

STREAM FLOW MANAGEMENT PLANS AND GROUNDWATER MANAGEMENT PLANS

TECHNICAL AUDIT PANEL

Review of Plenty River 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 the current best practice for water resource management:
 - REALM - resources allocation model - a generalised simulation package for analysing 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 within acceptable limits of risk to the environment.
3. The TAP accepts the difficulty in establishing causal linkages between particular environmental flows and the effects of those flows on the in-stream ecological processes and biota. However, TAP accepts that the FLOWS method provides the best scientific assessment currently available of the environmental flow requirements of in-stream ecosystems. 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. While committees should consider the whole range, it is the low flows in summer that are often the major focus of environmental concern. Adoption of the Sustainable Diversion Limits will address concerns about unsustainable winter use.
8. Geomorphological issues can be significant in particular plans. For example, the presence of a “sand slug” can have major implications for the management of a stream and on the flows needed to provide adequate habitat for fish and invertebrates. The TAP will treat these matters on a case-by-case basis.

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 expects that monitoring will be covered in plans on a scale commensurate with that plan

Documents reviewed:

1. Lieschke J, L Grgat & B Zampatti (2000): *An assessment of environmental flow requirements for the Plenty river catchment* for Melbourne Water (February 2000).
2. Sinclair Knight Merz (2001): *Assessment of farm dam impact on the Plenty River catchment* for Melbourne Water (Final 1 by April 2001) [known as the **TEDI Report**].
3. Doeg T J (2001): *Plenty River Streamflow Management Plan: Assessment of sustainable winterfill harvesting volumes*. Final Report (May 2001).
4. Diverters Representatives (2001a): *Report to the Plenty River Management Flow Plan working group farm Catchment dams model* (22 June 2001) [known as **Castle’s Report**]. Annex A and B not provided.
5. Letter from SKM to Melbourne Water (11 July 2001)
6. Diverters Representatives (2001b): *Response to assessment of Report to the Plenty River Management Plan Flow Working Group* (15 July 2001).
7. Stewardson M (2002): *Independent review of farm dams impacts in the Plenty River Catchment for the Stream Flow Management Plan* (February 2002).
8. Plenty River SFMP Working Group (2002): *Plenty River SFMP Working Group Winterfill Discussion to Date* (27 March 2002).
9. Zampatti B (2002): *Estimated winterfill water harvesting in Plenty River*. (14 April 2002).
10. Castle C (2002): *Comments - Minutes of meeting 11, 17 April 2002 - Percentage of natural flow pie charts - Availability of rain from rain to the Plenty River* (19 May 2002).
11. Hansen B & R Nathan (2002): *Response to Mt Charles Castle’s proposed improvements to the TEDI model* by Bill Hansen & Rory Nathan (June 2002).
12. Diverters Representatives (2002): *Report*. Plenty River Streamflow Management Plan Working Group (December 2002).

Summary

- The Plenty River SFMP process, which is taking into account the total water resources of the Plenty River catchment, has been underway since March 2001.
- Progress at the Consultative Committee has been hampered by major differences of opinion regarding the hydrology of the catchment.

- Dr Mike Stewardson was contracted as an expert to consider the contentious issues relating to the Diverters Representatives (2001a) document and to report his findings. He concluded that “the TEDI model is a more appropriate approach to estimating the impact of farm dams and should be adopted for the Plenty River Streamflow Management Plan” (Stewardson, 2002) , page 2).
- He recommended “that further investigations including a field program be undertaken to improve the hydrological basis for assessing impacts of farm dams”. We endorse this recommendation.
- A major source of uncertainty in assessing the impact of catchment dams using the TEDI model or any other approach is that there are no measurements of historical demand estimates.
- In line with current SFMP practice there is no information on what values the community places on the Plenty System or how such values, the scientific information, and diverters requirements might be combined to produce a generally accepted outcome. It should be noted that, for the Plenty SFMP, there appears to be little scope for ‘trade-offs’, and that it is likely that current diversions and the recommendations of the environmental flow study can be accommodated.

1. General

System considered

Briefly describe the system under review.

- The Plenty River system is located north of Melbourne and drains a catchment of 351 km². Toorourrong Reservoir (capacity of 273 ML), located on the Plenty River East Branch, drains a catchment of 43 km² and receives inflows from Wallaby Creek in the Goulburn River catchment as an inter-basin transfer. Another reservoir, Yan Yean, is an off-stream storage with a capacity of 30,227 ML and commands a catchment of 22.5 km² within the Plenty catchment but does not contribute to the downstream flow (Sinclair Knight Merz, 2001, page 1). There are 21 licensed diverters in the Plenty River catchment who, in 1999, were allocated 453 ML of which 335 ML/year were for winter-filling of on- and off-stream dams¹ (Lieschke *et al.*, 2000, page 7).
- Demand for Plenty River water is for direct irrigation diversions during summer low flows and for winter-fill of catchment dams for both stock/domestic and irrigation.
- Three stream-gauging stations are available on the Plenty River:
 - Plenty River at Mernda 229216 (catchment area of 274 km² including Yan Yean catchment of 22.5 km²)
 - Plenty River at Greensborough 229615 (catchment area of 329 km² including Yan Yean catchment of 22.5 km²)
 - Plenty River at Lower Plenty 229614 (catchment area of 344 km²) (Rural Water Commission, 1990, page 128).

Environmental values and issues

Significant values listed?

- There appears to be no documentation expressly dealing with *Environmental issues*. The section of Lieschke *et al.* (2002) dealing with *environmental values* (Section 3) does so under the following headings: Fish, aquatic macroinvertebrates, reptiles and amphibians, other vertebrates, and instream flora. The last three sub-sections are general, drawn from the VROTS database.

¹ For the purposes of this report, we have adopted the definition of farm dam given in the TEDI User Manual (Sinclair Knight Merz, 2001) as follows.

“The word *farm dam* is used generically to represent any type of small dam, whether licensed or unlicensed. A farm dam can be considered to fall into one of the three categories:

- *On-stream dams*, located directly on a clearly defined watercourse. These dams are generally intended to fill in winter and pass all inflows during summer.
- *Off-stream dams*, located immediately adjacent to a clearly defined watercourse and have no significant local catchment area. These dams store water which has been pumped from the water course during winter.
- *Catchment dams*, located away from a clearly defined watercourse, which utilises a land holders private water right.”

Sources of Data for Assessing Environmental Issues

ENVIRONMENTAL ISSUE	Derived as part of SFMP	Derived from other Studies on Plenty R.	Derived from VROTS, general literature, studies elsewhere
FISH		■ *	■
MACROINVERTEBRATES		■ **	■
REPTILES/AMPHIBIA			■
OTHER VERTEBRATES			■
INSTREAM FLORA			■

* Raadik and Lieschke, 1999

** Reed and Newall, 1990, Hardwick and Waller, 1999

- The *Fish* sub-section contains conservation status data from the literature and distribution information specific to the Plenty River from a recent survey (Raadik and Lieschke 1999). The data on which it is based form an adequate basis against which to measure future change. This is likely to be true for the macroinvertebrates as well though no details of the previous studies are reported by Lieschke *et al.* (2000).
- It is not clear if this is the best list of environmental values that could be developed and perhaps future reviews might examine this issue. Issues more specific to the Plenty, such as redressing some of the ecological changes resulting from the change from near-permanent to ephemeral flow conditions might be included then.
- The link between flow and some of the values (e.g. threatened species) is not made clear in the document. As part of the continuing SFMP process there will need to be a concise list of environmental issues, incorporating community aspirations, and linked clearly to broader catchment management strategies. Currently the information needed is not available. Future refinements to the development of regional catchment strategies and flow-ecology relationships will need to be incorporated at the review stage.

Were the values well documented?

- In the sense that appropriate literature sources were used and past work incorporated the documentation is good. The values were chosen by the consultant (largely on the basis of the VROT database?) but with the exception of fish and possibly macroinvertebrates there is no indication of how their condition relates to the existing flow conditions or what aspect will be preserved/improved by the SFMP.

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

- There is no indication that the community was explicitly canvassed to develop a set of environmental issues as a first step to the SFMP process. It is possible that the SFMP Consultative Committee provided some of this input, albeit *post hoc*, though it also may be that many of these were decided before the Consultative Committee was assembled. There is no reference to a community-based catchment strategy or any other broad-scale strategy into which the SFMP can be slotted. With regard to the latter, it is important that a set of measurable outcomes and some notions of their significance to the catchment as a whole be developed as part of the final SFMP.

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

- Three sites were used in setting minimum summer flows. The consultants appeared to be well aware of other drivers.

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

- Lieschke *et al.* (2000) were aware of other work in the field, appear to have carried out a good literature search, and incorporated other findings in their report.

Existing uses

Is the existing allocation and use well documented?

- As reported by Lieschke *et al.* (2000) existing water allocations are known but there are no data on actual consumption by licensed diverters. Stewardson (2002), page 2 concludes that the “estimates of water demand from catchment dams are the major source of uncertainty ...” in the analyses. He recommends “...developing more reliable models of dam water demand should be a priority to support streamflow management planning throughout Victoria”. TAP recommends that a more detailed diverter survey be undertaken to provide more certainty about demand estimates.

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

- In the TEDI analysis, future development of catchment dams was set at 7165 ML (Sinclair Knight Merz, 2001). This is a little more than double the present level of development. No other projected usage was included in the modelling.

Is current security of supply well documented?

- Security of supply was considered by Doeg (2001, page 14) using the 18 years of TEDI flow data at Greensborough. He noted that the security of supply outside the high flow season was low, with the total demand exceeding the total natural streamflow in 10 years out of 18 years examined.

Are projections made of future security of supply?

- No specific projections of future demand were made but rather the impact of catchment dams were examined relative to the volume of catchment dams as a percentage of mean annual flow (see Figure 4-3, Sinclair Knight Merz, 2001).
- This figure shows, for example, that a 33% increase in catchment dam above the present level would not affect the 10% exceedance flow (at Greensborough) but would reduce the median flow and the 90% exceedance flows by about 17%. If the volume of catchment dams were increased by 50% above the present volume, the 10% exceedance value would be reduced by 10% and the median and 90% exceedance flows by approximately 25%.
- Doeg (2001, page 14-16) examined the security of the environmental flows recommended by Lieschke *et al.*'s (2000) along with the security in drought years and during low and medium flow season.

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

- Because future diverter demands were not estimated and are unknown, a scenario approach was adopted, and so the accuracy cannot be determined. However, as the historical demands were not measured but were estimated, any conclusions as a result of modelling the system that included historical water use will be subject to large uncertainties, as discussed by Stewardson (2000). 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?

- The TEDI model (Sinclair Knight Merz, 2001) was used to assess the effect on the estimated natural streamflows at Greensborough streamgauging station as a result of development of catchment dams in the Plenty River catchment.
- No formal hydraulic measurements were made but at two sites on the Plenty River water depths and flow velocities were measured to assess habitat availability. Water quality parameters were also measured at these sites.

Was the methodology properly applied?

- The TEDI (Tool for Estimating Dam Impacts) model, which operates on a monthly time, step was developed for the Murray Darling Basin Commission by Sinclair Knight Merz Pty Limited (Sinclair Knight Merz, 2001). Subject to several queries noted below we believe the model was properly applied to the Plenty catchment.

Was the methodology used appropriate for the circumstances?

- Yes, except that this reviewer would have made use of recorded streamflow data at Mernda as well as the streamflow record at Greensborough. However, I appreciate that this was not done because there were reported effects at the gauging site as a result of bridge constructions, limited measurements and unstable control (see page 4, Sinclair Knight Merz, 2001). It should be further noted that to do such additional investigations more resources would have been required to implement the added detail.

Data

Have the technical investigations used relevant data?

- As noted in the previous comment, the consultant chose to use only the streamflow data for Greensborough. An alternative and slightly more rigorous approach would have been to use in addition to Greensborough data the record at Mernda, corrected where possible, along with rainfall records for the catchment to determine a more accurate estimate of natural streamflows using a rainfall-runoff model. However, this would have increased the cost of the basic study substantially and, given the overall errors in the demand and hydrologic data, probably would not have been warranted.
- The source of the streamflow data used in the Lieschke *et al.* (2000) report is not given and, consequently, we are unable to comment on the adequacy of the data with respect to the time step adopted, the length of data, how gaps were in-filled and how the data was adjusted for errors, given that inadequacies were noted in the Mernda streamflow record (Sinclair Knight Merz, 2001, page 4). This comment is particularly relevant to the interpretation of the recommended extraction rates set out in Table 7-2 of Lieschke *et al.* (2000) report.
- On the other hand, Doeg (2001) used the streamflows generated by the TEDI model in his assessment of sustainable winterfill harvesting volumes.

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

- The TEDI model is 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. As noted above there is some additional data at Mernda but insufficient to provide the non-linear relationship for much of the catchment.
- The Castle models reported in Diverters Representatives (2001a) and Diverters Representatives (2002) were attempting to provide a more realistic model to estimate the natural inflow to the catchment dams than the TEDI model. However, we conclude this has not been achieved, which is consistent with Stewardson's (2000) recommendation. Further comments about the adequacy of the TEDI model are made later.

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

- Although there is no evidence in the various reports that streamflow data had been checked for inconsistencies and inhomogeneities, some preliminary checking by the reviewers would suggest the Greensborough station is well rated and the streamflow data are of good quality.

Have gaps in data been reasonably dealt with?

- Gaps occurred in the Greensborough streamflow record but the extent of these was not noted. Gaps were infilled adopting a very strong relationship between the Mernda and the Greensborough monthly flows for the period June 1989 to September 1996. Outside this period linear interpolation was used on a daily basis but no details are given. Given the resources available for the TEDI modelling the gaps were dealt with in a reasonable way.

Modelling

Are natural flows defined? (existing plus usage?)

- Natural flows at Greensborough were estimated using the following equation:

Natural streamflow = Gauged streamflow at Greensborough
plus licensed diversions throughout the catchment
plus Toorourong inflow (0.2 ML/day passing flow)
minus treatment plant discharge
plus farm dam impacts

This equation takes into account known diversions and additions. Natural streamflow at any point within the catchment is then estimated by assuming uniform runoff over the catchment.

- 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, recorded streamflow data are sufficiently representative to assess the requirements for an ecologically healthy stream.

Have catchment dams been included in the estimates?

- Yes. The approach adopted in the TEDI model takes the current level of development of farm dams into account as illustrated in Figure 2-1, Sinclair Knight Merz (2001).

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. Although a Bypass function is available in TEDI which could be used to simulate average monthly releases, the effect of any development on environmental flows should be assessed externally from the model. This has been done in reports by Lieschke *et al.* (2000) and Doeg (2001).

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

- The TEDI analysis provided data to assess the effect of development on winter and summer flows and allowed broad generalisations to be made about the impact of development on flooding. But the TEDI model is based on monthly data and, consequently, the effect of catchment dams on flood hydrographs and flood frequencies, which are likely to be expressed inadequately at that time scale, could not be adequately assessed.
- Appropriate analyses of winter and summer flows were carried out.

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

- No formal hydraulic data were collected during the field visits nor has any hydraulic modelling been carried out. However, at two sites on the Plenty River, water depths and flow velocities were measured to assess habitat availability.

Have model predictions been reviewed (QC/QA)?

- Yes. Because there was disagreement among members of the Consultative Panel about the validity of several of the conclusions reached in the TEDI report, Dr Mike Stewardson was contracted to carry out an independent review of the TEDI Report and the Castle Report. He concluded that “The TEDI model is a more appropriate approach to estimating the impact of farm dams and should be adopted for the Plenty River Stream Flow Management Plan”. In addition, the technique has been presented publicly at several professional conferences – see for example Neal *et al.* (2002a) and Neal *et al.* (2002b).

Any need to improve the modelling?

- Much of the concern by the Diverter’s group of the TEDI modelling arises from their differing estimates of natural runoff from the catchment of the farm dams. This reviewer appreciates the inadequacies in the TEDI modelling approach that the Castle models were developed to overcome. However, as pointed out by Dr Stewardson, a rainfall-runoff model will only be justified if data are available for small rural catchments to validate the model parameters. In reviewing the TEDI model, Stewardson (2002) recommends that further investigations be undertaken including a field program to improve the hydrologic basis for assessing the impact of

catchment dams. Estimating runoff from small catchments is one of the major gaps in hydrology and is a source of major uncertainty. TAP recommends modifications be made to the TEDI model to allow for spatially varying runoff after field data have become available. (This will require implementation of an appropriate major research project). In the meantime the current version of the TEDI model is appropriate.

- Given that Figure 4-2 in Sinclair Knight Merz (2001) is incorrect (Stewardson, 2002, page 9), it would be prudent that the first dot point conclusion on page 17 namely that “For each additional ML of farm dam there is a 2.2 ML decrease in mean annual flow” was more fully documented and related to the results in Table 4-1 of Sinclair Knight Merz (2001) where the impact on the *mean* annual streamflow is 2.1 rather than 2.2.
- This latter issue is particularly important as the Diverter’s claim (Diverters Representatives, 2002, pages 17 & 18) that the impact of farm dams is much less than that concluded from the TEDI modelling.
- Stewardson (2002), page 13 proposed an alternative method using TEDI analysis but only for flows generated in the portion of the catchment containing catchment dams. However, given the mayor uncertainties in the other inputs, this reviewer agrees with Dr Stewardson that the effect would have little impact on the conclusions relating to available water for diversion.
- We have noted above that there are two areas, namely, uncertainty in diverter demand estimates and assumption of uniform runoff that Stewardson (2002) identified as areas in which the TEDI model could be improved to better assess the effect of farm dams on hydrology. He noted two other aspects that 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. TAP recommends that the SFMP process proceed but that a research programme be implemented to address inadequacies before the Plan is next reviewed.
- In a letter from SKM to Melbourne Water (11 July 2001), SKM noted that the average annual impact of dams was calculated as 7329 ML. They comment further that if the TEDI model was re-run with a demand factor of one rather than two, the annual dam impact reduces to 7262 ML. It is hard to conceive that by allowing a *potential* doubling of irrigation from the irrigation dams, which probably make up 40% - 45% of catchment dams in the Plenty, an increase of only 67 ML per year in dam impact occurs.

3. Geomorphology

The environmental flow assessment methods used in the Plenty study make no explicit reference to geomorphology. This has been redressed in the FLOWS methods.

Is the river channel and habitat properly accounted for?

- There is no explicit consideration of geomorphic effects of flow. There is no information on the relationship between flow and lateral connectivity, though longitudinal connectivity is considered. Channel morphology is included in the establishment of fish habitat / flow relationships.

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

- There appears to be no major geomorphologic issue in the Plenty system.

Is future geomorphic change and connectivity allowed for?

- This is not an issue along the Plenty River.

4. Ecological Responses to Flow Change

Methodology

What methodology was used?

- The ‘modified available habitat method’ (since replaced by the FLOWS method) was the preferred method in Victoria at the time of the study and was applied in the Plenty study. The method appears to have been applied appropriately.
- The shortcomings of the MAHM methods are examined in a separate report. It is no longer employed in Victoria.

Was the methodology used appropriate for the circumstances?

- It was appropriate at the time. It has been adequate to support the SFMP process for the Plenty to this point as the draft recommendations are conservative, not currently subject to challenge within the Committee, and do not involve issues which cannot be addressed by the method. Future reviews may need to take a broader approach as envisaged in the FLOWS method.
- *Was the methodology properly applied? Is the methodology for site selection described?*
- Yes, though three sites is minimal. Methodology for site selection is not stated.

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

- Not directly. The method used by Doeg (2001), Cascading Seasonal Flow, provides an estimate of ‘flow stress’ that may be interpreted in terms of ecological stress. He concluded that, using either estimate of farm dam impact (3,500ML or 7,400ML) the level of ‘flow stress’ was above that thought to result in ecological stress. There was no indication of which components of the Plenty ecosystem were threatened. More importantly there have been no links made between the flow recommendations and the ecological values listed earlier – therefore no means of assessing progress in this regard.
- The environmental flow assessment has concentrated on summer flow minima and has not explicitly provided an analysis of the flow regime. Some such analysis, or a justification for not including them, should be attempted before the SFMP goes to public review.

Ecological information

- At this stage in the SFMP process there has been no systematic provision of ecological data. In view of the restricted power of the flow assessment method to consider a reasonable range of ecological issues it is desirable that such information be provided. Large-scale ecological surveys are expensive and they will plainly have to be limited well short of what might be optimum. However, ideally, sufficient information should be collected against which to measure progress towards projected outcomes (yet to be stated). There is a limit to the monitoring effort that can be expended on a small and highly modified system such as the Plenty. On the other hand, establishing an environmental flow protocol without the means of knowing if it has worked or not also is an unsatisfactory use of resources. Our information is that a monitoring program is being carried out in the area by Melbourne Water (though these data do not seem to have

contributed to the current study). It may be useful to examine this program with a view to linking its output to the SFMP.

- In essence, there is a need for diverse ecological knowledge to broaden the basis for dealing with environmental flows. Specific information needs and knowledge gaps can be identified only when the desired outcomes from proposed flow modifications are clarified. This process is necessary in order to use the limited resources available for the task efficiently.

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

- Yes – with regard to blackfish and summer flows.

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

- Assessment of blackfish habitat under a range of low-flow conditions. This is taken as a surrogate for habitat and other resource requirements of other biota.

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

- Data exist for macroinvertebrates and fish (see earlier table). No specific links to habitat condition (except for blackfish and other fish to the extent that blackfish is a good surrogate for their requirements).

Have key ecological components and related flow components been identified?

- Not in the scientific reports to hand.

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

- Yes

Have gaps in data been reasonably dealt with?

- Yes. However the important knowledge gaps still to be identified are the impediments to linking flow modifications to ecological outcomes. This process will help target any further data requirements.

Is there a summary of available data?

- Not explicitly although the reports are well referenced.

5. Environmental flow recommendations

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

- Short-term variability has not been considered explicitly in the reports to hand. Summer minimum flows and winter flows (in bulk) have been.

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?

The Committee has not reached this stage yet.

Detail the uncertainties.

- Awaiting Committee decision.

Were the estimates of risks to the environment reasonable?

- Awaiting Committee decision.

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?

- This is incorporated in the development of flow recommendations. The Committee is yet to decide on these.

Were the estimates of risks to security reasonable?

- Awaiting Committee decision.

8. Other comments

- An important progress document is the Plenty River SFMP Working Group (2002) that summarises the Working Group discussion to 27 March 2002. Unfortunately the natural streamflow data underpinning the summary figures are unclear.
 - Mernda data (both measured and natural flow estimates) were used without reference to their source and how missing data were accounted for were not discussed.
 - Nor was the source or procedure to estimate the relevant components outlined. However, DSE explained the procedure and intent of the analysis to this reviewer. From that discussion TAP concludes that the analysis is acceptable, however, the details need to be documented by DSE for future reference.
- Castle (2002) reviews the information in the above report (Plenty River SFMP Working Group, 2002). We agree with Mr Castle's comment in the penultimate paragraph of his report that there is much more information required to understand the hydrology of the catchment, nevertheless, the reviewers believe there are sufficient data for the Committee to make decisions now. Therefore, the TAP recommends that the Precautionary Principle be adopted in the light of uncertainty about the hydrology and the demand estimates and likelihood of irreversible or serious consequences if harvesting of winterfill is not capped.

9. Conclusions and recommendations

Are the estimated environmental flow requirements reasonable?

- This is a complex question. The set of flow requirements may describe an ecologically acceptable set of flows (or may not). There is a good chance that they would be an improvement on the current situation – or the future with unmanaged development - and to this extent they are

reasonable. There are two issues that make the further evaluation of the requirements difficult.

1. There is very little linkage between the flow recommendations and the ecological values defined earlier in the process (see comments in Section 8 above). It is therefore not possible to assess objectively the extent to which the recommendations are reasonable for preserving or enhancing those values.
2. There are no explicit (and therefore assessable) conceptual models describing the components of the ecosystem expected to respond to the flow changes or the mechanism of that response. This means that the reasoning behind the recommendations is not clear and difficult to evaluate independently. More importantly it results in 'black and white' recommendations to the extent that, without the conceptual models describing how flow changes will change the ecosystem, it is virtually impossible to evaluate incremental changes to the recommendations. In other words there is no **ecological** basis for assessing trade-offs with alternative water uses and compromises must be developed without a shared appreciation of what small changes will mean for the river ecosystem.

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

- This process has not been completed. Possible lack of ownership of the 'ecological values' to be protected, plus points 1 & 2 above, may make this process difficult and risk sub-optimal outcomes.

Is the outcome logical and repeatable with proper referencing?

- The work has been appropriately referenced. The process has been set out clearly and could be repeated.

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

- Not explicitly – except for making allowance for differing estimates of catchment yield (or farm dam harvesting). See also Section 8 above.

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

- Only on the broadest time-scale, referring mainly to volumetric allocation rather than details of flow pattern.

Is the assessment adequate?

- The Committee has not made an assessment yet.

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

- Future hydrological research, identified in the Stewardson (2002) report, is endorsed by TAP. Monitoring has not been addressed by the Committee to date and will depend on the final flow recommendations.

References

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- NRE (2002a). *FLAWS - a method for determining environmental water requirements in Victoria*, Prepared by CRCFE, Freshwater Ecology and Lloyd Environmental Consultants for Dept Natural Resources & Environment, Melbourne, Feb 2002, pp90.
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