Submission on the Merimbula Sewage Effluent Outflow EIS.

Mick Harewood, September 2021.

The Merimbula sewage effluent ocean outfall Environmental Impact Statement is a vast document which is heavy on regulatory jargon but rather coy about the actual environmental problems it is seeking to address. It is only when you get to page 90, in table 4.2 on past reports, that there is a mention of *Hinksia sordida*, the filamentous alga that produces “red tides”, skin irritations in swimmers and foul rotting-seaweed odours. It cites “anecdotal evidence” from local residents that these algal blooms occurred from time to time before the Merimbula STP beach outfall was established. It fails to mention the evidence from fish-spotting pilots that red tides have most often been seen near the Eden, Merimbula and Bermagui sewage effluent outfalls.

This raises the intriguing question of why nutrients from sewage outfalls seem to stimulate algal blooms but much larger nutrient loads from agricultural lands do not seem to cause such problems? The Healthy Rivers Commission report on the Bega Catchment cites an estimate that there is around 27 times the nutrient load from agricultural activity compared to that coming from human waste. The difference is that most of the nutrient from agricultural land runs off in large rainfall events, and so most of the nutrients are bound to soil particles like clay and humus. By contrast, nutrients from sewerage treatment plant outflows are more or less constant or daily (? nightly) events and they are not likely to be bound to fine soil particles. Thus nutrients from STPs are available in the water column and can cause blooms of microalgae in warm weather.

Evidence that the nutrients eroded from agricultural lands are mobilised mainly during large rainfall events comes from the water quality data reported in the Candelo Village Sewerage Scheme EIS (ERM 2004)

The following table is reproduced from the Candelo Village Sewerage Scheme EIS (ERM,2004)

Table 9.4 *Water Quality Data - March 2000 (Rain Event)*

	CAND04 Candelo Creek (upstream of village)			CAND03 Candelo Creek (downstream of village)		
Date	**Total Phosphorous** (mg/L)	**Total Nitrogen (mg/L)**	**Faecal Coliforms (cfu/100ml)**	**Total Phosphorous** (mg/L)	**Total Nitrogen** (mg/L)	**Faecal Coliforms (cfu/100ml)**
9/3/00	0.06	0.47	3000	0.08	0.52	1400
9/3/00	0.39	2.3	30700	0.18	1.3	12000
9/3/00	0.42	2.3	30300	0.22	1.4	17200
10/3/00	0.09	0.8	3200	0.09	0.8	3800
11/3/00	0.03	0.47	8000	0.03	0.38	600
12/3/00	0.02	0.41	400	0.02	0.29	300
19/3/00	<0.01	0.3	50	0.01	0.28	80

1. Source: Bega Valley Shire Council (2000)

Results of the water quality monitoring show that turbidity in the creek is generally low, however levels increase following wet weather.

The rainfall- event water quality sampling showed that faecal coliforms, nitrogen and phosphorus concentrations were higher at the upstream sampling site compared to the site below the village. Note that concentrations are not total loads, and the concentrations of pollutants reported from the village are no doubt in part due to dilution by quickflow rainfall runoff from bare and compacted surfaces such as building roofs and roadways. (The Candelo EIS incorrectly labels the sampling sites with the same label but an exposure draft provided by Resource Allocation clearly shows the upstream agricultural site had the higher concentrations.)

Nutrients from agricultural activities only seem to cause problems when they are discharged into impounded or poorly flushed estuarine water bodies. When the eroded soil particles reach the salt water, they flocculate and settle on the estuary or sea bed. If there is a subsequent period of warm, calm weather, temperature stratification can occur so that there is little mixing of the surface and deeper waters. Anaerobic bacteria growing on or near the bed tend to make the water acidic. This releases the nutrients, particularly phosphorus, from the clay into the water column. A bloom of noxious or even toxic algae can occur.

Examples include the oyster killing event in March 2002 in Wonboyn Lake. (Imlay Magnet 21/3/2002). Intense bushfires in 1972 and 1980 in the Wonboyn catchment, as well as erosion during significant rainfall events in 1971 and 1975 which followed intensive clearfall logging in parts of the catchment, would have led to the accumulation of nutrient in the surficial sediments of the lake bed. Wonboyn Lake is relatively poorly flushed so when prolonged dry, hot and calm weather arrived in March 2002, a bloom of a toxic marine algal species occurred and killed about 90% of the oyster stocks.

Various outbreaks of *Pseudonitzia* (the causative organism of amnesic shellfish poisoning) in Wagonga Inlet have disrupted the Narooma Oyster Festival on at least two occasions.

If nutrients from agricultural activities or sewerage treatment plants enter impounded fresh water bodies, they can cause toxic cyanobacteria blooms. (See, for example, Figure 2 in "Implementing the NSW Algal Management Strategy, Biennial Report 1994-1996, DLWC). Such blooms have been a serious problem in the Murray Darling basin streams, where relatively low flows and relatively stagnant waters combined with high temperatures and temperature stratification can lead to high concentrations of available nutrients in the water column.

So, the key objectives of a sustainable effluent disposal or reuse scheme should be to:

- Avoid high concentrations of available nutrients in fresh water or salt water
- Avoid accumulation of nutrients bound to clay particles in the benthos of impounded or poorly flushed fresh or saline water bodies

It should be borne in mind that erosion of soil particles in very large rainfall events is natural and unavoidable, and that this may carry a significant nutrient load from agricultural, forestry, wildfires or other events and activities. This is unlikely to cause problems unless these end up in poorly flushed water bodies which are subject to temperature stratification. They generally flow out to sea in times of low solar radiation.

Effluent Disposal Alternatives.

Fact sheets 1, 2 a, b and c, 3 a and b referred to in table 4.3 (page 93 onwards) in the EIS (https://begavalley.nsw.gov.au/cp_themes/default/page.asp?p=DOC-DKK-80-42-24) quantify the rather disappointing volumes of reuse at rather high cost in infrastructure and ongoing greenhouse gas emissions.

I presume they all adopt the deficit irrigation protocol as described in the village sewerage schemes and the 2005 Merimbula Scheme (ERM 2005). Deficit irrigation allows for irrigation up to a 10mm deficit below estimated irrigation demand, presumably to reduce the amount of nutrient-rich runoff should a rainfall event occur following irrigation. Such a protocol is likely to reduce the potential beneficial reuse volume and plant growth and is unlikely to avoid significant pollution events if a very large rainfall event ensues. A much better policy would be to capture runoff from the area irrigated in a reasonably large storage for subsequent reuse in the catchment above during hotter, dryer weather.

A comparison of average monthly pan evaporation versus average monthly rainfall for Bega shows that there is an excess of pan evaporation over rainfall of about 160 mm per year, mainly in the months of November to February. (See attached figure 1). Note that potential evaporation exceeds pan evaporation, depending on vegetation type and condition. Of course monthly averages hide the real variability of rainfall and evapotranspiration. The far south coast climate is characterised by significant periods of fine, dry weather with occasional very wet periods of a few days duration, often associated with east coast lows.

During the volumetric conversion process, dairy irrigators suggested 7 ML per hectare per annum was a reasonable amount of water required to maintain dairy pastures in a good condition. They aspire to wet the top 50mm of soil for grass growth. Taller deep rooted vegetation types are likely to use considerably more water, perhaps up to twice as much.

Because the peak output from coastal sewerage treatment plants occurs during about 5 or 6 weeks over summer plus a week or so at Easter, much of the peak outflow is likely to occur in the months when evapotranspiration greatly exceeds rainfall.

My proposal is to use treated effluent to irrigate rainforest vegetation plantations placed strategically to provide a buffer of mesic vegetation as a barrier against bushfires. Balancing the STP outflow with irrigation demand will require considerable storage. The location of such storages should be based on two main criteria, namely the suitability of the subsoil to form an impermeable earth dam and the ability to capture most of the nutrient-rich runoff from the irrigated area above should a rainfall event occur. This latter criterion may not be particularly onerous if feeder drains (sometimes called "greedy" drains) are located below the irrigated areas to direct water to the dam(s).

The use of "smart" culverts along the feeder drains gives the design great resilience. Smart culverts are simply a culvert with a through-pipe leading along the feeder drain and a conventional culvert pipe through the wall of the feeder drain with the entrance to the through-pipe considerably below that of the conventional culvert pipe. These pipes need not be of very large diameter (90mm PVC pipe will do) if they are protected from fouling with a "weldmesh" strainer and the surface of the feeder drain is shaped so that, in a very intense rainfall event which causes the culvert well to overflow, the stormflow spills over the surface. In this way, most of the nutrient rich effluent will either be used by the rainforest vegetation or returned to the dams(s).

In an extreme, intense rainfall event, nutrient rich stormflow runoff may occur from the overwhelmed smart culverts or the dam spillways, but this will be associated with turbid flows, that is, clay soil particles. Thus the nutrients will be tightly bound and the vast majority will flow out to sea within a day or two.

Dairy farms have to deal with wastewater from dairy wash-down operations twice a day. They have generally adopted a policy of pumping this nutrient-rich effluent to higher parts of the landscape for spray irrigation. This enhances pasture growth on higher ground and minimises the risk of contamination of streams. There is no reason why effluent from human waste could not be disposed of safely and beneficially in areas a bit closer to urban settlements. Most pathogens in human waste do not survive for long in the extended aeration tank, and subsequent exposure to high intensity ultraviolet radiation should eliminate any that do, provided the turbidity of the effluent is low. This might require a further filtration process and monitoring. Note that dairy effluent is likely to contain the relatively resilient pathogen *Cryptosproridium parvum*, which is resistant to even swimming pool strength chlorination. Cryptosporidium does not seem to have caused serious gastro-intestinal disease in the Bega Valley in recent years.

The energy requirements for spray irrigation of treated effluent are likely to be lower than those associated with pumping effluent out to sea against the considerable water pressure at 30 meters depth. The cost and greenhouse gas emissions associated with pumping up hill for spray irrigation could be minimised by using solar photovoltaic panels and timing the pumping to storages or spray irrigation networks to coincide with maximum solar electric generation. This peak would, by and large, coincide with the daily peak in evapotranspiration and the seasonal peak in effluent flows from tourist visitation as well as the seasonal peak in the difference between average monthly pan evaporation and rainfall.

Storing nutrient-rich fresh water in surface dams risks the development of blooms of toxic cyanobacteria (“blue-green algae”). This risk has been managed elsewhere by the use of rafts supporting aquatic plants, thus limiting the solar radiation reaching the dam surface.

The preferred location of rainforest plantations irrigated by treated effluent has to take into account a number of factors.

- Runoff in extreme rainfall events that is in excess of the storage capacity should not enter a poorly flushed estuary or other impounded water body
- Land availability
- The strategic value of bushfire protection
- The ease of weeds management by mechanical means (this probably relates mainly to slope and the presence of rocky outcrops etc.)
- The possibility of nuisance odours in unfavourable weather impacting residential areas (note that this is already an issue near the existing STP during the summer tourist peak.)
- Pumping costs

I am reluctant to publicly canvass particular parcels of land for this purpose. Council has previously sought approvals for a waste management site in a disused quarry, only to have the owner raise the price to an extortionate degree once the approvals had been obtained.

The greatest benefit in terms of bushfire risk mitigation might come from irrigating forested areas within the Merimbula township, such as along the steep gullies of Merimbula Creek and its small tributaries. However, it is difficult to see where a significant storage could be located in order to capture excess runoff from such areas during large rainfall events. Choosing a suitable location (s) may require negotiation with a range of landholders, including State Forests and National Parks.

In relation to pumping costs, the EIS has virtually no information on the additional energy requirements to pump effluent against the considerable water pressure at 30 meters below sea level. Under the Clean Energy Plan, page 542, is the statement that the Merimbula STP currently is responsible for about 7% of the total BVSC emissions. Table 24-4 Preliminary Sustainability Assessment, the last category: Energy (page 549) is the statement "Energy use and Carbon Monitoring has not been completed as part of the concept design for the project but could be calculated during detailed design." This is an appalling deficiency given the high ongoing cost of pumping effluent against the massive back pressure of sea-water at 30 meters depth.

My proposal for irrigation of rainforest plantations in the fringe of settled areas would also entail considerable pumping costs. However, the emissions associated with this could be minimised by the installation of solar photovoltaic systems on whatever roofs the BVSC could rent for the purpose. Spray irrigation during the afternoons would maximise evapotranspiration, creating the optimal microclimate, and have the advantage of timing the energy use to coincide with maximum solar energy availability. There have already been some occasions when the wholesale price of electricity is negative, due to the installation of considerable variable renewable electricity generation capacity in the east coast grid. (See Snowy Hydro 2.0 EIS).

The use of spray irrigation raises the issue of the risks to human health and the environment of pathogens in treated effluent.

On page 75 of the EIS the use of chlorination is mentioned. "This is to ensure that any treated wastewater that is being used for irrigation would meet the log removal requirements for effluent reuse." I have been referred to the Australian Guidelines for Managing Water Recycling 2006. These set out a comprehensive risk management approach for the reuse of treated wastewater. Without going into a detailed critique here, I wish to make the following points:

- Chlorination is most likely to be justified only if the wastewater is to be recycled for potable use. The combination of processing in the Extended Aeration Tanks and subsequent exposure to high intensity ultraviolet light (provided turbidity is monitored and minimised by filtration if required) should give adequate protection against human pathogens if wastewater is to be recycled for irrigation.
- Chlorination can result in the production of carcinogens, such as trichloromethyl compounds.
- The Guidelines base pathogen risk on the likely fate of a bacterium (Campylobacter), two viruses (Rotavirus and Adenovirus) and a protozoan (Cryptosporidium). Nutrients in recycled water pose the additional risk of the development of toxic blooms of cyanobacteria in freshwater and toxic marine micro-algae in saltwater, including Alexandrium (the cause of paralytic shellfish poisoning, which caused the suspension of mussel farming in Twofold Bay in December 2006) and Pseudonitzia, the cause of amnesic shellfish poisoning, which has

disrupted the Narooma Oyster Festival. This means the catchment for reuse of wastewater by irrigation should avoid poorly flushed estuaries such as Pambula/Broadwater Lake. The Merimbula Lake is by contrast quite well flushed (see Heathy Rivers Commission Inquiry into ICOLLS).

- I do not favour the reduction in phosphorus levels in treated effluent by the use of poly aluminium chloride. Australian soils are generally deficient in phosphorus and most rainforest species are not adversely affected by high nutrient levels. Irrigation of forest plantations at Wagga has been shown to result in the proliferation of de-nitrifying bacteria in the soil. Major nutrient export from irrigated sites is unlikely to occur.

Finally, in the longer term the use of nutrient rich effluent may be part of schemes to decrease atmospheric CO2 by bio- sequestration. A number of microalgae make hydrocarbons as their energy store. These might be cultivated and harvested to produce biofuels for transport. Some years ago, the Cobargo effluent storage developed a bloom of algae which caused the pH to reach about 9 due to CO2 removal. It seems inappropriate to construct and ocean outfall and lock-in the wasteful disposal of water and nutrients at the considerable expense of pumping to a depth of 30 meters when much more beneficial reuse options could be developed.

References:

Healthy Rivers Commission (2000) Independent Inquiry into the Bega River System. Final Report, May 2000

Candelo Sewerage Scheme (2004). Environmental Impact Statement. ERM October 2004.

Imlay Magnet (2002) “Oyster Kill at Wonboyn” 21/3/2002.

Merimbula Sewerage Scheme Augmentation Part 1 (2005). Environmental Impact Statement. ERM December 2005.

Implementing the NSW Algal Management Strategy (1996) State Algal Coordinating Committee. Biennial Report 1994-1996. ISSN 1327-7820. December 1996.

Australian Guidelines for Water Recycling (2006) A publication of the Environment Protection and Heritage Council, the Natural Resource Management Ministerial Council and the Australian Health Ministers’ Conference. Web copy: ISBN 1 921173 06 8
Print copy: ISBN 1 921173 07 6

Figure 1:

Mean Monthly Rainfall and Pan Evaporation (Bega)