Water Management Planning
Report Series

Consultative Group

Water Resources Information Package

for the

South Esk Catchment
(above Macquarie)

Water Management Plan

Meeting Four

Summary of the Environmental Flows Report
for the **South Esk Water Management Plan**

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The Department of Primary Industries and Water (DPIW)

The Department of Primary Industries and Water provides leadership in the sustainable management and development of Tasmania's natural resources. The Mission of the Department is to support Tasmania's development by ensuring effective management of our natural resources.

The Water Resources Division provides a focus for water management and water development in Tasmania through a diverse range of functions, including implementing the *Water Management Act 1999*, the Water Development Plan for Tasmania and the National Water Initiative; design of policy and regulatory frameworks to ensure sustainable use of surface water and groundwater resources; monitoring, assessment and reporting on the condition of the State's freshwater resources; and facilitating water infrastructure development projects.

Contents

1. Summary

The Environmental Flows Report was produced to establish the environmental requirements for the South Esk Water Management Plan. The objective of the analysis in the report is to identify the key natural features of the flow regime to attempt to preserve the natural values and ecosystem requirements that are unique to the South Esk catchment. The Environmental Flows Report includes a description of the Tasmanian Environmental Flow Framework, the identification of freshwater ecosystem values in the catchment and their linkages to flow, an assessment of the hydrology of the catchment, conceptual models, and the assessment of ecosystem requirements during low flow and high flow regimes in different parts of the catchment.

2. Introduction

This document summarises information from the Environmental Flows Report for the South Esk Water Management Plan.

Flow assessments of ecosystem requirements in the report were based on studies of the water requirements of the river at six locations: four along the main stem of the South Esk River, one on the lower St. Pauls River above the township of Avoca, and one on the Nile River upstream of the township of Nile. The reaches were chosen because they are considered representative of the river within the water management subregions of the catchment, and according to the Conservation of Freshwater Ecosystem Values (CFEV) database and field surveys, they contain physical and biological features that are of significant conservation value. A catchment map showing the location of the environmental flow sites is given on page 5 in the information package presented in Meeting 2.

3. Tasmanian Environmental Flow Framework

The Tasmanian Environmental Flow Framework (TEFF) is the methodology used to derive the environmental flow recommendations. The TEFF is a 'holistic' approach to determining environmental flows that is based on the premise that freshwater ecosystems have evolved as a result of the natural flow regime, and that the natural flow regime provides the best guide to the water needs of the river ecosystem. The approach also relies heavily on use of the CFEV database to objectively identify important environmental values that can then be used to guide the *a priori* development of objectives for the environmental flows.

4. Environmental Values on the South Esk catchment

The main environmental values that were identified by the CFEV database relate to native fish and riparian plant communities that occur throughout the catchment, aquatic macrophyte communities in the lower reaches, and geomorphic features of the river in the middle and upper reaches of the catchment. A number of 'special values' were also highlighted, including lowland *Poa* grassland and shrubby *Eucalyptus ovata* forest communities, several aquatic macroinvertebrates such as caddisfly (*Hydroptila scamandra*) and the South Esk freshwater mussel (*Velesunio moretonicus*), and platypus (*Ornithorynchus anatinus*), which are present in all of the major rivers in the catchment.

All of the values identified in the catchment are listed in Table 1. These values were used to derive appropriate objectives for the environmental flow assessment. Conceptual models, which were presented in the information package in Meeting 2, were constructed using knowledge of the freshwater-dependent ecosystem values of the catchment and the likely impact that current water use has had on the hydrology.

Table 1. Values identified in the catchment include 'Primary biophysical classes' and 'special values' identified from the CFEV database. The regions in the catchment where these values are present are shown on page 8 of the information package from Meeting 2.

Primary biophysical classes	Special values
Native fish assemblage Riparian tree assemblage In-stream plants and macrophytes Geomorphology and channel structure.	In-stream fauna: • South Esk freshwater mussel (*Velesunio moretonicus*) • Hydrobiid snail (*Beddomeia krybetes*) • Caddisflys (*Oecetis gilva, Hydroptila scamandra, Oxyethira mienica*) • Platypus Riparian flora and communities: • Lowland Poa grassland • Shrubby *Eucalyptus ovata* forest • South Esk Pine • Midlands wattle • Tall quillwort • Tasmanian *Bertya* • Purple loosestrife • Slender knotweed • Small leaf *Spyridium* • Narrow leaf *Pomaderris* • Bitter *Cryptandra* • Native riparian vegetation communities.

5. Assessment of natural flow and construction of hydraulic models

Daily 'natural' baseflow data from a hydrological model for the catchment were used to construct hydraulic models of flow in the river channel at each study reach, using the River Analysis Package (RAP). Based on these models, monthly minimum flows that provide in-stream habitat for faunal assemblages have been recommended. RAP was also used to examine the duration and magnitude of flood flows at each of the reaches, along with the rates of rise and fall in river discharge. Based on these analyses, recommendations regarding water extraction during flood periods have also been made.

6. Calculation of environmental limits for minimum flows

The recommended minimum environmental flows at all study reaches provide two flow volumes. The first flow level maintains 75% of in-stream habitat under 'natural' baseflow, and is the recommended cease-to-take for extraction into storage. The second recommended flow level maintains 50% of the in-stream habitat, and is the recommended CTT for direct takes. The minimum flow information is provided on a monthly basis to ensure that seasonal changes in base-flow are preserved. Any further extractions of water beyond these flow levels are likely to lead to an increased risk of chronic flow-related stress to the aquatic ecosystem. The discharges that relate to the maintenance of 75% and 50% of in-stream habitat at the Llewellyn gauging station for the South Esk River, Deddington gauging station for the Nile River, and Avoca gauging station for the St. Pauls River are provided in Tables 2 - 4.

The current cease-to-take of 40 ML/day protects less than 20% of species habitat, and is sufficient to maintain most species and allow for the system to recover after short periods low flow. However, the current cease-to-take it is not high enough for longer periods of low flow or for a sustained period of flow below that level. Multiple years at this level would

generate a significant long term impact the native flora, fauna and natural processes in the river. With the threat of longer periods of drought as a result of climate change, and with larger amounts of water being extracted than in the past, there is a much greater chance of low flows lasting longer. Therefore, a realistic level of protection is required to allow the natural processes in the river to continue, and consequently allow native species to survive in the long term.

Table 2. Discharges (ML/day) that relate to maintenance of 75% and 50% of in-stream habitat associated with the environmental flow recommendations at Llewellyn gauging station. Also included are flows at 40% of in-stream habitat maintenance, 25% of in-stream habitat maintenance and current cease-to-take (CTT) levels for direct take and flood takes at the Llewellyn gauging station. The S6 and S8 refer to surety 6 and surety 8 licences only.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
75% habitat maintenance	339	223	188	264	501	1060	1185	1185	1185	1051	527	295
50% habitat maintenance	104	112	118	160	252	452	726	945	1016	562	227	111
40% habitat maintenance	85	85	104	137	184	356	547	769	886	386	139	85
25% habitat maintenance	69	69	69	85	156	254	408	632	701	162	86	69
Current CTT	40	40	40	40							105 (S6)	40
Current CTT for storage takes.	172	172	172	172	250	400	700	800	850	475	172	172

Table 3 Discharges (ML/day) associated with the maintenance of 75% and 50% of in-stream habitat in the Nile River, at the Deddington gauging station.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
75% habitat maintenance	23	19	19	23	28	23	19	23	23	27	33	28
50% habitat maintenance	17	9	9	18	19	18	18	18	13	18	22	22
25% habitat maintenance	6	4.5	4.5	6	11	11	11	11	11	11	13	9.5

Table 4. Discharges that relate to maintenance of 75% and 50% of in-stream habitat in the St. Pauls River, associated with to the environmental flow recommendations at the Avoca gauging station. The St. Pauls River is in a low rainfall area, and under the current extended dry-period flows in the river system are extremely low to the point of flowing underground between pools during the summer. Between 5 ML/day and 1.5 ML/day farmers currently have a sharing arrangement.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
75% habitat maintenance	32	25	22	27	56	106	123	122	123	57	31	23
50% habitat maintenance	16	16	16	16	17	21	39	48	47	22	16	16
25% habitat maintenance	16	16	16	16	16	16	16	23	18	16	16	16

Current CTT	1.5	1.5	1.5	1.5								1.5

7. Calculation of environmental limits for high flow extraction

Recommendations regarding the extraction of water during flood events are made to ensure there is minimal impact on the duration of floods and rates of change in flow to maintain channel form and habitat structure, watering of riparian and floodplain flora, transportation of sediment and pollutants, cues for different stages of life cycles and groundwater recharge.

In all subregions, recommended rates for water extraction are about one fifth of the corresponding flow, which in most cases is equivalent to bank-full flows. Recommended rates of extraction and trigger flows for each subregion are presented in Table 5. In the upper catchment, the recommended rate of extraction is 450 ML/day for 4 days once flows exceed 2,250 ML/day. In the lower South Esk River, this has been increased to 600–700 ML/day for 5 days once flows exceed 3,000–3,500 ML/day. Lower flow triggers and daily extractions are recommended for the Nile River and St Pauls River because of the differences in the duration of floods and rates of change in flow that occur in these rivers (Table 5).

Currently the flows under the Hydro Tasmania Memorandum Of Understanding (MOU) do not satisfy the environmental requirements of the catchment, but are based on the requirements of Hydro Tasmania to generate power. With a larger number of users, increased volumes being extracted and the prospect of lower flood frequency in the future, there is a significant risk to the high flow requirements of species of value and ecosystem process in the catchment, especially in the spring and autumn when higher flows a most needed.

Table 5 Recommended flood extraction for each of the South Esk catchment subregions based on the analysis of the duration and magnitude of bank full flow and 10% exceedance flow events in each study reach (ML/day).

Catchment subregions	Flow trigger	Rate of extraction	Duration (days)
Upper Esk	2250	450	4
Avoca to Break O'Day	3000	600	4
Current Hydro flood triggers at the Llewellyn gauge	2020 or 1750	None	5
Lower Esk (Glen Esk)	3000	600	4
Lower Esk (Neck of Bottle)	3500	700	5
Nile River	775	150	4
St. Pauls River	233	50	7

8. Conclusion

The objective of the recommended minimum flow and flood flows is to maintain the natural features of the flow regime, to attempt to preserve the natural values that have been identified as important to the catchment.

Minimum flows have been recommended to ensure connectivity between pools, maintain in-stream habitat for macroinvertebrates and fish, and provide sufficient habitat for in-stream ecological processes.

The recommended flood extraction rules will ensure water use during flood events does not impact significantly on the size and duration of floods, and rates of change of flow at these times. By preserving these features of the flow regime, all of the ecosystem processes they support (e.g. cues for different stages of life cycles, watering of riparian and floodplain flora, maintaining channel form, groundwater recharge, sediment transport etc.) should be maintained.

These recommendations will help maintain the significant freshwater-dependent ecosystem values that exist within the South Esk catchment.

For more detail about how environmental flows were obtained please refer to a copy of the report on Environmental Flows for the South Esk Water Management Plan, which can be downloaded from the web at http://www.stors.tas.gov.au/au-7-0054-00126, or can be obtained from the Water Resources Division in Hobart.

9. Glossary of Terms

Baseflow: The level of stream discharge in the absence of recent rainfall.

Benthic habitat: The environment associated with organisms that live in and on the bottom and/or sides of an aquatic ecosystem.

***'*Current flow':** Flow in a river where water has been extracted for consumptive use. For the purpose of this report, this involved subtracting the licensed water use for 2003 from the entire 'natural' flow record produced by hydrological catchment models.

***CFEV* project:** The 'Conservation of Freshwater Ecosystem Values' project which has developed a planning and information tool (a database) to support the inclusion of freshwater values within a strategic framework for the management of Tasmania's freshwater resources.

***DPIW*:** Department of Primary Industries and Water (previously DPIWE).

***Exceedance flows*:** Presented in the form of a percent value, this is an indication of the amount of time flow is predicted to exceed a given threshold or specified time. For example, a 5% exceedance flow value indicates that flows larger than this amount occur less than 5% of the time; flows that are equivalent to the 5% exceedance level indicate large flood events.

Ecosystem: Community of organisms interacting with one another and with the chemical and physical factors making up their environment.

***Geomorphology*:** The scientific study of the evolution and configuration of landforms on the surface of the Earth, and of the processes that create them.

Hydrology: The study of interrelationships and interaction between water and its environment in the hydrological cycle.

***Macroinvertebrates*:** Invertebrate (i.e. without a backbone) animals that can be seen with the naked eye. In rivers, common macroinvertebrates are insects, crustaceans, worms and snails.

Macrophytes: Plants that grow in lakes, ponds and rivers. They can be rooted in the bottom and be totally submerged beneath the water throughout their life, or can emerge and stand above the water surface. Some are free-floating, preferring slow-flowing or still waters.

*'**Natural flow'***: Flow that is expected to occur in a river where there is no water extracted for consumptive use. This is generally produced from a hydrological model for a catchment using rainfall and evaporation as the primary input data. It does not take into account any changes in land-use that may have occurred over the period of interest.

Riparian: Area on the banks of, adjacent to, or in the floodplains of a natural water course. The upper limit of the riparian zone is the upper limit of floods or high water.

***TEFF*:** The recently developed 'Tasmanian Environmental Flows Framework'. This framework provides a 'holistic' approach to setting environmental flow recommendations.

CFEV project terms

***Biophysical class*:** Under the CFEV Project, biological and physical variables relating to freshwater-dependent ecosystems were used to develop a 'biophysical classification' that is applicable at a state-wide scale. For riverine ecosystems, the main biophysical classifications are for fish assemblages, geomorphic features, aquatic plant assemblages, tree assemblages and crayfish assemblages.

***Integrated Conservation Value (ICV)*:** Freshwater ecosystems that need to be considered in future developments or changes to land or water management within the catchment. It is a summary estimate of the priority for conservation management integrating assessed conservation value, ecosystem condition and special values (below). An ecosystem can be categorised as Very High, High, Moderate or Low Integrated Conservation Value.

***Special Values*:** Unique or 'distinctive' conservation values other than those captured by the representativeness assessment process. These include values such as threatened flora and fauna species, threatened flora and fauna communities, priority geomorphic and limnological features and important bird sites.

***Naturalness*:** A measure of the departure from pre-European natural reference condition. This was derived for each ecosystem unit within the audit process as a single score based on a variety of sources of biophysical information.

Representativeness: This was assessed by undertaking a biophysical classification of each ecosystem based on pre-European settlement natural features (e.g. fish, riparian vegetation, hydrology, etc.). It is defined as the degree to which each ecosystem is representative of the class to which it has been assigned.

***Distinctiveness*:** The component of the conservation value assessment is expressed in two ways: whether the ecosystem unit contains rare classes of ecological components (a rare biophysical class) and/or 'Special Values' (i.e. conservation values other than those selected for representativeness, such as threatened flora or fauna).