Ref. No. FR21
File No. FSC 01/06

RECOMMENDATION

INSTALLATION AND OPERATION OF INSTREAM STRUCTURES AND OTHER MECHANISMS THAT ALTER NATURAL FLOW REGIMES OF RIVERS AND STREAMS

The Fisheries Scientific Committee, established under Part 7A of the *Fisheries Management Act 1994* (the Act), has made a recommendation to list the Installation And Operation Of Instream Structures And Other Mechanisms That Alter Natural Flow Regimes Of Rivers And Streams as a KEY THREATENING PROCESS in Schedule 6 of the Act.

Listing of a Key Threatening Process is provided for by Part 7A, Division 2 of the Act.

The Fisheries Scientific Committee has found that:

1. Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands is recognised as a major factor contributing to loss of biological diversity and ecological function in aquatic ecosystems. Alteration to natural flow regimes can occur through reducing or increasing flows, altering seasonality of flows, changing the frequency, duration, magnitude, timing, predictability and variability of flow events, altering surface and subsurface water levels and changing the rate of rise or fall of water levels. Natural flow regimes are determined by the climate, run-off, catchment size and geomorphology without the impacts of dams, weirs, extraction and river management.

2. Structures that alter natural flow regimes include dams, weirs, canals, navigation locks, floodgates (including those at the freshwater/estuary interface), culverts, flow regulators, levee banks, erosion control structures and causeways. Thousands of such structures exist in NSW freshwater rivers and streams. Bridges and other similar structures that have minimal impact on flow are excluded from this recommendation. Structures within off-stream waterways such as man-made/artificial canals, farm dams, and reservoirs are excluded.

   Mechanisms that alter natural flow regimes include the operation of the above structures and water extraction, pumping, and diversion, and gravel and sand extraction.

3. Instream structures that alter natural flow regimes of rivers and streams have been installed and operated for a variety of reasons. Navigation locks were constructed to provide for navigation on large rivers, such as the lower Murray River, to facilitate commercial freight and other boating traffic. Many weirs have been installed to create weir pool environments for diversions into irrigation channels, stable pool heights for pump intakes, recreational boating, and other aesthetic reasons. Dams have been constructed for purposes such as storage of water for irrigation and domestic water

supply, and flood mitigation. Floodgates and levee banks have been constructed to control floodwaters on urban and agricultural land, and to prevent saltwater intrusion upstream. Culverts and causeways have been constructed to allow for traffic over waterways. The operation of all these structures alters the natural flow regimes of rivers and streams.

4. The installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams have several ecosystem impacts including:

- Cold water releases from low level outlets in large dams impair spawning, growth, recruitment, feeding and other life cycle processes in native fish species.
- Dams, weirs, culverts, navigation locks, floodgates and other instream structures present barriers to migration for native fish species. Weir pool environments provide ideal conditions for harmful algal blooms and the proliferation of non-native species such as carp and water hyacinth.
- Changes to natural seasonality and variability of flow regimes (duration, extent and rate), as a result of water regulation for flood mitigation and irrigation, impact on native species by disrupting natural environmental cues necessary for reproductive cycles (including migration, spawning, growth and recruitment).
- Reduction of habitat due to changes in the area, frequency and duration of inundation of floodplains and terminal wetlands limits distributions and reduces spawning successes. These areas are used by some fish and invertebrates during flood periods for the purposes of breeding and dispersal.
- Extraction of water at all scales, ranging from diversion into irrigation canals to pumping, reduces the total availability of water for riverine ecosystems.
- Extraction of gravel and alluvial sands and dredging destroys bottom habitat, changes natural flow regimes, and can cause decreases in water clarity, all of which negatively affect aquatic ecosystems.
- The natural processes of sediment deposition, erosion and transport are affected by instream structures in various ways. Weir pool environments enhance the deposition of sediments. Elevated water velocity in tailwater environments increases erosion. In addition, rates of rise and fall of river levels downstream of large dams are often unnaturally rapid, leading to bank slumping and other erosional impacts, and degradation of the riparian zone. These altered sedimentary processes have been shown to result in the loss of fish habitat including important breeding and feeding sites, causing declines in native fish numbers.
- Alteration to the natural flow regimes by instream structures and other mechanisms can cause changes in physical, chemical and biological conditions that in turn alter the biota. Species composition can change. For example, due to changes in natural flow regimes, algal biofilms have replaced bacterial biofilms in some rivers and as a result some invertebrates may no longer occur. Disruption of ecological processes may continue long after initial flow alteration, causing continued decline in biological diversity.

5. The Aquatic Ecological Community in the Natural Drainage System of the Lower Murray River Catchment is listed as an Endangered Ecological Community in NSW. That listing identifies many of the undesirable outcomes of the alteration to natural river

flow regimes by the installation and operation of instream structures and other mechanisms, including barriers to fish migration, cold water pollution, and erosion.

6. The installation and operation of instream structures and mechanisms that alter natural flow regimes adversely impact the following Endangered Species: Murray hardyhead (*Craterocephalus fluviatilis*), southern pygmy perch (*Nannoperca australis*), river snail (*Notopala sublineata*), eastern freshwater cod (*Maccullochella ikei*), trout cod (*Maccullochella macquariensis*); Vulnerable Species: Macquarie perch (*Macquaria australasica*), and silver perch (*Bidyanus bidyanus*); and Endangered Populations: olive perchlet (*Ambassis agassizii)* and purple spotted gudgeon (*Mogurnda adspersa*). Many other protected or unlisted species of invertebrates and fishes are adversely impacted by the installation and operation of instream structures and mechanisms that alter flow.

7. The Prevention of Passage of Aquatic Biota, the Alteration of Natural Flows, the Alteration to the Natural Temperature Regime of Rivers and Streams and Increased Sediment Input into Rivers have been listed as either Potentially Threatening Processes or Threatening Processes under the *Victorian Flora and Fauna Guarantee Act, 1988*. These listings are all related to this proposed recommendation in that they are outcomes of the installation and operation of instream structures and mechanisms that alter natural flow regimes. The NSW Scientific Committee has made a complementary determination to list the Alteration to the Natural Flow Regimes of Rivers and Streams and Their Floodplains and Wetlands as a Key Threatening Process under the *Threatened Species Conservation Act 1995*.

8. The Committee acknowledges that actions have been taken to ameliorate some of the effects of the installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams. These include construction of fishways to provide for fish passage, construction of multi-level offtakes and/or mixing devices to provide for release of warmer surface waters, design improvements for culvert crossings and causeways, and, in some cases, removal of redundant weirs. However, the committee does not consider that the scale of these remedial actions, or their effectiveness, has led to a substantial reduction in the overall level of threat posed by the installation and operation of instream structures and mechanisms that alter natural flow regimes of rivers and streams.

9. In light of the above, the Fisheries Scientific Committee is of the opinion that the Installation and Operation of Instream Structures and Other Mechanisms That Alter Natural Flow Regimes of Rivers and Streams adversely affects more than two threatened species, populations or ecological communities, or could cause species, populations or ecological communities that are not threatened to become threatened. Therefore, this process qualifies for inclusion in Schedule 6 of the *Fisheries Management Act 1994* as a KEY THREATENING PROCESS.

Dr Patricia Dixon
Chairperson
Fisheries Scientific Committee