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Submission on the Review of Harvestable Rights for NSW Coastal Catchments

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Introduction

The modelling for the Harvestable Rights review uses existing flow regimes minus the impact of existing farm dams as the baseline condition for comparison of impacts. This is a reasonable and practical position to take. However, these coastal catchments have already been severely impacted by changes in land use which have caused deleterious changes to the flow regimes.

As previously argued in my comments of the South Coast Water Strategy, European invasion and settlement has resulted in a number of changes which have degraded catchment values. These include soil compaction by hard-hoofed animals, draining of wetlands, road construction and the associated altered and concentrated drainage patterns, gully erosion in intense rainfall events following land clearing, with the consequent accelerated drying out of riparian areas, and water extraction for irrigation and town water supplies. In addition, the replacement of old growth forests with dense regrowth or pine plantations can result in a significant reduction in baseflows. (see review by Vertessey, 1999).

The only developments reversing these impacts on flow regimes are the construction of water storages and detention basins.

Vegetation clearing might be expected to increase water flows because of the reduced evapotranspiration losses when forests are replaced by grasslands. However, in coastal catchments, vegetation clearance almost always causes subsequent streambank erosion and incision of drainage lines during intense or prolonged rainfall events. Therefore, while total annual runoff may increase in association with a loss of forest cover, flow duration almost never does, except perhaps in the very flat inland catchments.

We do not have hydrographs from the pre-European settlement era but we can infer what they might have been using fluvial geomorphology and by studying the (very few) remaining intact catchments. For example, in the appendix to the report on the Character and Source of Sediment to

Pambula Lake (Thoms and Bergs, 1994), an excavation adjacent to the Pambula racecourse shows a dimorphic picture of sediment accumulation. The lower sediments are relatively uniform loam but the more recent sediments are predominantly sand, said to be the result of major erosion events following vegetation clearance.

The Far South Coast Catchment Management Committee commissioned Professor Gary Brierley and his team from Macquarie University to study the fluvial geomorphology of the Bega catchments. Fluvial geomorphology studies (e.g. Campbell Murn in the Cobargo (Narira) Catchment, Gary Brierley and Krystie Fryirs in the Bega Catchment) have described how land clearing following European settlement lead to massive erosion of sedge and tea-tree swamps at the foot of the escarpment. (Brierley and Murn, 1997, Fryirs and Brierley, 1998)

In brief, about 21.7 million cubic meters of “bedload sediment” has been eroded in major rain events following vegetation removal. About half of this forms the Bega Sands Aquifer, about 11% has gone out to sea (along with the fines and organic matter) and the rest is in transit. This has made the flow regime in all our streams much peakier, with worse flood damage and poor flow-duration into dry periods.

Coastal streams have changed from a “chain of ponds” form, where dense sedge vegetation filters flow between a series of pool habitats, to deeply incised gullies and sand-choked reaches with little or no surface flow between significant rainfall events.

The Healthy Rivers Commission report on the Bega Catchment emphasised the need to repair the riparian corridor as a priority (Crawford/HRC, 2000). In negotiations over the Bega Water Sharing Plan (as a representative of the (Bega) Environment Network), I cited the relative paucity of native fish species in the Bega vs Brogo rivers and the poorer macroinvertebrate diversity in pool-edge habitats (Australian Water Technologies/Growns, 1998) as evidence that low flows in the Bega river required better protection from excessive extraction. The deal negotiated was for continued access to low flows by dairy farmers for dairy wash-down and some limited irrigation in return for a program to restore native vegetation along the river corridor.

Subsequent drought years meant there was not that much effective progress in native riparian vegetation restoration. Then the massive flood event of March 2011 smashed riparian fencing and plantings.

The commendable attempts by Local Land Services, the BVSC and the Bega River Anabranch Wetlands Landcare group to restore native vegetation at the Bega Riverside Park, Spenco lagoon and Bega/Brogo Anabranch have been repeatedly set back by massive flood events such as 2011, 2012 and 2016, with subsequent weed invasion.

Restoring the riverine corridor without first restoring the flow-regime is likely to be a frustrating, expensive and perhaps futile exercise. As stated earlier, European settlement has involved significant land clearing, especially of the vegetation on high fertility soils supporting sedge and tea-tree swamps. These have incised in significant rain events resulting in massive soil erosion and a change in the hydrological regime so that flood damage has increased and flow duration into dry periods had decreased.

Unless the hydrological regime can be repaired and restored, there will be more conflict over access to low flows and continued poor river health in aquatic and riparian environments.

Restoring the hydrological regime in coastal streams can be, to some extent, achieved by increasing on-farm water storage throughout the catchments. The SMEC report (Bega River Catchment, Water Storage Project, November 2007) found that large on-stream storages would provide a poorer outcome in terms of meeting irrigation demand that smaller storages distributed throughout the catchment because the latter would provide benefits to many more farms.

Filling on-farm storages by extraction from streams has major disadvantages, namely the cost of pumping and the limited availability of water at low and medium flows. A better option would be to:

- Locate storages as high as practicable in the farmed landscape
- Fill such storages by the interception of stormflow runoff with feeder drains
- Manage the flow in feeder drains using "smart culverts" (These are culvert- wells placed at intervals along the feeder drains with a through-pipe leading along the feeder drain towards the storage and a pipe under the wall of the feeder drain, whose inlet is above that of the through-pipe. This limits the flow to the storage in intense rainfall events and therefore avoids significant erosion along the feeder drain and obviates the need for a concrete-armoured spillway on the dam.)
- Utilise the water stored, as soon as economically opportune, by gravity-fed irrigation.

The hydrological effect of capturing stormflow runoff high in the catchment and releasing it for irrigation in dryer times would be to maintain a proportion of the catchment soils in a wetter condition for longer overall. Baseflow in small tributary streams could be to some degree sustained and subsequent small rainfall events would be more likely to produce some additional streamflow, due to the antecedent wetness of these areas.

The availability of surface fresh water throughout coastal catchments could make an important contribution to facilitating the response to bushfires. Having some of the pasture lands in a greener condition for longer into the summer drying period would also provide some bushfire protection.

Farm dams represent some aquatic habitat. They can provide important refuges for mobile aquatic species such as water dragons and turtles, as well as an essential resource for birds. The Bega water sharing plan calls for the quarantining of the last 10% of water stored in new dams from consumptive use for irrigation. This provision should be applied for all new farm dams constructed under the Harvestable Rights provisions.

<u>Magnitude of Harvestable Rights</u>

Harvestable rights are currently set at 10% of average runoff, which may be a negligible proportion of runoff in wet years and a highly significant proportion in drought years. It would be better to focus on the proportion of <u>stormflow</u> runoff captured and stored and subsequently used for irrigation to wet catchment soils in dry times. The SMEC report shows how little of the total available (modelled) streamflow is licensed for use (SMEC 2007 page 48, figure 28). Note that median flows are considerably lower than average flows because infrequent but very large flood flows skew the distribution.

In order to encourage a reduction in the extraction of low flows, the Bega Water Sharing Plan offers increased access to water from higher flow classes as a trade-off for the surrender of "A class" water access. This has not been taken up due mainly to the high cost of double-pumping from stream to off-stream storage then from off-stream storage to the irrigation system.

Some pilot projects whereby stormflow runoff is captured by feeder drains and stored in dams high in the landscape might be offered a subsidy for dam and feeder drain construction in return for access to data collection to assess performance.

Feeder drains intercept a proportion of interflow (the lateral movement of water through the soil profile towards drainage lines) and any incident rainfall on their compacted surfaces. As such, they impact baseflow, through-flow and stormflow generation. However, the preponderance of total annual runoff in coastal streams is in very large flow events. Analysis of the area under hydrographs or flow-duration curves suggests that around 70% of the total annual volume of flows might be out-to- sea within a week of the rainfall event. Some of this flow in "freshes" is useful to aquatic biota but most of it is just damaging to the river corridor due to the historical changes in flow regimes.

The HARC report "STEMI" modelling did not include any estimate of leakage from farm dams, due to the difficulty of doing so given the high variability of dam performance in different geologies. (See email from Amy Halliday 12/4/21 which included advice from hydrologist Jon Sayers). The very modest effect on the duration of fresh flows caused by the construction of farm dams on first and second order stream catchments would be further ameliorated by leakage as the clay aqualude in dam walls expands and effectively seals.

If water intercepted by feeder drains is stored and then dispersed by irrigation in the nearby landscape as soon as is opportune, the overall effect will be to reduce stormflow runoff and enhance flow-duration in streams.

Modelling of farm dams fed by feeder drains could be undertaken to help determine optimal location of dams, size, the spacing of smart culverts, size of through-pipes and culvert pipes, slopes on feeder drains, design of irrigation works and timing of utilisation of stored water. Keeping these farm dams full for a "rainy day" could be disastrous! The idea is to wet up the landscape a high as is practicable throughout. Storage should be as much in the soil as in the dams.

A modest increase in the harvestable right, say to 20% of median annual runoff, could be considered given the likely impact of a reduction in severity of floods and an improvement in flow duration, provided the stored water is used as soon as irrigation becomes prudent.

Estimating the magnitude of historical changes in flow regimes

Potential evaporation is the evapotranspiration that occurs when there is complete vegetation cover and no constraint on the availability of moisture to vegetation. (Dingman, L. 1994)

Table 3-4 (Page 44/96) of the SARC modelling report sets out potential evaporation for the coastal catchments studied. The three catchments with the highest proportion of harvestable rights already exercised, Wollondilly, Double and Bega/Bemboka, all show potential transpiration at about double annual rainfall. And yet these catchments are almost certainly producing more total runoff that during the pre-European era, mainly as stormflow runoff during significant rainfall events.

Were rainfall evenly distributed throughout the year, coastal catchments would produce very little streamflow, perhaps only during the coolest winter months. However, rainfall occurs sporadically, with more than half the median annual rainfall typically occurring in 2 or 3 significant rainfall events of a few days' duration.

The water balance of a catchment is not like a bank balance. A money overdraft has to be paid back but a deficit of rainfall relative to potential evaporation does not have to be made up. Plants stop transpiring when water is no longer available. So, a rain event after a severe period of drought will quickly wet up the soil and quickflow runoff can occur even though there is a long-term average soil moisture deficit.

It would improve the overall productivity of coastal catchments if a proportion of stormflow runoff could be captured and stored for use during dry periods. This could also help restore the low flows to what they might have been prior to European settlement.

Stream Order

The construction of farm dams on third or higher order streams may have adverse impacts on fish habitat. Most native fish species are diadromous, so that migration between estuaries and upper reaches is essential for breeding cycles. Any dam on a third or higher order stream should have provision for fish passage with a fish ladder and appropriate transparency and translucency rules.

Modelling of new farm dams on first or second order streams, fed by feeder drains with “smart culverts”, which capture stormflow runoff from adjacent first order stream catchments, could be undertaken to assess their viability and impact on the flow-duration curve.

Near Neighbour Issues

At the consultation meeting in Bega on 25 February 2021, the issue of neighbouring property dams intercepting flows from springs was raised. The size of any approved harvestable rights dam should be set at a percentage of the median rainfall run-off from the actual property, not a percentage of the run-off from catchment above the property which feeds a spring.

This raises the issue of mixed rights dams, that is, dams which are filled in part by harvestable rights and in part by extraction from a stream for which a licensed entitlement is held. The landholder may wish to construct a very large storage which could never be filled from just one-years’ entitlement but might be filled over a period of years to provided stock water in a severe, prolonged drought. Given that pan evaporation greatly exceeds rainfall during most summers, the economics of doing this are questionable. (A roofed tank might be a better option). However, the view was expressed that it is viable to buy –in feed during a drought but not to buy-in water.

The environmental impact of such large dams could be minimised by limiting extraction from streams for dam filling to periods when the flow is above the 50^{th} percentile of average daily flows, with the proviso that the first 48 hours of a “fresh” flow should be embargoed.

Other Catchments

The granite geology of the Bega Catchment (biotite granodiorite) makes the bedload sediments very visible and quantifiable.

Historical landscape paintings (such as Streeton’s views of the Hunter valley or Drysdale’s “The Rabbiters”) show gully and streambank erosion and sedimentation of stream-beds has been ongoing since land-clearing and the introduction of foreign animals began.

The HARC report on modelling shows the relatively high take-up of harvestable rights provisions in the Wollondilly catchments, a portion of the greater Hawksbury/Nepean catchment above Lake Burragorang.   An increase in farm dams in the Wollondilly catchment could help alleviate the need to raise the Warragamba Dam wall as a flood mitigation measure provided that water stored in farm dams is used as soon as is opportune. If these dams are kept as a scenic reserve or are kept full even in dry times as a reserve for an extreme drought, they will be unable to provide any capture and storage of very large rainfall events. Management of private-land dams is usually at the whim of the landholder, so the main opportunity for a government department to have influence is at the approval stage for construction.

A practical solution to this quandary might be to insist on transparency and translucency provisions in new harvestable rights dams. For example, a small diameter pipe (e.g. 90mm PVC) could be inserted into the wall of a new dam of >2 ML capacity at, say, one half of the height of the wall. Thus, the dam would function as a detention basin for a period of time. The pipe would require a trash screen on the inlet end, e.g. a 25mm weldmesh cage. After the first, say, 48 hours of flow during a freshet, the pipe might be capped to retain more water for dry times.

Some of the north-coast streams are subject to intense rainfall on steep catchments which leads to the scouring out of the stream bed in the flood plain. To quote Ian Mannix book “Great Australian Flood Stories”:

“With every flood, river beds on the plains a scoured deeper and deeper, making river banks steeper, increasing the velocity of the next flood. The damage along the riverbank can be substantial. This scouring has resulted in some parts of the Macleay River now lying below sea level; and the inflow of sea-water is threatening groundwater further and further upstream.”

It would seem that strategies to reduce flood peak flows throughout these coastal catchments might be worth exploring.

Interception by plantations and regrowth forests

Farm dams intercept water flowing into streams. As such, they are similar to pine plantations or dense regrowth forests that result from intensive logging. There has never been any attempt to regulate water use by pine plantations or regrowth forests in this country, even though there has been evidence going back more than 50 years that perennial streams can become winter-flow only following conversion of old growth forests to pine plantations. There is no “cease to pump” for pines or regrowth forests. Perhaps some water storage within industrial forestry areas should be mandated e.g. “Helicopter Dams” for firefighting.

Conclusion

A modest increase in harvestable rights to 20% of median annual runoff and limited to first and second order streams could make a useful contribution towards restoring the flow regime in coastal catchments to that which prevailed prior to European invasion and settlement. The design of farm dams should attempt to capture stormflow runoff and preserve important “freshes”.

References

Brierley G J and Murn C 1997. European Impacts on downstream sediment transfer and bank erosion in the Cobargo catchment, NSW, Australia. Catena. 31, 119-136.

Fryirs K and Brierley G J 1998. The use of river styles and their associated sediment storage in the development of a catchment-based river rehabilitation strategy for the Bega/Brogo catchment South coast, NSW. School of Earth Sciences, Macquarie University. June 1998.

Crawford/HRC (2000) Independent Inquiry into the Bega River System. Final Report. Healthy Rivers Commission of NSW, May 2000.

Dingman, S. L. 1994 Physical Hydrology. Macmillan College Publishing Company. Pages 291, 292.

Mannix, Ian “Great Australian Flood Stories” pages 168, 169.

AWT (1998) Growns, I. Baseline ecological study of the Bega River system. Australian Water Technologies Report No 97/251. March, 1998.

SMEC November 2007. Bega River Catchment Water Storage Project. Stage 1 Draft Final Report.

Thoms, M. and Bergs, M. (1994). The Character and Source of Sediments to Pambula Lake. Report prepared for the Environment Protection Authority, Wollongong Office.

Vertessey R A. (1999) The impact of forestry on streamflows: A Review. In: Forest Management for Water Quality and Quantity. Proceedings of the Second Forest Erosion Workshop. May 1999. Croke J and Lane P (eds). CRC for Catchment Hydrology, Report 99/6, pp 99-108.