sediment from the stream.

These ecological functions only occur once the peaks reach a certain size. This threshold is defined as the flow that naturally would have occurred 50% of the time (the median flow) (NRE, 2002A).

In the Steels, Pauls and Dixons Creeks, the creeks often cease to flow between 1 December and 30 May. There is only one 2.0 ML domestic and stock all-year licence in the catchment allowing diversions during this period. Therefore the medium flows during these non-winter months are protected by licence limitations on pumping, thus allowing the stream to be rejuvenated after low flow periods.

Storm peaks can also occur during winter and as would be expected, are bigger than the summer peaks. To protect these peaks, the committee recommend limiting the total volume of daily extraction between 1 July and 30 November to ensure that water users only take a portion of the peaks and the remaining water in storm events is able to pass through the river system.

6.8 Aesthetic dams

Aesthetic dams do not need a licence to take and use water, yet they can still capture significant volumes of water. As water is lost from the dams through evaporation, and replaced by rainfall, they can impact on the availability of water downstream. The SFMP does not permit a person to operate an aesthetic dam if the replenishment of evaporation from that dam will cause the allocation cap to be exceeded. Dam owners in this situation would be encouraged to obtain a volume of water by transfer that is equal to the annual evaporation from the dam.

Melbourne Water will liaise with the Shire of Yarra Ranges to encourage the Council to have regard to this prescription of the SFMP when considering applications for planning permits that include dams for aesthetic purposes.

Aesthetic dams will need a licence if the size of the dam is large. The SFMP does not permit the construction of dams on waterways, however a large dam off a waterway may still be allowed if a licence to construct works etc issued under Section 67 of the Act is granted. Once the allocation cap has been reached, any Section 67 licence issued to construct an aesthetic dam can include a condition requiring the dam owner to obtain a volume of water by transfer of water entitlement that is equal to the annual evaporation from the dam. Under the prescriptions of this SFMP, this licence would be issued with winter-fill conditions.

6.9 Licence Conditions

With the approval of this SFMP the conditions of licences will be amended to ensure they reflect the requirements of the SFMP.

Schedule 3 outlines the conditions that must be placed on all licences. The conditions are specific to each licence type and will be applied on renewal or granting of new licences.

6.10 Stream flow monitoring program

The SFMP requires Melbourne Water to maintain the Steels Creek and Pauls Creek monitoring gauges, which are used to monitor stream flows.

After the commencement of this SFMP, Melbourne Water must, as soon as practicable, review the existing gauging arrangements and propose new locations and numbers of gauging stations where necessary to enable continuous recording of flows in Steels Creek, Dixons Creek and Pauls Creek.
New locations recommended by the committee include:

(a) Steels Creek below Gulf Road and adjacent to the aqueduct; and

(b) Dixons Creek on the highway below Gulf Road or, alternatively, at the bridge and siphon crossing; and

(c) Pauls Creek on the Old Healesville Road or alternatively, below Botting's Lane.

Melbourne Water must continuously record flows at the Steels Creek and Pauls Creek gauging stations and at any gauging station installed as a result of the review referred to above.

Recommendation 9.

The consultative committee recommends the following new gauge locations to monitor environmental flow compliance

(a) Steels Creek below Gulf Road and adjacent to the aqueduct; and

(b) Dixons Creek on the highway below Gulf Road or, alternatively, at the bridge and siphon crossing; and

(c) Pauls Creek on the Old Healesville Road or alternatively, below Botting's Lane.

6.11 Monitoring the effects of the Plan

During the implementation of the SFMP, it is important that information is collected to allow a meaningful review of the effectiveness of the SFMP in meeting its objectives. Whilst it is important to measure the success of the SFMP against its objectives, it is also important to keep in mind that environmental change may be incremental and cumulative. Therefore, short term monitoring may not identify any significant changes to stream health over the five-year period.

Melbourne Water currently monitors stream health across the Yarra basin by undertaking water quality, macroinvertebrate, fish and geomorphological studies. SEPP Schedule 7 outlines monitoring requirements and goals for river health and water quality. The Victorian River Health Strategy 2002 further recommends monitoring and rehabilitation activities be undertaken by Melbourne Water. This Stream Flow Management Plan supports the implementation of these monitoring programs.

It is proposed to incorporate the data collection on the stream health of the Steels, Pauls and Dixons Creeks into the existing Melbourne Water program. Data collected by metering and stream flow gauging will also be an integral part of the monitoring review.

The intent of the monitoring program specifically linked to this SFMP is to assess the availability of fish and macro-invertebrate habitat (including water quality and availability of woody debris) at the lower negotiated cease to divert level, especially during times of low flow and drought. Some of the parameters considered important to assess may include oxygen and nutrient levels, water temperature and turbidity.

Accordingly, within twelve months of the SFMP being approved it is recommended that Melbourne Water develop a monitoring program to enable the evaluation of the newly implemented SFMP.

The monitoring program should collect data to:

> confirm assumptions about water use, specifically from catchment dams

> assess in stream environmental health

> assess whether the SFMP is protecting the agreed environmental flows.

Recommendation 10.

The monitoring program must include:

> *A study on fish migration opportunities (ie. adequate water depths to allow movement) by fish specialists to ensure that 5.0 ML/day is suitable for fish migration. This includes checking the adequacy of the resulting flow regime for opportunity fish movement between pools.*

> *A study on the health of pools (ie. water quality) to ensure fish can be sustained during low flows.*

> *A assessment of fish populations and macro-invertebrate communities.*

Melbourne Water will not attempt to demonstrate any environmental improvements from the implementation of the environmental flows.

6.12 Reporting

In accordance with section 32C of the *Water Act 1989,* Melbourne Water is required to prepare an annual report for each approved Stream Flow Management Plan.

As part of the annual report, Melbourne Water will make an assessment of the following matters:

> changes to the level and type of development within the area including:
  – the extent of water usage resulting from transfers
  – the activation of inactive licences
  – the location and impact of new take and use licences

> water usage information

> the impact that any new development may have had on the reliability of existing water users and the flows in the waterway

> the effectiveness of management prescriptions in meeting the objectives of the SFMP including:
  – metering
  – monitoring
  – bans
  – licence conditions

> any difficulties associated with, and progress towards, meeting environmental flows specified in the SFMP.

The report will be provided to the Minister and the Port Phillip Catchment Management Authority on or before 30 September in each year. It will be made available to the public for inspection free of charge at the offices of the Authority and on the Internet. A notice will also be published in a local newspaper advising of the availability of the report at the time of its release.

Copies of the report will also be sent to the Department of Sustainability and Environment, Department of Primary Industries and relevant local government offices.

6.13 Review of the Plan

A review of the operation of an approved Stream Flow Management Plan will be required within five years to ensure that the Stream Flow Management Plan is meeting its objectives.

The annual reporting requirements specified under the *Water Act 1989* will help to determine when this review should take place. Stakeholders may raise issues for investigation during the review.

If the review concludes that the SFMP should be amended, the *Water Act 1989* requires a consultative committee to be established to advise on the amendment. Public submissions on the amendment would also be called for and considered by the Minister before an amendment would be approved.

7 Compliance

The *Water Act 1989* states that an approved management SFMP is binding on every person including every statutory body.

Anyone who takes water without proper authorisation may be guilty of an offence under the *Water Act 1989* and be liable for prosecution. This may include anyone who takes water without a licence or who takes more water than the licence allows.

Licence holders are also required to comply with their licence conditions and licences can be revoked if licence conditions are not complied with.

8 Other Matters

8.1 Land use planning

There is a need to ensure that the licensing and land use planning system is clear and easily applied. The provision of concise information is important to ensure that development of the water resource within the Protection Area is sustainable and equitable. The provision of appropriate reference material for municipal planning staff, water users and the public in the form of simple brochures, training and process flow charts should be a short-term priority. Melbourne Water will work with the Shire of Yarra Ranges to develop resources designed to assist with understanding of the land use planning and referral process and the water allocation licensing and referral process.

It is crucial that proponents for new developments, which require the use of surface water from the Steels, Pauls and Dixons Creek Protection Area, identify their water requirements and contact Melbourne Water to determine if that water is available. This is particularly important in the development of multi lot subdivisions which can have significant water needs, when the cumulative impacts of all lots within the subdivision are assessed.

8.2 Catchment and waterway management issues

During the development of the SFMP a number of key catchment management and stream health issues were examined.

The lower reaches of the creeks are particularly degraded. Lack of native vegetation in the riparian zone, weeds and stock access are all impacting on the environmental condition of the stream. Historical snag removal in these reaches has resulted in a loss of instream habitat considered necessary for instream health.

Melbourne Water's Stream Frontage Program is targeting the Steels, Pauls and Dixons Creeks over the next five years. Interested landholders within the Protection Area may be eligible to receive grants and other assistance to provide plants and fencing to protect the streamside environment. There is an active community of landowners currently participating in the program over the whole length of the creeks. The committee supports this and other programs to restore riparian vegetation to the creeks.

Programs which investigate the reinstatement of large wood (snags) in the lower reaches of the creeks are supported by the committee; to offset flow related stress to instream aquatic life. The availability of large wood in the area will be assessed, together with impacts of removing the large wood from the terrestrial environment.

8.3 Fish passage

At several stages during the SFMP development, the committee expressed concern regarding instream structures that prevent fish passage within the creeks.

Recommendation 11.

The committee recommends Melbourne Water and the Shire of Yarra Ranges investigate fish barriers as a matter of priority in order to reinstate fish passage in the creeks.

9 References

DSE, 2004, *Victorian Government White Paper, Securing our Water Future Together,* Victorian Government Department of Sustainability and Environment.

Doeg T., 2004, *Effect of Varying Environmental Objectives for Blackfish on Environmental Flow Recommendations for Steels, Pauls and Dixons Creeks,* unpublished Report to the Steels, Pauls and Dixons Creek Stream Flow Management Plan Committee.

Egis Consulting, 2001, *Steels, Dixons and Pauls Creeks Farm Dams Impact Assessment,* a report prepared for Melbourne Water, Egis Consulting.

Koehn, J.D. and O'Connor, W.G., 1990, *Biological Information for Management of Native Freshwater Fish in Victoria*, Victorian Government Printing Office, Melbourne.

NRE, 2002, FLOWS, *A methodology of determining environmental water requirements in Victoria,* The State of Victoria, Department of Natural Resources and Environment.

Raadik T., 2005, *Aquatic Fauna Assessment of Steels, Dixons, and Pauls Creeks, Yarra Glen, Victoria,* Freshwater Ecology Arthur Rylah Institute for Environmental Research.

SKM, 2003, *Estimation of Streamflow and Demand Data and Development of a REALM Model of Steels, Dixons and Pauls Creeks,* Sinclair Knight Merz.

SPDEFTP, 2003A, *Environmental flow determination of the Steels, Pauls and Dixons Creek catchments: Part A: Issues Paper,* unpublished Report by the Steels, Pauls and Dixons Creek Environmental Flows Technical Panel to Melbourne Water Corporation.

SPDEFTP, 2003B, *Environmental flow determination of the Steels, Pauls and Dixons Creek catchments: Part B: Final Recommendations,* unpublished Report by the Steels, Pauls and Dixons Creek Environmental Flows Technical Panel to Melbourne Water Corporation.

EPA, 1999, *State Environmental Protection Policy (Waters of Victoria) – Schedule F7 (Waters of the Yarra Catchment).* Publication No. 471, Environmental Protection Authority of Victoria, Melbourne.

10 Appendix 1

Consultative Committeee responses to community submissions on the draft SFMP

Recommendation Number	Respondent	Comment	Consultative Committee Comment
1. An allocation limit (cap) on all-year licence allocations. The allocation limit will be equal to the current volume of licence entitlements, which is 988 ML plus the volume of any existing farm dams still to be registered or Licensed.	Rod Thomas	There is not enough flow to warrant a cap - it is not an irrigation area that needs policing.	The committee recognises the limited available streamflows for diversion and has introduced a cap to ensure no further demands are placed on the resource. The environment is a primary user of water with minimum streamflow diversion flow levels set to protect water for the environment. Ensuring no pumping occurs below this level requires 'policing'.
	DSE	Recommendation for the Permissible Annual Volume (PAV) needs to be considered.	The committee discussed the setting of a PAV and determined this was not required.
2. The winter-fill (high flow) period is 01 July to 0 November.	DSE	Clause 8 needs to add "plus the volume of any farm dams still to be registered or licensed".	Agree. Clause 8 changed accordingly.
3. An allocation limit (cap) on winter-fill licence allocations. The allocation limit will be equal to the current volume of licence entitlements, which is 696 ML.	Anonymous	Subject to any future long-term changes in climate, keep under review.	Noted.
	Rod Thomas	Why put a cap on anything that cannot be measured.	The committee is required to identify a cap. The cap is measured by the sum of all licensed allocations in the catchment. Measuring use against licensed allocation is determined using metered use of water for commercial and irrigation demands. The Steels, Pauls and Dixons Creeks lie within the broader Yarra catchment which has been capped.
	DSE	Exceeds SDL (807 ML) but assume min flows will protect agreed environmental objectives.	Noted.
4. A licence cannot be transferred upstream into the catchments of the Steels, Pauls and Dixo Creeks.	DSE	The recommendation that the "PAV" and winter-fill cap will not reduce when water is traded out of the catchment therefore means that licences can be transferred into the catchment or upstream subject to assessment. An alternative is that the PAV and winter-fill allocation cap is reduced when water is traded out of the catchment which may lead to improved reliability of supply and potential river health benefits.	The committee considers they have negotiated to achieve a balanced outcome. All points have been considered in proposing the recommendation.
	Rod Thomas	Irrelevant	Noted.
5. A licence cannot be transferred between the catchments of the Steels, Pauls and Dixons Creeks	Paul Hyland	Preventing any inter catchment transfers even a temporary one is hindering the development of the property.	Noted. All users were considered when the recommendations were proposed. Water trading within each catchment is permissible and provides a mechanism for those wanting to buy additional water rights for development.
6. The maximum volume of a transferred licence will be determined by Melbourne Water after considering the water available at the new location, the water needs of existing licence holders and the environment at that location.	Rod Thomas	Keep the beaurecrats out of it - have no idea or commonsense.	Noted. However, the committee disagrees as they consider the licencing authority have been helpful in the development of the Plan, and have the expertise to make this assessment.
7. Melbourne Water may or may not alter the licence conditions of a transferred licence depending on whether the location of the licence changes as a result of the transfer. In other words, a licence that is transferred from one person to another but is still being used at the same location may not need to have its conditions changed.	DSE	Consider including recommendation that when transferring a farm dam licence, that a portion of the licensed volume is maintained within the dam to cover loss by evaporation.	The committee considers they have negotiated to achieve a balanced outcome..

Recommendation Number	Respondent	Comment	Consultative Committee Comment
8. A minimum environmental flow for the winter-fill period of 5.0ML/d or natural. Bans on taking water will be introduced when flows fall below this instantaneous level and bans will be removed when the seven-day average flows rise above this level.	Bill O'Connor	Needs to be reviewed in 5 years, using additional flow data from the 3 new gauges.	Agree.
	DSE	Need recommendations limiting extraction rates (eg maximum daily extraction rate) to protect freshes and medium flows in winter-fill period	Licences are already limited to a daily extraction rate of 5% of total annual licensed volume. In addition, the committee propose to use rosters to achieve this.
	DSE	Flow recommendations need to be reviewed in 5 years, using additional flow data from the 3 new gauges	Agree
9. The following new gauge locations to monitor environmental flow compliance (a) Steels Creek below Gulf Road and adjacent to the aqueduct; and (b) Dixons Creek on the highway below Gulf Road or, alternatively, at the bridge and siphon crossing; and (c) Pauls Creek on the Old Healesville Road or alternatively, below Botting's Lane	Steve Hosking	The request for an additional gauging point on the Dixons Creek comes with additional costs. Such costs need to be funded so users within the catchment should pay. Is the committee supportive of additional levies being introduced to cover the additional costs? (The 'extra gauge' is considered only, not the relocation of the existing gauges).	The committee considers that the addition of a new gauge in order to more effectively monitor streamflows in the three creeks is a benefit for the wider community and therefore the cost should be borne by all stakeholders.
	Rob Sutherland	Improved recording stations would be preferred to new locations	The committee discussed this point and notes that the existing stations are not suitably located due to being influenced by flows from the Yarra River.
Additional Comment	Bill O'Connor	The recommendations from the Aquatic Fauna Assessment regarding identification of barriers to fish passage and installation of fishways, and to improve the protection of instream and riparian zones by fencing and revegetation need to be more strongly stated. The recommendations should require that Melbourne Water address these issues.	The committee noted that the report was an independent assessment undertaken for Melbourne Water and no one party or parties can act on the recommendations in the report.
Additional Comment	Bill O'Connor & DSE	Melbourne Water & Shire of Yarra Ranges to investigate barriers within the creeks as a matter of priority to reinstate fish passage - There must also be instream and riparian improvements, to complement the environmental flows & other recommendations such as provision of fish passage with fishways.	Agree.
Additional Comment	Healesville Environment Watch Inc. (HEWI)	Objectives included in the plan are too general. Environmental Objectives from the Environmental Flow Study should also be included in Schedule 2.	The objectives were proposed at the start of the process to guide development of the Plan. The objectives from the Environmental Flow Study have been included in Schedule 2.
Additional Comment	HEWI	HEWI objects to the revised Blackfish objective.	The committee discussed this point at length and considers they have negotiated and compromised to achieve a balanced outcome.
Additional Comment	HEWI	The environmental monitoring recommended in association with the 5 ML/day minimum flow (page 18) should be included as a separate recommendation in section 6.11	Agree.
Additional Comment	HEWI	Submission shows a misinterpretation of Clause 15, where a 'status quo' is recommended until new gauges are installed. ie 7ML/day at the Steels gauge until a Dixons gauge is installed at which time the min flow will drop to 5ML/day in each creek.	Agree. Additional wording included in the text of the Plan for clarification. Due to legislative constraints the legal part of the plan cannot be amended.
Additional Comment	Leigh Ahern	Include the recommendations from the Aquatic Fauna Assessment (2005) in the body of the legal Plan.	The recommendations from the assessment were included in the text on Page 14 of the draft Plan.
Additional Comment	Leigh Ahern	Include the environmental objectives from the Environmental Flow Study in the legal section of the Plan.	The objectives from the Environmental Flow Study have been included in Schedule 2.

Recommendation Number	Respondent	Comment	Consultative Committee Comment
Additional Comment	Leigh Ahern	Blackfish objective should be looking to restore habitats rather than just maintain pools.	The committee considers they have negotiated and compromised to achieve a balanced outcome. EV agree with Mr Ahern's comment.
Additional Comment	Leigh Ahern	Include monitoring of the condition of pools in the legal Plan.	Agree. Included as Recommendation 10.
Additional Comment	Leigh Ahern	Disagree with Recommendation 1 as it does not assess the availability and sustainability of water with respect to the allocation cap.	The committee considered the recorded streamflow data for the past 5 years and compared this with the modelled data for the past 40 years and determined that capping the entitlements at existing levels was acceptable. In 'average' streamflow years, the allocation cap is not unreasonable and in all years minimum flows for the environment will be protected from diversion.
Additional Comment	Leigh Ahern	Weir on Steels Creek at Pinnacle Lane should be addressed and evaluated for fish passage.	Noted. This is an additional recommendation of the plan.
Additional Comment	Leigh Ahern	Confusion regarding Clause 15.	Agree. Additional wording included in the text of the Plan for clarification.
Additional Comment	Environment Victoria	Include the objectives in the legal part of the Plan.	Agree.
Additional Comment	Environment Victoria	Use layout as per Olinda draft Plan.	Agree.
Additional Comment	Environment Victoria	Strengthen ecological objectives (refer to Appendix 1 in EV's submission).	The committee considers the proposed objectives are adequate.
Additional Comment	Environment Victoria	Under section 6.11 of the Plan, include more detail in the wording plus reference stock fencing as complementary works	Noted. More wording has been included to the need for complementary works to assist the effectiveness of the Plan.
Additional Comment	Environment Victoria	Include text on monitoring from Page 26 in the legal part of the Plan.	Agree. The committee considers this does not change the intent or effectiveness of the plan.
Additional Comment	Environment Victoria	Additional words to be inserted regarding monitoring to be undertaken using the best available science.	Agree. The committee considers this does not change the intent or effectiveness of the plan.
Additional Comment	Environment Victoria	Add wording on Page 16, paragraph 4 "and the RELATIVE lack of in stream habitat"	Agree. The committee considers this does not change the intent or effectiveness of the plan.
Additional Comment	Environment Victoria	EV highlighted the aquatic fauna survey and it's "limited" sampling. Suggest change the wording on Page 15, paragraph 2 "nor in any previous SAMPLING of these creeks" and add wording on Page 16, paragraph 4 "especially as there are no DETAILED records in this creek"	Agree. The committee considers this does not change the intent or effectiveness of the plan.
Additional Comment	Environment Victoria	Also add wording to indicate the sampling was done at 10 sites.	Agree.
Additional Comment	Environment Victoria	Is the proposed permitted annual volume sustainable? State the SDL volumes and current cap in the plan	The committee discussed this point & considers the current volume is sustainable during average rainfall years. Protecting minimum flows for the environment ensures a balanced use of water for all users. SDL volumes and volume of current cap on licensed allocations in the catchment has now been included.
Additional Comment	Environment Victoria	Include stronger wording in the Plan regarding the removal of barriers to fish passage in amongst the recommendations.	Agree. This has now been included in the text of the plan.
Additional Comment	Steve Hosking	Trading from summer to winter-fill. - No mention is made of moving summer Farm Dam licenses to a winter-fill arrangement if the water is traded. other than the aspect that MW may or may not alter licence conditions of a transferred licence. Contrary to this potential objective both summer and winter allocation levels are capped, thus limiting any exchange. Was this considered under the plan? (If so and determined not to be an objective within the catchment then obviously this comment can be ignored.)	The committee is of the understanding that the government's Statewide Licensing Conditions will regulate that trade of farm dam entitlements will only be allowed if the transfer is to a winter-fill entitlement. The cap on entitlements within the catchment includes farm dams.

Recommendation Number	Respondent	Comment	Consultative Committee Comment
Additional Comment	Steve Hosking	Other than the major waterways of the Steels, Pauls and Dixons Creeks, has the committee considered the intention to exclude all potential dams on 'waterways' located in gullies that meet the 60ha waterway definition?	Noted. The Water Act 1989 requires a licence for the construction of any new dam on a water way, and the licence is also required to use the water collected in such a dam for any purpose other than domestic and stock.
Additional Comment	Steve Hosking	Condition 1.2 relates to a percentage of maximum daily volume that may be taken when flow is less than 15ML/day. Licence Schedule 1 has scope to insert Max Daily Volume into the licence. The current number used is somewhat arbitrary being 5% of total licence volume. If this figure (or a percentage of this figure) is going to be used as a controlling factor then the committee may want to consider what the appropriate maximum daily figure should be.	Noted. The committee is happy to adhere to the existing daily volume restriction being 5% of total licence volume. Any change to this figure is considered to be a matter for consideration by the licensing authority in consultation with water users.
Additional Comment	Steve Hosking	The committee needs to ensure the terms used in the Plan are consistent. Existing Licenses state 'Maximum Daily Volume' as the term in Licence Schedule 1. Ideally, the licence conditions should use the same term rather than 'daily allowable licensed volume'. It is suggested this condition could be written as follows, "The Licensee must not take more than a specified percentage of the Maximum Daily Volume specified in the First Schedule of this Licence from a waterway when the daily stream flow at the compliance gauging station.....etc."	Agree. Suggested wording has been incorporated.
Additional Comment	Steve Hosking	Metering of registered farm dams will come at a cost and is not part of the current metering program. This cost has not been included in diversions pricing and as such the additional costs should be borne by licence holder.	It's not the intention of the committee to meter these dams. The recommendation has been included to allow for this additional monitoring to occur should the funding become available from the government. At present, metering of these dams is not considered practical.
Additional Comment	Steve Hosking	The reference to aesthetic dams appears a bit ambiguous in separating new aesthetic dams from existing aesthetic dams. I suggest that Section 16 should make some reference to these controls being applied to new aesthetic dams only.	Agree.
Additional Comment	Rod Thomas	Fanciful ideas of fish existing in the Dixons Creek area are irrelevant. There is not enough flow. The upper reaches of Dixons Creek does not flow for 9 months of the year for no other reason than there is insufficient rain and flow off. I have been observing it for 10 years.	The Aquatic Fauna Assessment sampled 3 sites on the Dixons Creek and recorded 12 species of freshwater fish. Maintenance of pool habitat in ephemeral streams is critical for the survival of fish and macroinvertebrate species.
Additional Comment	A. Leckie	The way I read this the people are licensed. I believe the property should be.	Noted. This is a state government policy decision and outside the scope of the SFMP.
Additional Comment	Judy Anderson	I feel so strongly for the health of the waterways - lets all consciously plant and support many more indigenous varieties, leave the water be, sit quietly and watch for platypus. More shade means fewer blackberries.	Noted. The committee encourages landholders to protect the flora and fauna of the creeks in the catchment.
Additional Comment	Rod Thomas	Major rain events - I believe that during very high flow periods (>100ML/day) water diverters should be able to obtain water regardless of all other restrictions on the licence. This means that winter fill licences would be able to obtain water outside of the winter fill period. There would be environmental benefits because the amount that is able to be taken is small compared to the daily flow, so there is no concern about "flushing" the system because a large amount of flow remains even if people are pumping. This also reduces the pressure during the winter fill period when flows are just above the ban levels but pumping can occur.	Noted. Most licensed diverters in the catchment already benefit during times of high flows as runoff is captured in off-stream storages. Taking water during very high flow periods outside of existing licensing restrictions is a state government policy decision and which the committee feels is not warranted in this catchment and outside of the scope of the SFMP.

Recommendation Number	Respondent	Comment	Consultative Committee Comment
Additional Comment	Rod Thomas	Flow measurement - There are times when Pauls Creek is meeting the requirements of the lifting of the ban but the measurements taken especially either side of a weekend will not reflect this because of the highly variable flow rates of Pauls Creek. I think improved measurements of flow rates would improve the water management of the creek along with improved notification of when bans are lifted or imposed. I do not think that the once a day posting of flow rates 5 days a week is adequate for the smaller more variable streams in Melbourne water catchments.	Noted. The committee agrees with the comments, however recognises that management of water resources across the entire Yarra catchment is a large task. It recognises that additional monitoring of streamflows comes at a financial cost and does not consider the benefit of improved management outweighs the additional cost. The introduction or lifting of bans are currently determined based on 7-day rolling averages of streamflows. This is aimed at protecting the flushing flows critical for biological processes. In addition, most diverters have farm dams that capture rainfall during high flows on weekends.
Additional Comment	DSE	Need recommendation consistent with Clause 13.1 (ie that water taken under all irrigation or commercial licences, including registered farm dams, be metered), but with date or dates when meters will be installed. A recommendation to meter all registered dams >5ML could also be considered.	It's not the intention of the committee to meter farm dams. The recommendation has been included to allow for this additional monitoring to occur should the funding become available from the government. At present, metering of these dams is not considered practical.
Additional Comment	DSE	Need a recommendation regarding dams on subdivision (c.f. Clause 20 Diamond Creek SFMP)	Additional text included under Section 8 of the Plan - Other Matters
Additional Comment	DSE	It is recommended that a minimum of two additional fish surveys be taken by MW over the next two years to provide further evidence of the status of Blackfish in the SFMP catchment. This is to provide a greater level of confidence in the decision to remove the River Blackfish objective.	Agree.

11 Appendix 2

STREAM FLOW MANAGEMENT PLANS AND GROUNDWATER MANAGEMENT PLANS TECHNICAL AUDIT PANEL

Review of Pauls, Steels & Dixon Creeks Stream Flow Management Plan

Background

The Technical Audit Panel (TAP) was established by the then Minister for Environment and Conservation, Sherryl Garbutt, in June 2002 to review the Stream Flow Management Plans (SFMPs) and Groundwater Management Plans (GMPs) that have been prepared or are being prepared across Victoria. The main purpose of the reviews is to answer two fundamental questions:

- Was the information and methodology used the best available at the time?
- Has the assessment of risks (to the environment and to security of supply) been properly done?

The following points underpin all TAP reviews, unless specifically mentioned otherwise.

1. The TAP accepts and operates within the Victorian River Health Strategy framework, which has been adopted by the Victorian Government.
2. The TAP endorses the following methodologies as providing satisfactory tools for assessing stream flows within the reasonable constraints set by available time and resources and the relative significance of the water resources under investigation.
   - REALM – resources allocation model – a generalised simulation package for analyzing the yield and security of supply of water supply systems.
   - FLOWS – a method for Determining Environmental Water Requirements.
   - TEDI – Tool for Estimating Dam Impacts on stream flows.
   - SDLs – Sustainable Diversion Limits – a tool for establishing the upper limit of water extraction from a catchment during winter before there is a risk to the environment.
3. The TAP recognises the difficulty in establishing causal linkages between particular environmental flows and the effects of those flows on the in-stream ecological processes and biota. We believe that, when properly applied, the FLOWS method enables environmental water requirements as defined in the Victorian River Health Strategy to be defined that are precautionary and ecologically appropriate.
4. Some draft management plans being reviewed by the TAP were prepared using older methods. The TAP acknowledges the recent evolution that has taken place in the methods used to develop stream flow management plans. Where possible comments on older methods are made on the understanding that they provide a first-cut of the environmental water requirements. It is expected that these requirements may need to be revised when future reviews of the plans take place. In some cases the TAP will recommend these reviews take place as a priority.
5. The TAP acknowledges that there are often significant differences between plans. Some are still in the information collecting stage (often the case with groundwater management plans), while others have a substantial amount of relevant information at hand (often the case with hydrological information) The TAP recommendations will take these differences into account.
6. The TAP recognises that there have been significant changes to nearly all Victorian catchments since European settlement. The TAP accepts the Victorian River Health Strategy (VRHS) approach that in most cases it will not be possible to return stream flows to their pre-European state, and that SFMPs should seek to provide streams with flows that are sufficient to achieve an ecologically healthy river (refer to VRHS p22- 32).
7. The TAP recognises that in-stream and riparian ecological processes require a range of flows, which cover the whole hydrologic range (volume, temporal and spatial pattern). Unless demonstrated otherwise, all components of the natural flow regime are of equal ecological importance. Low Summer flows are often a major focus of concern as these are usually the component of the flow regime most affected by human activity. It is reasonable, therefore, that SFMP Committees concentrate on this area of concern but consideration should also be given to the affects of management recommendations to all aspects of the flow regime.

Full consideration of stream flow and ecosystem health monitoring are major statewide issues that are beyond the scope of the TAP in the normal review of SFMPs and GMPs. However, the TAP also recognises that it is consistent with good resource management principles to identify clear objectives (including environmental outcomes) and the means of measuring their achievement when planning changes to stream flow management – particularly if such changes include restriction of current or future access.

Documents reviewed:

1. Egis Consulting Australia (2001); Steel's, Dixon's, and Paul's Creeks Farm Dams Impact Assessment. Report prepared for Melbourne Water (Egis, 2003).
2. Sinclair Knight Merz (2003): Estimation of Streamflow and Demand Data and Development of a REALM Model of Steels, Dixons and Pauls Creeks. Report prepared for Melbourne Water Final 2 (SKM, 2003).
3. SPDEFTP (2003a): Environmental Flow Determination of the Steels, Pauls and Dixons Creek Catchments: Part A – Issues Paper. Unpublished Report by the Steels, Pauls and Dixons Creek Environmental Flows Technical Panel to Melbourne Water Corporation.
4. SPDEFTP (2003b): Environmental Flow Determination of the Steels, Pauls and Dixons Creek Catchments: Part B – Final Recommendations. Unpublished Report by the Steels, Pauls and Dixons Creek Environmental Flows Technical Panel to Melbourne Water Corporation.

Abbreviations

S-D-P Creeks Steels, Dixons and Pauls Creeks

Summary

This is the first TAP assessment that this team has attempted that did not have flow modelling at the level which clearly presented 'natural' flow regimes against current modified flows. It has resulted in a different approach in which the FLOWS method has been applied to the level possible but the assessment has depended on partly theoretical inputs from a very well-credentialed expert panel. The situation is further complicated by the fact that substantial changes to the morphology of the lower parts of the streams have resulted in a permanent (and irreversible) change to their nature. These are small, intermittent, streams in the Yarra catchment and their condition will depend on the general wellbeing of the larger system as well as strictly local circumstances. This being said, every effort should be made at the local level to conserve and improve their ecological condition – hence the value of a regional SFMP. Under the circumstances, the approach adopted by the Technical Panel, a mixture of local observation and an estimation of what biota would be present in the system in ideal circumstances, is reasonable. This is particularly so under the current circumstances in which it is difficult to provide a clear comparison between current and 'natural' flow conditions – at least in terms of frequency, timing, and duration of specific events.

The recommendations have thus centred on the components of the flow regime which need to be protected. The options available at the moment appear to be either to assess the situation 'event-by-event' or to accumulate sufficient flow data to prescribe necessary changes to diversion protocols (if necessary) to preserve key flow events.

1. General

System considered

Briefly describe the system under review.

> Pauls, Steels and Dixon Creeks, which are located north-east of Melbourne near Yarra Glen township, are ephemeral streams draining south from the Great Dividing Range at elevations between 300m and 450m and have a combined catchment area of 130 km^2. The upper parts of the Steel's Creek catchment, which is 96.1 km^2 in area, are located in Kinglake National Park and are in a near natural state with little development. Dixon's Creek with a catchment are of 35 km^2 is the major tributary of Steels and has its headwaters also in the National Park. The middle and lower parts of Steels has been extensively cleared for agriculture and the lower reaches of the streams have been realigned. Paul's catchment is 33.2 km^2 in area. The lower reaches have not been aligned but extensive clearing has taken place.

Environmental values and issues

Significant values listed?

> Yes. The report concentrates on Geomorphology, Fish, Macroinvertebrates, and vegetation.

Were the values well documented?

> Yes

Were they derived from regional catchment strategy or similar community endorsed document?

> The values appear to have been decided by the Steels, Pauls and Dixons Creek Environmental Flows Technical Panel. With the lack of flow information, the use of technical experts to establish values and goals is sensible. Future decisions, when adequate flow data are available, should incorporate community aspirations.

How many locations were used to assess river health? Is there recognition that flow is only one component of river health?

> Ten locations were visited initially with three sites chosen for detailed assessment. Considerable attention was given to non-flow factors.

Has the committee or the consultants investigated the availability of information on the environmental condition of the stream?

> Yes

Existing uses

Is the existing allocation and use well documented?

> No data are available on the actual usage. However, current levels of water demand were estimated from a water survey conducted by Melbourne Water in November 2001. Full levels of demand were estimated by assuming all licence volumes were fully utilised (SKM, 2003, p.46).

> The assumptions made to make these estimates seem appropriate.

> There is a note in SKM, 2003 (pp.47-47) that "… some of the off-stream dams in the catchment have significant catchment area…and these off-stream dams may be collecting rainfall runoff in addition to diversions from waterways". One can only assume at this stage that these volumes are not significant.

Is future use projected (including use of sleeper licences)?

> In estimating future demands all licences were considered so any sleeper licences would be accounted for.

Is current security of supply well documented?

> Yes. A key feature of the REALM model is that it can be used to estimate reliability of supply. A daily time-step version of REALM was developed for the S-D-P Creeks system. Four levels of development were simulated and reliability of supply for water users was examined. The results are shown as a time series of flows and flow duration curves at the Steels and Pauls stream gauging stations for present and future scenarios. In addition, time series of the number of weeks of shortfall in demand, the unrestricted demand and the demand that was satisfied are graphed.

Are projections made of future security of supply?

> Yes! For potential increases in water allocation and winter-filling, security of supply is examined as noted in the previous dot point.

How accurate are these estimates of present and future allocation? i.e. what is the uncertainty?

> The REALM model was calibrated against recorded data (April 1998 to September 2002). However, because of the shortness of the streamflow record, no data were available to validate the model, nevertheless the calibration fit was excellent providing confidence in the model and adopted parameters.

> However, as noted below, there are major differences in the estimated streamflows for the simulation period for 1965 to 2001 between those of Egis (2001) and those estimated by SKM (2003). Because these differences were substantial the Technical Panel argued that they were unable "…to derive full environmental flow recommendations with any confidence". This issue is addressed later.

> Because future demands were not estimated and are unknown, a scenario approach was adopted, and so the accuracy cannot be determined. However, any conclusions as a result of modelling the system that included historical water use will be subject to uncertainties. Nevertheless, notwithstanding these uncertainties and adopting the Precautionary Principle, there is sufficient information to determine the available water for allocation.

2. Hydrology and hydraulics

Methodology

What methodology was used?

> Two hydrologic models (REALM and TEDI) were used to understand the hydrology of S-D-P Creeks system and the HEC RAS component of the Flow Events Method (FEM) was the basis of the hydraulic modelling.

> REALM is a Resource Allocation Model and was used to assess the impacts of providing environmental flows requirements and also to assess an operating rule for licensed winter-filling (SKM, 2003).

> On the other hand, TEDI is a Tool for Estimating Dam Impacts. It was used to determine how natural flows in the catchment have been modified by farm dams and to assess the effect on runoff of future dams (Egis, 2001). This information is an input to REALM.

> HEC RAS is a one-dimensional steady-state backwater analysis model and was used to compute longitudinal and cross-section water levels at selected reaches in the three catchments.

> To estimate the streamflows for the period from 1965 to March 1998 (measured flows were available from April 1998 to present), two rainfall-runoff models (AWBM and HYDOLOG) were used. The Australian Water Balance Model (AWBM) developed by Walter Boughton was used by Egis (2001), pp. 9-10, 29-30 to extend the short historical records to 30 years. On the other hand, SKM (2003) adopted HYDROLOG, a more complex conceptual rainfall-runoff model than AWBM, to carry out the same exercise. The differences in estimated flows by the two models were considered by the Technical Panel to be too large to provide confidence in the estimated streamflows (1965 to March 1998) used in the REALM or TEDI.

Was the methodology properly applied?

> Sinclair Knight Merz has considerable experience in applying the REALM model in Australia. Subject to several queries noted below and the inadequate streamflow sequence noted above we believe the model was applied properly to the S-D-P Creeks system.

> This reviewer is unaware of Egis's experience in applying the TEDI model. Nevertheless, subject to several queries noted below and the inadequate streamflow sequence noted above and discussed below, TEDI appears to have been applied correctly.

> Details to estimate irrigation demands are unclear. In previously reviewed SFMP reports the PRIDE model is used to estimate irrigation demands. In the Egis (2001), monthly demand patterns are tabulated along with evaporation estimates but the method to convert these values to monthly irrigation demands are not presented.

> This reviewer (TAMcM) has examined the streamflow estimates from the AWBM and from the HYDROLOG models and believes the streamflows from HYDROLOG (SKM, 2003) could have been used by the Technical Panel as a general indicator of the variation in streamflow in these catchments. This comment is based on the fact that the comparison between the measured and the estimated mean flows and flow duration curves (for the period April 1998 to March 2001) were probably adequate for the purposes on environmental assessment. Nevertheless, he acknowledges the Panel's assessment that there was too much doubt about the accuracy in the measured data due to incomplete rating at high flows and potential influence on the rating curves of backwater effects from the Yarra River to have sufficient confidence in the measured flows for calibrating and assessing the extended streamflow data.

Was the methodology used appropriate for the circumstances?

> Yes. The application of the TEDI and REALM models is the most appropriate methodology to assess the impact of future farm dam or irrigation development on the hydrology of the S-D-P Creek system.

> HEC RAS is the most appropriate model to determine the hydraulic characteristics at a site.

Data

Have the technical investigations used relevant data?

> Overall yes, subject to inadequacy of streamflow data and a query noted above about irrigation demands.

> The lack of hydrological data and rigorous fish surveys in the past resulted in a change to the way in which the environmental component of the work was carried out. Reference states for the fish community were estimated using survey data from nearby catchments and expert knowledge of native fish biology. Macroinvertebrate communities were assessed in comparison to modelled reference sites (using the AUSRIVAS protocol). Under the circumstances this is a sensible approach.

Have the technical investigations used reasonable values and parameters in calculations and computations?

> Both the REALM and TEDI models are based on the fundamental assumption that runoff is uniform across the whole watershed and the inflow to each dam is assumed to be linearly proportional to the size of catchment area of the dam. In reality this is not so as typically sub-catchments in the upper parts of a catchment yield more runoff than those located in the more downstream areas. But to enable an appropriate non-linear relationship to be established, more streamflow or other hydrologic data are required. Under the circumstances, the technical investigations based on TEDI and REALM used reasonable values and parameters in calculations and computations but at the same time noting the inadequacy of the streamflow estimates.

> HEC RAS calibration was not based on measured discharge. This is a significant shortcoming in the hydraulic analysis. Nevertheless, the modelers have some experience in adopting an appropriate Manning's n values based of field observation and published tables and photos.

> (see comments above re Fish and AUSRIVAS) The use of 'theoretical' reference conditions is reasonable under the circumstances but it is necessary to note that 'natural' can be a reference point without being a target – in fact, as is pointed out in the report, the natural or pre-European condition is an impossible goal in this system. I think the Objectives listed in Table 15 of the Issues Paper recognise and make allowance for this but it is important to note that the setting of targets and the quantity of water required to reach them is the core task of the SFMP

Has data quality (eg rating, gauge type, sampling design) been checked?

> Although daily rainfall records were available at three stations outside but near the catchment only one covered the entire modelling period (1965 - 2001). As well, there were missing data. In the end only the Mt St Leonard station was utilized, but that needed considerable adjusted because it was located in the headwater of the catchments and measured rainfall was the highest of the three gauges.

> According to SKM (2003) p. 43 for the two stations adopted in the study, approximately 50% of the evaporation records was missing. No details are given in Egis (2001) how the data were infilled.

> The SKM (2003) report comments on the quality of the streamflow data, however, one is not left with a very clear picture of the quality of the daily discharges. For example, how satisfactory are the discharge rating curves for each station?

Have gaps in data been reasonably dealt with?

> Missing data are identified in the rainfall (only 0.2% for Mt St Leonard), evaporation and streamflow records. The methods used to infill the rainfall and evaporation data are not described but probably are not particularly important in the context of the overall modelling.

> As noted above, extending the streamflow records was carried out separately by SKM (2003) and Egis (2001) with very different results. Issues regarding this modelling are discussed above and also under Other Comments below.

Modelling

Are natural flows defined? (existing plus usage?)

> Natural flows were estimated by adjusting the estimated or recorded flows for the effects of existing catchment dams using the TEDI model results.

> Natural flows at key environmental sites were estimated as a linear function of contributing runoff generating area.

> Changes in land cover since European settlement probably have altered the hydrology of the system. Virtually no information is available to make any firm assessment of such an effect. Nevertheless, estimated streamflow data are considered to be sufficiently representative to assess the requirements for an ecologically healthy stream.

Have catchment dams been included in the estimates?

> Yes, through TEDI model.

Are future scenarios accounted for? (land use, licences, trading, environmental flows, water use efficiency)?

> The approach adopted in the TEDI model allows the impact of future catchment dams to be assessed. The TEDI model does not take into account the effects of land-use changes across the catchment. However, appropriate changes could be made to the input streamflow data and their effects assessed. Again licensing, water trading, and water use efficiency cannot be taken into account within the TEDI model. However, if the average demands can be adjusted to mimic such changes, the effects could be approximately considered. REALM modelling can deal with these issues.

Has a broad level of analysis been undertaken (eg floods, winter and summer flows)?

> In the FLOWS methodology, high flow freshes, bankfull flows and overbank flows are assessed.

Has hydraulic modelling (habitat scale) been undertaken? (see also geomorphology below)

> Yes. Detailed hydraulic modelling was undertaken, using the new Flows Event Method developed by Dr Mike Stewardson.

Have model predictions been reviewed (QC/QA)?

> No formal external assessment of the models' predictions has been made. Nevertheless, both the TEDI and the REALM models have been presented for peer-review at several professional conferences – see, for example, the references of Neal et al. (2002a) and Neal et al. (2002b) regarding TEDI and Perera & James (1999, 2000) and Perera & Seker (2000) regarding REALM.

> Both models, AWBM and HYDROLOG, have been extensively reviewed in the professional literature.

> HEC RAS model is a commercially available model and has been well-tested.

> The FLOWS methodology has been peer reviewed and is being constantly assessed as it is being used.

Any need to improve the modelling?

> There are two areas, namely, uncertainty in demand estimates and assumption of uniform runoff, that could be improved to better assess the effect of farm dams on hydrology. Two other aspects need research: the first deals with the assumption of independence of dam impacts, and the second, the functional relationships between dam surface area, dam volume and dam catchment area.

> There is a need to develop daily streamflow estimates that are scientifically defensible.

3. Geomorphology

Is the river channel and habitat properly accounted for?

> Geomorphologic issues are dealt with in some detail in the Issues Paper (SPDEFTP (2003a). The significant values have been addressed and main flow objective components specified. The final report SPDEFTP (2003b) considers these appropriately.

Has historic change (eg sand slugs & levees) been allowed for?

> Major changes resulting from the drainage of previous swamp areas and the resultant deepening of the channel have been noted clearly. These appear to be irreversible in practice. There appears to be no major historic geomorphologic change that needs to be addressed.

Is future geomorphic change and connectivity allowed for?

> Yes, though it is well recognised that the major geomorphological changes are unlikely to be reversed – and this is not an aim of the SFMP.

4. Ecological Responses to Flow Change

Methodology

What methodology was used?

> The FLOWS method was used - modified by the lack of daily flow estimates.

Was the methodology used appropriate for the circumstances?

> Yes. It is interesting to see how the method can adapt to different levels of base-line information.

Was the methodology properly applied? Is the methodology for site selection described?

> Yes. Site selection was minimal but adequate.

Has there been an ecological analysis of the flow regime (eg return frequency, priority, what may be lost or impacted, what is flow stressed)?

> To the extent that was possible without daily flow estimates. There are data on current macroinvertebrate communities but less substantial information on fish. They can be (and are) linked to actual flow rates and to characteristics of a flow regime but there is no satisfactory means of estimating duration, frequency, etc. of these events.

Ecological information

Have the environmental investigations used relevant data that provides a causal link to flow?

> This has mostly occurred at the theoretical level. As such it has depended on the individual expertise of the panel members - this is of high standard in this particular case (but is a potential risk in future assessments). Without reliable information on the flow regime experienced by the existing ecosystem it would not be useful to attempt to link the current communities with flow. Instead the panel has provided information on what elements of a flow regime are needed to maintain suitable habitats as a means of supporting the biota. They have then identified reference conditions (for fish and macroinvertebrates) and provided objectives which could be adopted as target conditions and would certainly provide the basis for measuring progress.

Have any site-specific biological investigations been undertaken to arrive at the flow allocations?

> Yes, though these are not the only basis for recommendations.

Have the distribution and abundance of biota been documented? Has the relationship between habitat and biota been established?

> Yes, particularly for vegetation and macroinvertebrates. Biota-habitat relationships are based on the wider scientific literature and experience rather than direct observation at the three streams.

Have key ecological components and related flow components been identified?

> Yes

Have the environmental investigations used reasonable values and parameters in calculations and computations?

> Yes

Have gaps in data been reasonably dealt with?

> Yes. The major gaps are in terms of daily flow data and direct links between the current biota and flow. This has forced a 'generic' approach to flow events and the use of expert opinion to reconstruct expected fish (and to a lesser extent macroinvertebrate) communities.

Is there a summary of available data?

> The underlying data are presented throughout the report.

5. Environmental flow recommendations

Has the full flow regime been considered, including summer and winter flows, and the need for flow variability?

> As far as possible - recognising the shortcomings in flow data and the fact that changes to the channel in the lower reaches makes some historic flow events no longer possible.

6. Environmental risk assessment

Did the Consultative Committee in balancing the needs of the environment and of existing users make estimates of risks to the environment? ie were the uncertainties outlined?

> No Consultative Committee stage. These risks are difficult to estimate without daily modelling which allows clear comparison of current stream flows verses other scenarios in terms of ecosystem requirements.

7. Risks to security of supply

Did the Consultative Committee in balancing the needs of the environment and of existing users make estimates of risks to the security of supply of existing users?

> No Consultative Committee stage. See above.

Were the estimates of risks to security reasonable?

> N/A

8. Other comments

> Several issues that have been alluded to above need discussion. The main one relates to assessment of the hydrology which is considered by both consulting reports - Egis (2001) and SKM (2003).

> The Egis (2001) report deals inter alia with extending the streamflow records from three years (April 1998 to March 2001) to 30 years. Egis used the Australian Water Balance Model (AWBM) which is a well known model in Australia. It is a daily lumped parameter conceptual model that requires 9 parameters to be estimated through optimisation. The values of the 9 parameters for the three catchments - Steels, Dixons and Pauls - are given in the report but no details are set out on how the values were obtained. What objective function and related time-step were used, what method of optimisation was adopted, were constraints placed on the model parameters, how were the large differences in rainfall averaged in the model and what was the value of the calibration correlation, e.g. the coefficient of efficiency (Nash & Sutcliffe, 1970)?

> In section 5.3 of the Issues paper (SPDEFTP, 2003a), it is implied that the Egis (2001) generated streamflows using a monthly time step. While this is correct for TEDI, it is incorrect for AWBM as it is a daily model and from the Egis (2001) report p.9 AWBM was modelled on a daily basis.

> To validate the modelling results, the monthly flow estimates from TEDI (based on the AWBM streamflow estimates) are compared for the period from November 1974 to March 1999 with the monthly flows for Watson's Creek, a catchment that has "… only been lightly developed…" (Egis, 2001, p. 29). Egis (2001) have interpreted this plot as confirming "… the natural streamflows generated by TEDI, and also the extended streamflows generated by AWBM are valid". If we accept the comparison as valid, this reviewer would suggest that TEDI (and by implication AWBM) overestimates the natural streamflows considerably. Some of this will be due to the inclusion of catchment dam runoff for the S-D-P Creeks but had not been allowed for in Watsons streamflows. This observation of overestimation is consistent with the plots in SKM (2003), Figure 7-11 which also suggests that the AWBM estimated streamflows are overestimated compared with the measured flows.

> Independently, SKM (2003) used the HYDROLOG model for the same exercise. However, details of the calibration process are not outlined. Plots of both models, especially Figure 7-11 in SKM (2003), showed that the flow duration curves derived from HYDROLOG were much close to the curve computed from the observed streamflows than those from AWBM.

> The information about the rainfall-runoff modelling in the SKM (2003) report is considerably more complete than that provided in the Egis (2001) report, nevertheless it would have been helpful to this reviewer if some details were given about the optimisation procedure.

> As pointed out by SKM (2003) p.54 the R2 and CE values are low and the HYDROLOG modelling poor. SKM (2003) recommend "… that the rainfall runoff modelling be revisited after a number of years of further data collection". This is a sensible strategy. But first, a thorough analysis of the effect of both backwater from the Yarra River and groundwater on the streamgauging rating curves should be embarked on. This should provide some guidance as to whether or not the rating curves are affected and if so by how much. Irrespective of the outcome of the rating curve assessment, at least two additional rain gauges should be installed within the S-D-P Creeks catchments.

> In the issues paper (SPDEFTP, 2003a), p 13, it is suggested that SKM flow estimates are low when compared with RORB modelling for the same area. If the RORB modelling was done correctly the flow estimates will be for instantaneous peaks (for which units of ML/day could have been used) rather than daily flows, and consequently the RORB design flows should be much larger than those estimated by HYDROLOG.

> In SKM (2003) the application of Equation 2, p. 64 is incorrect. Alexander (1972) developed this equation for transposition of hydrograph peak estimates and not for other flows. Estimates for daily low flows could be in error.

9. Conclusions and recommendations

Are the estimated environmental flow requirements reasonable?

> The estimates appear to be quite reasonable but it is difficult to translate them into quanta of water with the present level of information

Were they properly used by the Consultative Committee to determine environmental flow provisions, which balance the needs of the environment and existing users?

> Consultative Committee stage not yet reached.

Is the outcome logical and repeatable with proper referencing?

> Yes

Has there been an assessment of errors and the associated risks in the various report components?

> Not in a strict sense. However the process has been quite transparent and is therefore open to such assessments.

Have the consultants assessed the flow pattern and likely development resulting from the recommendations?

> Within the limits imposed by the lack of detailed flow modelling. Their recommendations will need to be assessed against achievable flow patterns when these are known in more detail.

Is the assessment adequate?

> Refer to notes above. The assessment is adequate to the extent that it describes the types of flow characteristics that need to be preserved to protect or enhance the ecological character of the system. The extent to which these recommendations differ from current practice is not completely clear. On the other hand, the report provides clear indications of the types of measurements that will help determine if improvements are being achieved.

Are recommendations for modelling and monitoring provided and are they adequate?

> Yes

References

Nash, J.E. and Sutcliffe, J.V. (1970): River forecasting through conceptual models, 1. a discussion of principles. *Jour. Hydrology*, Vol. 10, pp. 282-290.

Neal, B., R. Nathan & J. Green (2002a): The effects of farm dams on streamflows in ungauged catchments in the Hawkesbury- Nepean Basin. *Hydrology & Water Resources Symposium, Melbourne.* The Institution of Engineers, Australia.

Neal, B., R. J. Nathan, S. Schreider and T. Jakeman (2002b): Identifying the Separate Impact of Farm Dams and Land Use Changes on Catchment Yield. *Aust. Journal of Water Resources,* Vol 5(2): 165-175.

Perera, B.J.C. & Seker, M.P. (2000): Water Quality Modelling Using REALM. *3rd International Hydrology and Water Resources Symposium,* I.E. (Aust.), Perth, 20-23 November 2000, pp.1075-1080.

Perera, B.J.C. & James. B. (2000): Advance Use of REALM in Water Supply System Simulation. *Xth World Water Congress, Melbourne,* 12-16 March 2000, Paper No. 0347 (CD ROM).

Perera, B.J.C. and James. B. (1999): REALM REsource ALlocation Model. *Civil and Environmental Engineering Conference: New Frontiers and Challenges,* 8-12 November 1999, Bangkok, Thailand, pp. V~187-196.

T.A. McMahon & T.J. Hillman

22 May 2004

12 Appendix 3

STREAM FLOW TENDER

Environmental flows as set by the Stream Flow Management Plan will be implemented in five years (on 1 July 2012). To help achieve these environmental flows earlier, the State Government has made financial assistance available to licence holders via *Stream Flow* Tender, in exchange for changing licence conditions to improve environmental flows.

Stream Flow Tender was held in Olinda Creek, Stringybark Creek, Pauls Creek, Steels Creek and Dixons Creek in May-July 2007. Participants in *Stream Flow Tender* submitted bids for funding in exchange for altering their licence conditions in one of three ways:

- Changing the time of access to water to reflect the environmental flow recommendations in the Stream Flow Management Plan;
- Reducing their licence volume by a specified amount; or
- Surrendering their entire licence.

OUTCOMES IN PAULS, STEELS AND DIXONS CREEKS

One bid was received in Steels Creek and one in Dixons Creek and both were successful. This resulted in 50 ML of licence volume (2 licences) that will be managed in accordance with the licence conditions specified in the Stream Flow Management Plan.

Both successful bids will result in change to licence conditions on licence renewal on 1 July 2008. All other licence holders will change their licence conditions on 1 July 2012.

ENVIRONMENTAL OUTCOMES IN PAULS, STEELS AND DIXONS CREEK

Stream Flow Tender increased environmental flows in Steels Creek and Dixons Creek. The improvement in flows in Steels Creek is approximately 2%, and in Dixons Creek is approximately 10% of the benefit that will be achieved by the full implementation of the Stream Flow Management Plan, which will occur in 2012.

STEELS, PAULS AND DIXONS CREEK STREAM FLOW MANAGEMENT PLAN 2007

1. INTERPRETATION

1.1 Definitions

The following definitions apply in this SFMP.

"Act" means the *Water Act 1989.*

"all-year licence" means a licence issued under section 51(1)(a) or (ba) or 51(1A) of the Act to take and use water either:

(a) from a waterway; or

(b) from a dam, spring or soak

during an all-year period.

"all-year period" means the period between 1 January and 31 December in any year.

"catchment" means the catchment of Steels Creek including the area below the confluence of Steels Creek and Dixons Creek, Dixons Creek or Pauls Creek as shown in Schedule 1.

"daily stream flow" means the instantaneous stream flow checked in each morning.

"Melbourne Water" means Melbourne Water Corporation.

"Minister" means the Minister administering the Act.

"Pauls Creek gauging station" means the stream gauging station no 229245 located on Pauls Creek.

"Protection Area" means the Steels, Pauls and Dixons Creek Water Supply Protection Area.

"registration licence" means a licence issued under section 51(1A) of the Act.

"Steels, Pauls and Dixons Creek Water Supply Protection Area" means the area referred to in clause 4.

"Steels Creek gauging station" means the stream gauging station no 229246 located on Steels Creek downstream of the confluence with Dixons Creek at Yarra Glen.

"winter-fill licence" means a licence issued under section 51(1)(a) or (ba) of the Act to take water from a waterway or dam during a winter-fill period.

"winter-fill period" means the period between 1 July and 30 November in any year.

1.2 Rules for interpreting this Plan

Headings are for convenience only and do not affect interpretation. The following rules also apply in interpreting this SFMP, except where the context makes it clear that a rule is not intended to apply.

(a) Expressions defined in the Act have the same meaning as in the Act.

Note: Section 3(1) of the Act defines "dam", "person", "registration licence" and "waterway".

(b) A reference to:

(i) legislation (including subordinate legislation) is to that legislation as amended, re-enacted or replaced, and includes any subordinate legislation issued under it;

(ii) a document or agreement, or a provision of a document or agreement, is to that document, agreement or provision as amended, supplemented, replaced or novated;

(iii) a reference to a person includes a permitted substitute or a permitted assign of that person and that person's employees, officers, agents and contractors;

(iv) anything (including a right, obligation or concept) includes each part of it.

(c) A singular word includes the plural, and vice versa.

(d) If a word is defined, another part of speech has a corresponding meaning.

(e) If an example is given of anything (including a right, obligation or concept) such as by saying it includes something else, the example does not limit the scope of that thing.

2. AUTHORISING PROVISION

This SFMP is approved by the Minister under section 32A of the Act.

3. COMMENCEMENT

This SFMP commences on the day on which the Minister approves it.

4. WATER SUPPLY PROTECTION AREA

The boundaries of the Protection Area:

(a) were declared by the Minister by Order under section 27 of the Act on December 30, 2002; and

(b) are set out in Schedule 1; and

(c) may be inspected on Plan No. LEGL./02-0049 at the office of Land and Survey Information Services, Department of Sustainability and Environment.

5. SURFACE WATERS

This SFMP applies to the surface waters of the Protection Area.

6. OBJECT OF THE PLAN

6.1 The general object of this SFMP prescribed by section 32A(1) of the Act is "to make sure that the water resources of the "Protection Area" are managed in an equitable manner and so as to ensure the long-term sustainability of those resources".

6.2 For the purpose of achieving that general object, Melbourne Water must have regard to specific objectives proposed by the Steels, Pauls and Dixons Creek Stream Flow Management Plan Consultative Committee that are set out in Schedule 2.

7. ADMINISTRATION AND ENFORCEMENT

Melbourne Water has the duty of enforcing and administering this SFMP.

8. PROHIBITIONS ON GRANTING NEW LICENCES

Melbourne Water must refuse an application under section 51(1)(a) or (ba) of the Act in the Protection Area if, in its opinion, the approval of the application will or may cause:

(a) the total volume of water taken in any year under all year licence to exceed 988 ML plus the volume of any existing farm dams still to be registered or licensed; or

(b) the total volume of water taken in any year under winter-fill licence to exceed 696 ML.

Note 1: Section 51A of the Act allows a person to surrender a registration licence and apply for a licence under section 51(1)(a) or (ba) of the Act and Melbourne Water must within 14 days issue a licence for the same annual volume as the registration licence.

Note 2: Section 55(2B) of the Act prevents Melbourne Water from granting or renewing a licence if, in its opinion, the allocation or use of water under licence will or may result in the permissible annual volume for that year or a future year, being exceeded.

9. TRANSFERRING LICENCES

Note: Section 62 of the Act empowers Melbourne Water to approve an application temporarily or permanently to transfer a licence.

9.1 Melbourne Water must refuse an application made under section 62(3) of the Act to transfer a licence if, in its opinion, the approval of the application will or may cause the limits referred to in Clause 8 to be exceeded.

9.2 In deciding whether to amend, delete or add to the conditions to which a licence is subject when it is transferred, Melbourne Water may have regard to whether the location at which water is taken or collected will, or will not, change.

9.3 Melbourne Water must not approve an application to transfer a licence to take and use water from a waterway or collect water in a dam, to a location upstream of the existing licence.

9.4 Melbourne Water may only approve the transfer of a licence from a licensee to a person who proposes to extract water from the same catchment as the licensee.

10. NEW DAMS

After the commencement of this SFMP, Melbourne Water must not issue any licence under section 67 of the Act to construct a dam on a waterway within the Protection Area.

11. LICENCE CONDITIONS

For the purposes of section 32A(12) of the Act, a licence granted under section 51(1)(a) or (ba) of the Act for a purpose specified in Schedule 3 is subject to each condition set out in that Schedule, in relation to that purpose.

12. STREAM FLOW MONITORING PROGRAM

12.1 After the commencement of this SFMP, Melbourne Water must, as soon as practicable, review the existing gauging arrangements and propose new locations and numbers of gauging stations where necessary to enable continuous recording of flows in Steels Creek, Dixons Creek and Pauls Creek.

12.2 The review proposed under sub-clause 12.1 must consider the gauging station locations proposed by the Steels, Pauls and Dixons Creek Stream Flow Management Plan Consultative Committee:

(a) Steels Creek below Gulf Road and adjacent to the aqueduct; and

(b) Dixons Creek on the highway below Gulf Road or, alternatively, at the bridge and siphon crossing; and

(c) Pauls Creek on the Old Healesville Road or alternatively, below Botting's Lane.

12.3 Melbourne Water must implement the completed review referred to in sub-clause 12.1.

12.4 Melbourne Water must:

(a) continuously record flows at the Steels Creek and Pauls Creek gauging stations and at any gauging station installed as a result of the review referred to in sub-clause 12.1, and

(b) periodically inspect the condition of these gauging stations; and

(c) maintain these gauging stations in good condition; and

(d) keep a record of each inspection and all work undertaken under paragraph (a).

13. INSTALLING METERS

13.1 After the commencement of this SFMP, Melbourne Water must, as soon as practicable, ensure that a flow meter is installed to measure water taken for irrigation or commercial purposes under any licence which has been or is thereafter granted within the Protection Area under section 51(1)(a) or (ba) or 51(1A) of the Act.

13.2 Melbourne Water must:

(a) periodically inspect the condition of each flow meter installed under sub clause 13.1; and

(b) maintain each flow meter in good condition; and

(c) replace any damaged flow meter; and

(d) keep a record of all work done under paragraph (b) and (c).

14. READING METERS

Melbourne Water must:

(a) read each meter referred to in sub-clause 13.1 shortly after the beginning and end of the winter-fill period in every year; and

(b) record, for each meter:

(i) the reading obtained; and

(ii) the number of the relevant licence; and

(iii) the date on which the meter is read; and

(iv) any information about the accuracy of the meter which Melbourne Water considers relevant; and

(c) if a meter becomes defective, registers incorrectly or is removed for any reason, estimate the correct registration in any of the following ways:

(i) by comparison with the quantity of water taken under similar conditions during some other period; or

(ii) by comparison with the quantity of water taken after the meter has been restored to proper order; or

(iii) by comparison with the registration of a substitute meter used temporarily in place of the defective meter; or

(iv) by applying a correction factor if the meter is found to have a consistent error of registration.

15. MAINTAINING ENVIRONMENTAL FLOWS

15.1 For the purpose of this clause, a licensee is the holder of a licence issued under section 51(1)(a) of the Act for any purpose other than domestic and stock use.

15.2 Melbourne Water must do its best to ensure that, during the period 1 July to 30 November in any year, a licensee does not take any water from a waterway when the daily stream flow is below the minimum flow at the compliance gauge.

(a) Steels Creek minimum flow is 7.0 ML or less per day at the compliance gauge;

(b) Dixons Creek minimum flow is 7.0 ML or less per day at the compliance gauge;

(c) Pauls Creek minimum flow is 5.0 ML or less per day at the compliance gauge;

subject to sub-clause 15.4.

15.3 The compliance gauge is:

(a) Steels Creek gauging station for licensees taking water from any waterway within the Steels Creek catchment; or

(b) Steels Creek gauging station for licensees taking water from any waterway within the Dixons Creek catchment; or

(c) Pauls Creek gauging station for licensees taking water from any waterway within the Pauls Creek catchment;

subject to sub-clause 15.4.

15.4 After 1 July 2012, or the the installation of any new gauging station proposed in the review referred to in Clause 12.1, whichever is the later, the references to gauging stations in sub-clause 15.3 must be replaced with references to any new gauging station in that catchment, the minimum flow referred to in 15.2 (a) and (b) must be replaced with 5.0 ML per day.

15.5 Licencees may recommence taking water when the seven-day average stream flow at the compliance gauge referred to in 15.3 rises above the stream flow referred to in subclause 15.2.

16. ROSTERS

16.1 Melbourne Water must, within 18 months of the commencement of this plan, develop a roster for the equitable sharing of available water under low flow conditions. Melbourne Water must develop the roster in consultation of water users.

16.2 Melbourne Water must do its best to ensure water users comply with any roster agreed to under clause 16.1.

17. AESTHETIC DAMS

17.1 For the purposes of this clause, a dam is:

(a) operated for aesthetic purposes, if it is constructed after the commencement of this SFMP and is used for aesthetic or recreational purposes; but

(b) not operated for such purposes if it is:

(i) constructed or used for domestic, stock, irrigation or commercial purposes; or

(ii) designed specifically for environmental, rather than aesthetic or recreational purposes and is used for erosion control or nature conservation purposes.

17.2 A person must not operate a dam by taking, collecting, storing or concentrating water for aesthetic purposes at any time when, in the opinion of Melbourne Water, the volume of evaporation from that dam alone, or in combination with evaporation from other dams operated for aesthetic purposes in the Protection Area, would cause the allocation cap for the Protection Area to be exceeded.

18. MONITORING THE EFFECTS OF THE PLAN

18.1 Within 12 months after the commencement of this SFMP, Melbourne Water must propose to the Minister a program to monitor the implementation of the SFMP.

18.2 A program proposed under sub-clause 18.1 must include arrangements to monitor:

(a) the effects of the SFMP on the reliability of supply to licensees within the Protection Area; and

(b) the ability of the provisions to maintain environmental flows set out in Schedule 3; and

(c) in-stream environmental indicators within the Protection Area; and

(d) indicators against which Melbourne Water's performance in implementing this SFMP can be measured.

18.3 The Minister may:

(a) approve a program proposed under sub-clause 18.1; or

(b) approve that program, subject to amendments made by the Minister; or

(c) refuse to approve the program.

18.4 Melbourne Water must implement a program in the form approved by the Minister under sub clause 18.3.

19. REPORTING

Melbourne Water must report on its activities in carrying out its duties in relation to this SFMP in each financial year and:

(a) give the report to the Minister and the Port Phillip Catchment Management Authority by 30 September in each year; and

(b) make a copy available for public inspection at its offices.

20. REVIEW OF PLAN

Melbourne Water must:

(a) review the operation of this SFMP:

(i) not more than 5 years after it commences; and

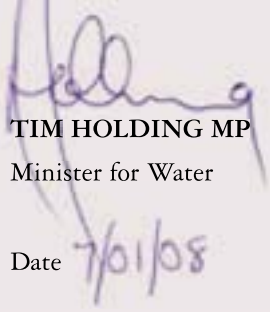
(ii) thereafter, at intervals of no more than 5 years; and

(b) propose any consequential amendment (if any) to the Minister.

Note: Sections 29, 31 and 32G of the Act provide for the constitution and convening of a consultative committee to develop any proposed amendment and the process to be followed by the Minister before approving it

21. APPROVAL

I, Tim Holding, Minister for Water, approve this SFMP in accordance with section 32A of the *Water Act 1989.*



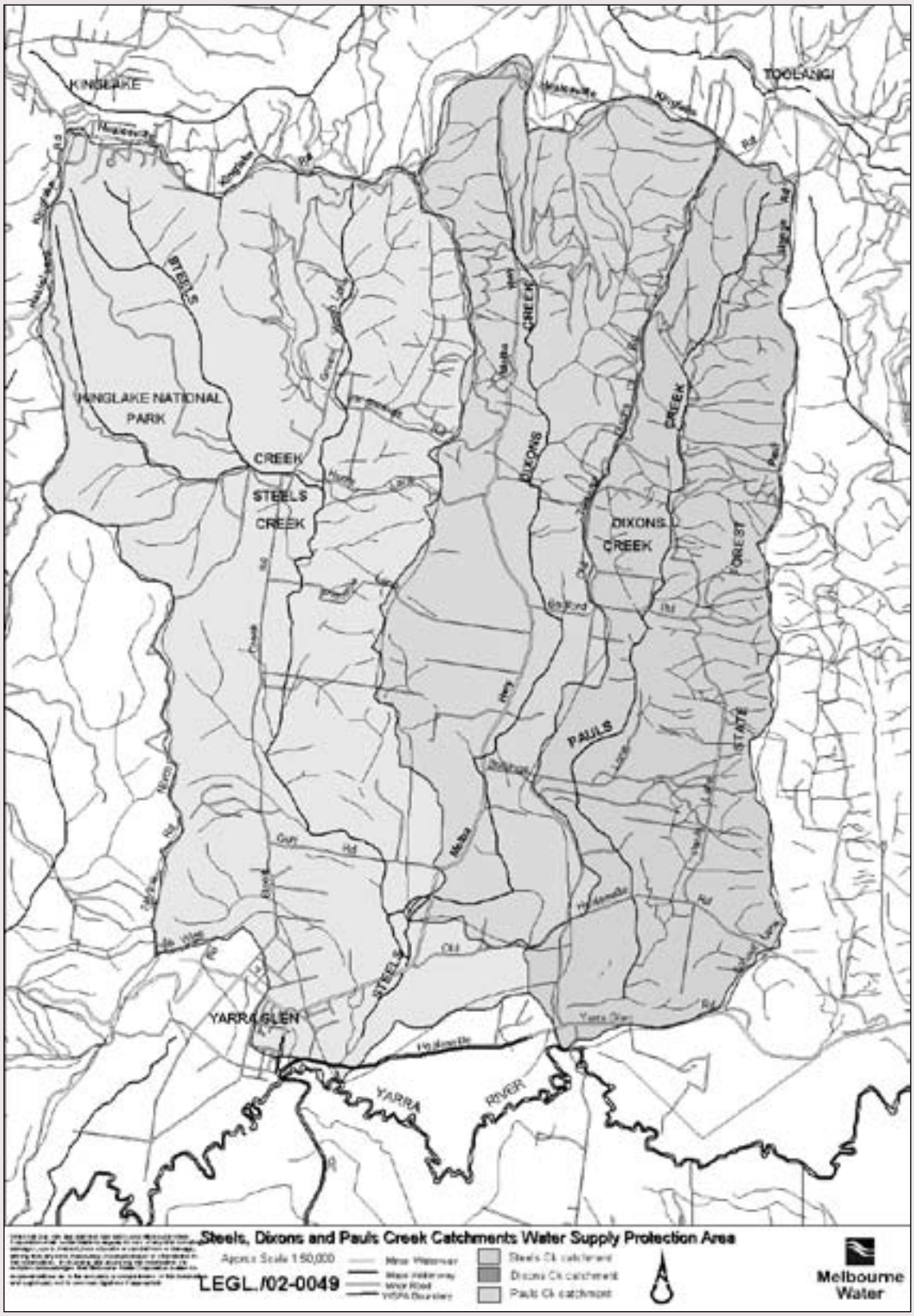
TIM HOLDING MP

Minister for Water

Date 7/01/08

Schedule 1

STEELS, PAULS AND DIXONS CREEK WATER SUPPLY PROTECTION AREA



Schedule 2

SPECIFIC OBJECTIVES PROPOSED BY THE STEELS, PAULS AND DIXONS CREEK CONSULTATIVE COMMITTEE

a) Stream flows that follow natural seasonal flow patterns and do not dry up any more frequently than would reasonably occur.

b) Local trading rules established.

c) Rules that adapt to longer term changes in water availability.

d) Suitable monitoring of stream flows and water usage.

e) Water access conditions that allow fair sharing of water between users.

f) No new development that diminishes water availability beyond cap levels.

g) Set caps on water allocation.

h) Water allocations in the Steels, Pauls and Dixon Creeks Catchments to be managed such that beneficial uses of these waterways and their tributaries are protected.

AGREED ECOLGICAL OBJECTIVES FOR THE STEELS, PAULS AND DIXONS CREEK SYSTEM

> Maintain or restore self-sustaining populations of Mountain Galaxias, Flat-headed Gudgeon and Southern Pygmy Perch

> Maintain existing populations of Blackfish by maintaining existing pool habitats

> Maintain or restore self-sustaining populations of Common Galaxias

> Maintain or restore natural invertebrate community

> Maintain or restore in-stream vegetation community

> Rehabilitate Riparian Forest bench and bank vegetation community

> Maintain geomorphic river and channel form

Schedule 3

LICENCE CONDITIONS

1. **Licence to take water from a waterway to fill a dam:**
{section 51(1)(a)}

1.1 From 1 July 2012, the Licensee must not:

(a) take any water from a waterway when the daily stream flow at the compliance gauging station referred to in the approved Steels, Pauls and Dixons Creek Water Supply Protection Area Stream Flow Management Plan is 5.0 ML or less per day, at any time between 1 July and 30 November;

(b) after any event referred to in subparagraph (a), resume taking water from a waterway until the seven-day average stream flow at any compliance gauge rises above the stream flow referred to in 1.1(a).

1.2 The Licensee must comply with any roster referred to in the approved Steels, Pauls and Dixons Creek Water Supply Protection Area Stream Flow Management Plan.

1.3 The Licensee must not take or collect water from a waterway to fill a dam, whether the dam is built on or off a waterway, between 1 December and 30 June in the following year.

Note: Notwithstanding clauses 1.1 and 1.2, where the Licensee was a successful participant in Stream Flow Tender, the Licensee must comply with their new licence conditions, as stated on their agreement with Melbourne Water, from 1 July 2008.

2. **Licence to use water from a dam constructed after the commencement of Steels, Pauls and Dixons Creek Water Supply Protection Area Stream Flow Management Plan 2005:**
{section 51(1)(ba)}

The Licensee must not allow water (other than rain water supplied to a dam from the roof of a building, or a bore or for use other than domestic and stock use) to collect in the dam between 1 December and 30 June in the following year.

3. **Licence to take and use water transferred into or within the Protection Area:**
{section 62(3A),62(6)(b)}

The Licensee must not take any water from a waterway or collect water in a dam between 1 December and 30 June in the following year.

4. **Licence for a purpose referred to in section 51(1)(a) or (ba)**

From the date upon which Melbourne Water installs a flow meter to measure water taken, used or collected for commercial or irrigation purposes, the Licensee is not required to comply with the condition describing the area to be irrigated in the First Schedule of this Licence.

Note: These conditions are additional to, or replace, existing licence conditions where appropriate.

Melbourne Water
100 Wellington Parade, East Melbourne
PO Box 4342 Melbourne Victoria 3001
Telephone 131 722 Facsimile 03 9235 7200
melbournewater.com.au

ISBN 0-9775858-0-8

Printed on paper manufactured at the Burnie mill in Tasmania, which has ISO14001 environmental system certification. Water at the mill is recycled and reused. The paper is acid free, has neutral pH and is made of pulp from plantation timbers and pre-consumer waste.