



# ENVIRONMENTAL FLOWS

## HEALTHY FLOWS...

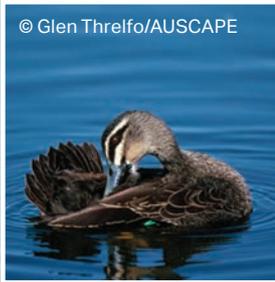
### Natural Creek Ecosystems



A naturally flowing creek is a dynamic living system of complex physical and biological processes that are always changing.

Five interacting elements combine to determine the health of a creek:

- **water quantity**
- **water quality**
- **physical character (i.e., the shape and size of the channel, sediments, amount of woody debris)**
- **condition of the land adjoining the creek ('riparian land')**
- **diversity and population of plants and animals living in the creek**



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Changes to any of these elements can have significant impacts on other parts of the system, thereby affecting the overall health of the creek.

This information sheet focuses on the effects of water quantity on the health of creeks. (See *Info Sheet 11: Riparian Vegetation* to learn about the effects of the condition of land adjoining the creek.)

### How the Flow of Water Down a Creek Affects its Health

The amount of water flowing down a creek can be reduced by:

- **a large, on-stream water supply dam**
- **direct pumping or 'extraction' from the creek for irrigation**
- **smaller farm dams that reduce the water flowing into the creek**

The *patterns* of water flow in the creeks can also be changed by this human use of the water.

If too much water is taken from a creek, and the patterns of flow changed, the following things can (potentially) happen:

- **Size, shape and stability of creek systems.**

The usual processes of downstream movement of sediments can be disrupted by the construction of physical barriers and by the reduced flow of water. These 'geomorphological changes' can also lead to ecological changes because they affect the movement of nutrients and energy, and alter habitat for all parts of the aquatic food-chain (including algae, invertebrates and fish). There may also be fewer 'flushing flows' (large surges of water that 'clean-out' the sediments in the creeks).

- **Creekside vegetation.**

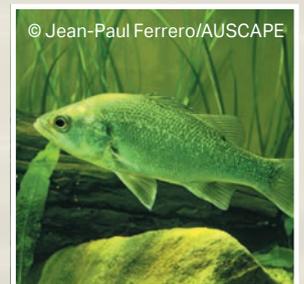
Water naturally flows in differing amounts down a creek, depending upon weather and seasonal events. When water is removed from the creek or it is dammed, the size, duration and frequency of these variations in the flow of water can be reduced.

This can significantly affect vegetation on the edges of creeks that have adapted to the natural flow patterns (usually a mixture of flood and drought). If the extremes of flow are lost, exotic species that are adapted to more stable conditions can become dominant. The biodiversity of plant and animal species can be reduced.



- **River fish.**

Dams provide a barrier to the movement of species between upstream and downstream. This means that species of fish such as the Australian Bass, which need to be able to migrate downstream to the estuary to spawn cannot complete an essential part of their life-cycle. Reduced flows, in terms of water depth and speed, can also make it difficult for certain species to move between pools.



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*A naturally flowing creek is a dynamic living system...*



## Rous County Council has planned and designed a new treatment plant for Emigrant Creek Dam... it uses the latest technology to deal with water quality hazards.

- **Aquatic invertebrates and other animals.**

Water extraction during dry periods can lead to very low flows in the creek, which create high temperatures, low oxygen levels and less habitat in the water. This negatively affects many animals in the creek ecosystem, including invertebrates on which many other animals feed. Fewer and smaller 'flushing flows' also reduce the health of creek-bottom habitats (eg, by the build up of unhealthy sediments) and make it more difficult for animals to move up or downstream.

- **Coastal fish.**

Reduced water flow in creeks and rivers affects the salinity, nutrient flow and turbidity structures in estuaries, which are important breeding grounds for coastal fish. Whilst it is often thought that "water going out to sea is wasted", there is growing evidence that the productivity of coastal fisheries is directly related to the flow of water out of rivers.

All of these effects can affect the health of the whole creek ecosystem, thereby reducing the water quality in the creek, river and estuary.

For all these reasons, the construction of more on-stream dams is now prohibited in most catchments, water sharing plans have been implemented to ensure both human uses and the environment receive a share of the available resource, and some restrictions placed on pumping directly from creeks during periods of low flow.



**Green tree frog**  
© Alex Dudley/AUSCAPE



**Saw-shelled turtle**  
© D.Parer & E. Parer-Cook/AUSCAPE



**Platypus**  
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## Researching Emigrant Creek

Rous County Council has been investigating the effects of Emigrant Creek Dam and other water extraction on the downstream environment. The outcomes from Rous County Council's research have been used to develop an 'environmental flow' regime which is compatible with both the water supply responsibilities and the ecological needs of the downstream environment.

*'Environmental flows' are a way of managing water to mimic natural flow patterns. They are not a volume of water that is specifically reserved for the environment, but rather how a particular type of flow should be managed or protected to support a natural process.*

The research involved undertaking a series of measurements and observations of a wide range of habitat and water quality variables in Emigrant Creek, in both the freshwater section of the creek above the tidal limit, as well as in the upper estuary. These measurements were repeated at a series of different flow conditions that were simulated via a series of experimental releases made from Emigrant Creek Dam. These experiments aimed at developing an understanding of the way in which biological risks change in relation to changing impacts arising from water extraction, as well as identifying how the quality and extent of habitat for a range of species changes under different flow conditions. In addition, the specific habitat requirements of a number of vulnerable species were monitored throughout the full range of experimental flows (see *Info Sheet 12: Aquatic Animals*).

Based on this research, Rous County Council has developed a complex system of releasing water from Emigrant Creek Dam that responds to and provides for the following:

- **Variability of natural flows:** environmental releases depend on the amount of water flowing into the dam (ie that would be naturally flowing through the creek).
- **Seasonality of natural flows:** environmental releases vary throughout the year according to the timing of various ecosystem processes.
- **Ecosystem baseflow requirements:** during critical low flows periods, all the water flowing into the dam is released to provide for the maintenance of downstream aquatic ecosystems.

- **Freshes (or moderate in channel rises in water levels):** the flow regime provides supplementary protection for critical needs such as migration periods for native fish, the triggering of breeding events, or the germination of plants in streams.
- **Natural rates of rise and fall:** changes in the rate at which environmental flows are released are maintained within natural bounds to ensure river channel stability and that fish or other aquatic animals can adjust to the altered conditions and do not become stranded.

When the dam is not full, these environmental flows are created by releasing water through the 'scour valve' (see *Info Sheet 13: The Dam*). When the dam is full, water simply flows over the top of the dam wall and down the spillway into the creek below.

## How Environmental Flows Help the Creek

The environmental flow regime for Emigrant Creek is based on the following functions and attributes of water flow.

**Low flows** support and sustain an array of ecological habitats and processes when larger flows have stopped or do not occur. These habitats and processes include wetlands, aquatic vegetation, fish and invertebrate communities. Among other things, low flows maintain riffle zones (where water flows over shallow rock and pebble surfaces) and transports sediment downstream.

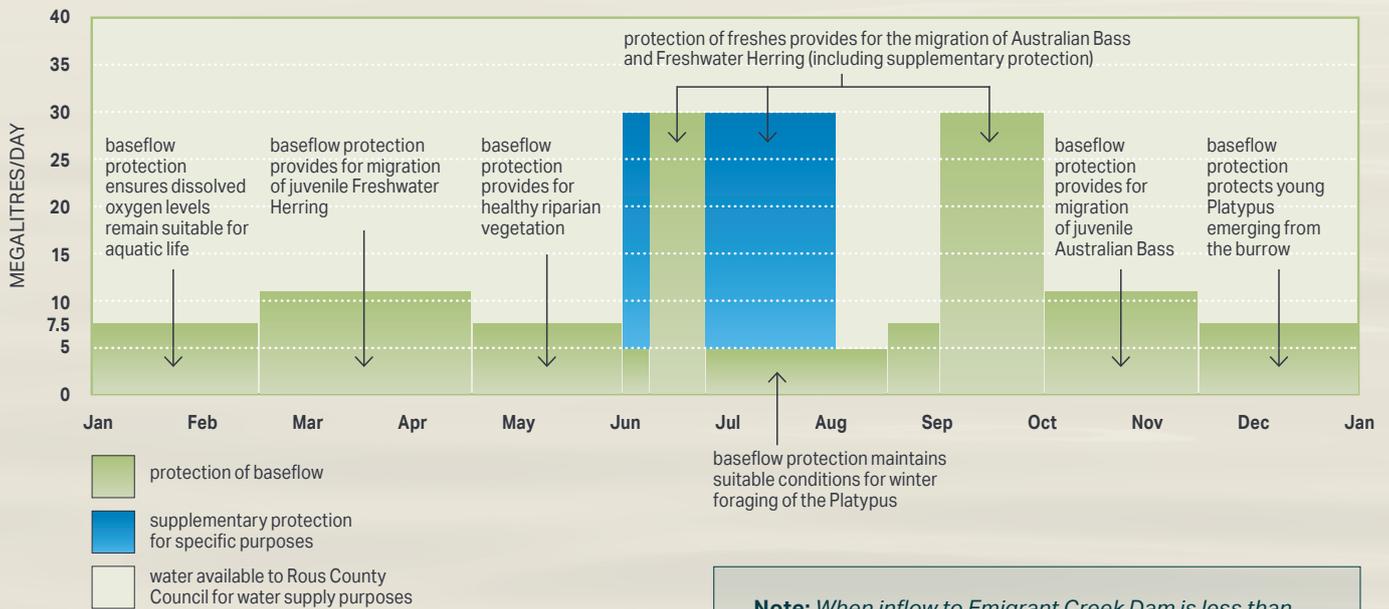
In addition to supporting many of the processes sustained by low flows, **medium and high** flows are essential for many other aquatic processes mostly associated with the size, duration and speed of events (eg, maintaining the features of the deepest channels in the creek). Medium and high flows also:

- provide cleansing flows or 'freshes'
- distribute nutrients to many habitats
- flush fine sediments from rocks, sand and gravel beds, which improve conditions for invertebrates, fish and other aquatic animals
- ensure the soaking of wetlands
- distribute plant seeds to many habitats
- provide soil moisture to riparian habitats and floodplains
- contribute to groundwater (water flowing under the surface)
- prevent weed infestation
- trigger the migration and breeding of invertebrates and some species of fish

**Variability** in these flows contributes to biodiversity.

**Seasonality** of these flows is important for the natural reproduction and dispersal processes of plants and animals.

Emigrant Creek Environmental Flow Releases



'Environmental flows' are a way of managing water to mimic natural flow patterns.

**Note:** When inflow to Emigrant Creek Dam is less than the amounts shaded, Rous County Council will release downstream all inflow to Emigrant Creek Dam. When inflows to Emigrant Creek Dam are greater than the amounts shaded Rous County Council will release downstream the amounts shaded.



## Farmers and landholders can also help Rous County Council to maintain healthy environmental flows...



### Helping to Maintain Environmental Flows

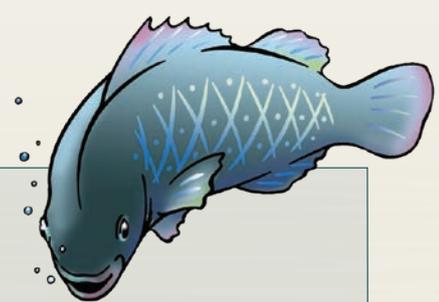
Through establishing healthy 'environmental flows', Rous County Council is working to minimise the effects of Emigrant Creek Dam on the creek, river and estuary downstream.

Landowners and farm operators in the creek's catchment also need to be aware of, and reduce, the effects that their farm dams and water use have on the health of Emigrant Creek.

If you live in the area that is supplied by Emigrant Creek Dam, you can help too. Remember that using less water means that more water is available to be released into Emigrant Creek downstream from the dam. This means a healthier creek!



### TRY THIS!



#### Learn with your...



"What are some of the effects of not enough water flowing through a creek? What are some of the effects of a change in the pattern of water flowing through a creek?"



"Take a look at the diagram of the creek, river and estuary without a natural amount or pattern of water flowing through it. Imagine what Emigrant Creek would be like if that happened. How would you feel about that?"



"Look at the creek that is flowing downstream from the dam. Does it look any different from other creeks? Can you think of ways it might be different, even if it looks the same? Now have a quick look at the dam wall. Can you see where water flows over the dam when it is full? Can you see the pipe that the water flows through when the dam isn't full? (Hint: You probably can't from where you're standing, but the next sign shows you a picture of it.)"

**Learning objective:** To understand the possible effects of damming a creek, the concept of 'environmental flows', and Rous County Council's interest in, and investigations of, the effects of Emigrant Creek Dam on the health of the creek; Rous County Council's responsibility and role in ensuring environmental flows; what the environmental flow regime is for Emigrant Creek.

(Sources: A Rehabilitation Manual for Australian Streams: Vol. 1 (2002) by Ian Rutherford et al, CRC for Catchment Hydrology; Environmental Flow Methodologies (1999) by Anthony Acret; 'Emigrant Creek Dam Environmental Flows Investigation' (Draft Nov 2001) by Dr K.A. Bishop; Environmental Flows Summary Brochure - Pioneer Valley Draft Water Resource Plan (2002) by Queensland Dept of Natural Resources & Mines)

For further information contact:

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These information sheets were originally prepared for Rous County Council by Sustainable Futures Australia in liaison with Widjabel elders. © Rous County Council and Sustainable Futures Australia 2007. This is an educational project for the protection of water land, and for reconciliation.

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