Feedback on Draft Far North Coast Regional Water Strategy

[redacted]

NB: **I DO NOT** support the proposed new Dunoon Dam (option 14)

Executive Summery

In Part 1 I establish that you (NSW Government & DPIE) have a greater responsibility to our community than to commercial interests. By consequence you must prioritise the use of bulk water over the delivery of that water. In Part 2, your contribution to population management is encouraged and other strategies such as a system-wide audit needs to inform a renewed and re-budgeted demand management plan, including scarcity pricing and legislative capacity for mandatory water use limits. Pitched against the culturally, ecologically, and socio-economically 'offensive' proposal to dam the Dunoon gorge, Part 3 will canvas the Byron desalination alternative by responding to common issues raised: brine, costs, filters, and energy use. Finally, in Part 4, the author offers a hypothetical scenario of contaminated dam water, to highlight the ultimate vulnerability of your option 14 'Dunoon Dam' idea.

Part 1 of 4

Introduction

I also acknowledge the complexity of what you and the Dept Planning, Industry & Environment (DPIE) does to help provide bulk drinking water throughout the Far North Coast.

Water security is central to our 21st century. We must get this right, but your Option 14's proposed Dunoon Dam is not the way to do it. Dams have been very important in the water security of last century. Dams will continue to be one vital and relevant part of future water security. But dams and the thinking behind them, are also deeply subject to a context of continually improving science, technologies, materials, and engineering in the bulk water supply industry; which are delivering a suite of modern systems fit for the 21st century.

Philosophically, you (DPIE) must expand your thinking about the many ways in which your reliable bulk water supply relates directly to all aspects of community planning. It is not good enough for you to simply assume your mandate of delivering bulk water, and take this as the limit of your responsibilities. We the community, relate to you as our representatives, but **you must find a way to relate to us**. Simply fulfilling your legislated input is NOT a form of relationship. Instead, I'm asking for your professional input into our community's needs – MORE than your legislated responsibility. This is why, your water strategy must prioritise the use of water, over the delivery of water alone.

You can do better than a cost analysis – you can do a lot better. The reason I say this with such confidence, is because despite us all paying for it, bulk water is NOT a commercial product! And neither you nor *Rous County Council* are a profit-driven company! And local population projections are NOT your predicted customers! When you present yourself in a commercial profit-driven way, it comes across as very offensive. While the commercial context is great, community is greater.

Your proclamation to 'supply' bulk water is ONE part of your responsibility. As a member of our community and a Government agency you are equally responsible for the 'demand' of that water. You may at times, find it easier to think of yourself as somehow separate to us, but in fact, you are as much a part of us as anyone in the community. And receiving feedback on your Water Strategy is an intimate opportunity for you to remember, embrace, and truly empower yourself with the only authentic mandate from the only real community to whom you belong.

In Part 2, I will highlight a few aspects of your current thinking which are of particular concern. Followed by Part 3, which will urge you to reconsider the option of the Byron Bay desalination plant. Part 4 offers a short cautionary hypothetical scenario. I finish with my references.

Part 2 of 4

Population

It's my view that you are never going to accurately or professionally address future water security until you can actively join in a "shared responsibility"[i] with us[ii] about what we all want our future human population to actually be – a target. Without an intentional target, we are proceeding into the dark, clutching at straws, believing that a project's financial accountability alone, is good enough: wrong!

If we can responsibly and consciously plan our community's future population target, then we will by definition, be in full control of future water demand. And thus, enjoy full conscious control of future supply needs. As I said above, I do not see your role as being simply responsible for a projected supply/demand scenario, but rather I see you as a leader in the critical decisions that we make as a whole community, and particularly about the sustainable population numbers that we want.

Notwithstanding, you need to be more transparent about your thinking behind suggested projected water demand. It troubles me, that you seem to consistently attribute demand with your bulk water 'connections'. It's not good enough to refer us to our Local Councils and their projections[iii], or assume census based statistical data[iv], and then claim somehow that these projections constitute a prediction. There's a big difference between a projection and a prediction, and I will not allow you to pretend they're the same thing, or try to justify huge 'white-elephant' expenses on an implied projection, inferred as prediction.

Rous County Council claims they'll require an additional 5 thousand megalitres of water per year, as at 2060, based on a projected 42% increase in connections over the next 40 years[v]. If we're presupposing a direct correlation between Rous's 'connection' numbers and our 'population' figures, I could refer to your own 2019 figures which actually suggest a population increase of under 12% over the same 40-year period[vi]. A casual reading of this may interpret Rous's projected demand as an error.

As I've said above, without the certainty of an actual *prediction*, we need to put bulk water supply second to the demand for that water first. Sincerely I ask: Is your Option 14 (proposed Dunoon Dam) planning for, or actually generating, future demand?

Demand Management

On the global stage, we as a country exhibit poor efficiency demand management. Although we have 'improved' from being the 2nd highest fresh water consumer per capita in 2014[vii] to being the 6th highest consumer of fresh water per capita in 2017[viii] (a trend corelating with increased water restrictions and decreased water availability for agriculture[ix]) it's not a particularly prominent source of pride for the driest inhabited continent in the world[x].

Domestically, the costs associated with delivering water has not risen out of proportion to population trends[xi]. While the average Far North Coast (Northern Rivers) resident consume water at 194 litres per person per day[xii], a rate somewhat higher than the average in all South East Queensland (163) and Melbourne (151)[xiii]. A statistical review of water use is a sobering exercise when we consider good human health is sustained by less than 3 litres per day. We can all do better.

You need to insist Rous reverse their apparent budgetary trend of de-funding[xiv], and drastically increase their resource allocations for their *Regional Demand Management Plan*. In fact, you need to help fund a system-wide detailed audit of every individual end-use application for Rous's bulk water. You need to focus specifically on Rous's biggest water users, with particular focus on agricultural/horticultural connections, as this sector represents, by far, many times greater consumption than other sectors[xv]. Though also including your industrial/manufacturing connections; every educational institution (primary, secondary and tertiary schools); and all hospitals.

This audit needs to be prioritised with a view and mission of installing any and all changes for reducing levels of bulk water demand; including making rainwater collection for toilet/laundry/outdoor use compulsory by law. By focusing on the biggest water users, you are also setting examples and precedents for mandatory water saving measures that you need to be implementing for every water user. Despite initial commentary from Rous's Chair discrediting this approach[xvi], experience demonstrates this is the cheapest[xvii] and fastest way to ensure supply-demand balance[xviii]. By focussing on system efficiency, Sydney added an additional 950,000 people without a rise in consumption[xix]. With adequate consultation and proper planning, you can make this happen.

> [Rous's prior investment in demand management has been] "more consistent with a foundational education and communication program rather than a planned and costed investment strategy that recognises that improving the water efficiency of customers and the supply and reticulation system represents the largest, cheapest and quickest way to improve the supply-demand balance" (S. White 2020)[xx]

Many years of demand management incentives, encouragement, competitions, subsidies and grants have demonstrated loudly and clearly that user responsibility for water use is unfortunately not effective while in the form of a voluntary strategy. Moreover, I firmly agree with R. Swinton (2020) that Councils' "advice to limit [tank] water to secondary use works against acceptance of tank use"[xxi]. In other words, you MUST now consider how you are going to make water use efficiency strategies (such as tanks[xxii]) compulsory in legal terms. You need to investigate the process for legislating compulsory water saving measures. You CAN refuse supply, if a users' demand is not in-line with our community's standards – which are also your standards. Access to drinking water is a human right, but equally, wasting drinking water is a crime.

Pricing

Another demand management tool, is 'scarcity pricing'. Best practice water supply pricing requires utilities to provide strong pricing signals to encourage efficient water use[xxiii]. Some water authorities, with encouragement from regulators[xxiv], have already implemented such pricing schemes[xxv]. And in fact, two of our Far North Coast Councils (Richmond & Ballina[xxvi]) can administer at least some form of pricing threshold for water users.

It's really not conceptually difficult, and with adequate resource allocation, I have no doubt, that you can help water authorities implement and administer an appropriate pricing system fit for contemporary society and the water scarcity issues of 21st century Australia[xxvii]. I agree with the *NSW Independent Pricing and Regulatory Tribunal* when they say they want to send users a "pricing signal on the value of water"[xxviii]. At the moment, the signal being sent is that wasting water does not matter. Experience in Australia shows us that scarcity pricing works[xxix]. Again, it's really just about finding the organisational capacity to actually manage demand, rather than simply satisfy demand.

The second part of my feedback has emphasised a system-wide audit in order to achieve control of supply-demand balance. If you cannot, or will not, work with existing water authorities to find the necessary water savings, then my feedback sees no other option, than to offer you a referenced alternative bulk source of bulk drinking water.

Part 3 of 4

Context

Apart from Rous's wilful disrespect towards tens of thousands of years of ancient cultural heritage[xxx] and endangered lowland rainforest ecology[xxxi], the most offensive aspect of your Dunoon Dam (option 14) proposal is your implication that hinterland landscapes, communities, and ecologies can be sacrificed for the benefit of coastal urban development.

This implication is deeply divisive on many levels and comes across as a typical manifestation of a disparity of political power in action. I say this, based on existing socioeconomic disparity among constituent Council LGAs[xxxii] – that is, the intrenched divergence of a rural working-middle class inland zone (Lismore & Richmond Valley), and an urban middle-upper class coastal strip (Ballina & Byron)[xxxiii]. Indeed, experts in the field such as R. Reddy (2009) warn that water is increasingly becoming a political good rather than an economic or social good[xxxiv]. Please do not allow your decisions to become subject to Australia's east-coast political interests, commercial incentives, or developmental pressure coming from the wealthiest of domestic and international cohorts. We are relying on you to honour your professional place among us, by standing upright for our whole community – especially those who actually live here.

I also note that Councils are required under State planning regulations to:

> "Focus development to areas of least biodiversity sensitivity in the region and implement the 'avoid, minimise, offset' hierarchy to biodiversity, including areas of high environmental value."[xxxv]

The best way to provide more bulk water for coastal communities is to work with those coastal communities. Fortunately, we live in an age when a suite of options exists for sourcing bulk water from within the community who actually require it, when they require it[xxxvi] for example:

- Water reuse
- Storm water harvesting
- Groundwater when environmentally safe
- Atmospheric water generation

Specifically, it is my view that within the scope of your *Water Strategy* the option of the Byron Bay desalination plant needs to be further investigated and taken seriously.

Alternative

Popular media often tries to balance perceptions of pros and cons of desalination[xxxvii], as one would expect with any emerging technology. In my assessment, desalination offers the most CONTROL over bulk water supply. Indeed, others in Australia are currently using desalination simply to produce food[xxxviii].

As Rous has already identified[xxxix] the best location of a desalination plant is in the industrial precinct of Byron Bay, alongside the existing sewage treatment plant. Byron Bay was recently subject to water restrictions[xl] and this location has the potential to supply Byron's entire current and projected bulk water needs[xli]. Indeed, desalination technology is proven throughout the world[xlii] as an on-demand solution to ever changing water consumption patterns[xliii].

Brine

Most critics are weary of environmental threats due to the by-product known as 'brine', and rightly so. Brine is a concentration of sea salt, and the chemicals which are used in the desalination process for maintaining internal surfaces and process efficiency. However, this concern is mainly founded on the inherent lack of research which comes with emerging technologies. Indeed, water resource engineer P. Roberts responds by describing the issue of brine as a "red herring"[xliv].

In particular, one of our State's most recent research projects into this issue, actually revealed increased marine life as a result of desalination's brine[xlv]. Dispersal jets referred to as 'duckbill' nozzles can be used to provide adequate dilution[xlvi]. Furthermore, I note Rous's Byron desalination investigation specifically suggests a merger of desalination brine waste with Byron's existing sewage ocean outflow[xlvii].

Costs

Traditional surface-water dams such as Option 14, often seem to be the cheapest option for bulk water supply. However, what may appear to be economically convenient is not always the best option. Times change, technologies change, social expectations change, and our cultural values change over time and they always will.

The Byron desalination investigation nominates two comparable plants in Australia: **Agnes Waters, QLD**[xlviii] producing 1.5MLD at a cost of some $41m[xlix] ($27.3m/MLD) at 2010 prices and **Belmont, NSW**[l] initially producing 15MLD at an estimated cost of $100m[li] ($6.7m/MLD) at 2019 prices. This trajectory of cost per MLD is generally in agreement with other plants[lii] and the indicative estimation of $55m (5.5m/MLD) for the 10MLD Byron desalination plant at 2020 prices. The cost trajectory suggests a slight downward trend – in tune with improving desalination technologies[liii].

The *Australian Water Association* cites the cost to users as follows: "For large-scale municipal seawater desalination projects in Australian, the approximate range is $1-$4 per kilolitre"[liv]. Rous's current retail water charge of $2.43 per kilolitre[lv] and Rous's wholesale price to constituent Councils of $1.66 per kilolitre[lvi] paints a picture of existing 'cost of production' being at least on-par with the 'cost of production' for desalinated water. Moreover, your own staff have disclosed that the Dunoon Dam would actually increase the cost of supplying water by as much as "four times"[lvii].

If you or Rous are going to maintain an argument describing desalination as being not financially viable or a 'white elephant'[lviii] you will need to articulate that argument much more clearly. Indeed, we all need to see a full comparative 'net present value' analysis, before predicting true comparative desalinations costs. Not looking does not constitute not seeing.

Given an indicative Dunoon Dam (option 14) cost of over $220M I do not consider desalination as excessively expensive, especially given the security of rain independent, quality bulk drinking water. Just as desalinated seawater can be produced at incremental rates in proportion to demand, so to, can the cost of desalination be staggered over a period of projected increased demand. This factor also helps deflates the economic risk of allocating budget for future demand projections which may not actually come to pass.

Some extra money spent now on desalination infrastructure, may well actually save a lot of money over the long term. In any aspect of Governmental procurement: What appears to be the most convenient option is rarely the best possible solution. I believe that in economic value for money terms, you can and should, do better than Option 14, the Dunoon Dam.

You might feel concerned by the Byron desalination plant's relative expense, but it's worth the money, for a far superior project outcome, compared to the cheap-and-nasty option represented by out-dated dam technology. In my mind, the cost of desalination is just as manageable as any other municipality scale infrastructure development.

I think the proposed Dunoon Dam option, appears an easiest possible option for you and Rous, because it absolves local Councils from their 'user' responsibilities. My feedback is that our community will not settle for what's easiest for you, because we believe there's more important things in life than costs alone.

Filters

Another contentious issue is the perceived waste generated by virtue of the filtering membranes used in standard seawater reverse osmosis desalination plants. Traditionally, these desalination plants have used polypropylene 'blown cartridge' material wound over a rotating spindle[lix]. Indeed, those traditional types of filters have been a pollution issue[lx] alongside concerns of microplastics generally[lxi]. However, the most up-to-date desalination plants are utilising titanium membranes[lxii], 'cross-flow' filters[lxiii], and other advances to achieve advanced 'clean-in-place'[lxiv] methods for vastly increasing the life of reverse osmosis filters[lxv] far beyond your already anticipated 5 yearly replacement cycle[lxvi].

Some Australian water filtration companies have already commercialised these systems[lxvii]. In this sense, modern seawater desalination filters are effectively **reusable**, eliminating previous problems associated with plastic pollution and the perpetually discarded filters which were once a part of the industry's infancy.

Energy

Energy use is also a perceived issue. Traditional water treatment processes (think dam water) uses about 1kWh per cubic meter of drinking water (per Kl), in comparison desalination plants world-wide can have energy consumption at rates of up to 10kWh per Kl of drinking water. However, the most modern examples of desalination are now achieving rates of as little as 2.5kWh per Kl of drinking water[lxviii]. The downward trend should be obvious, and a post-fossil energy future beckons a range of renewable energy sources for desalination[lxix].

Given the limited electricity supply from the Ewingsdale substation[lxx] I am proposing the use of photovoltaic solar electricity as the primary energy source for the Byron desalination plant, in line with common desalination plants throughout the world[lxxi]. Though you may also want to consider other forms of solar powered desalination as well[lxxii].

For the purpose of this feedback I could use an energy consumption rate of 3.6kWh/Kl which is derived from equivalent coastal desalination technology currently in use at South Australia's *Adelaide Desalination Plant*[lxxiii]. However, to be fair, desalination plants are often attributed with energy consumption of between 3.5 and 5kWh/Kl[lxxiv] so with this in mind I will take Rous's own assessment of 4kWh/Kl of required energy[lxxv]. Moreover, Rous's desalination investigation nominates a 10MLD (Mega-Litres per Day) production quantity which is a fair compromise between current and future (2036) drinking water demand for the population "in the area" of Byron Bay[lxxvi]. Given Rous is projecting an overall need for an additional 13.7MLD (over current demand of 31MLD)[lxxvii]; I therefore infer that their investigated desalination plant, as it is, would produce 73% of their projected bulk water requirements; on par with your Option 14 (Dunoon Dam) proposal.

Generic calculations:

- 10,000 X 4 = 40,000kWh/D (14.6gWh per year) of energy required (as above)
- 180W/m² (18% efficiency)[lxxviii] over 4.5kWh/D[lxxix] = 0.81kWh/D/m² solar production
- 40,000 ÷ 0.81 = 49,383m² or approximately 5 hectares of solar 'farm' space required[lxxx]

The above calculation illustrates a simple fact that Rous's required bulk water could be supplied by either the 253 hectare[lxxxi] footprint of your Dunoon Dam, or the same required bulk water can be supplied with a 5 hectare footprint of solar panels for the Byron desalination plant. That's equivalent of a desalination footprint under 2% of the Dunoon Dam footprint.

But I can hear you saying it's not that simple: what about solar power's intermittency? In response, I urge you to carefully consider the following scientific report from the Europe Commission last year:

> "… the benefits of energy storage in batteries and/or water reservoirs are usually higher than its costs. This suggests that water management policies could consider desalination more broadly and encourage PV-based RO, as a possible win-win and cost-effective strategy to improve water and energy resources security."[lxxxii]

While research is ongoing[lxxxiii] some desalination plants are currently operating with stored renewable energy[lxxxiv] and there's no reason why we cannot do that here in Byron Bay also.

My vision is that the Byron desalination plant will effectively (not literally) disconnect Byron from the Rous bulk supply network, in effect, freeing up current bulk water sources for the remaining network.

Part 4 of 4

Caution

Here's one example of what could happen:

> Let's say you've allowed Rous to build the Dunoon Dam, and it's the year 2040. As predicted, another 20 years of increasing temperatures have also increased the growth of vegetation in the Dunoon Dam catchment, while also the frequency and severity of hot wild-fires. Let's presume the predicted conditions have come to pass, allowing a particularly severe wide-spread hot fire to incinerate the biomass of your Dunoon Dam catchment. The result, is a steady flow of toxic runoff[lxxxv] directly into what you're proposing as our community's primary source of drinking water. The influx of nutrients may cause blue-green algae events and with elevated mercury, iron, and manganese, these serious cyanotoxins significantly slow down the treatment process[lxxxvi]; resulting in unexpected expenses, for delivering what was thought to be the most cost-effective solution.

This is just an example, for sure, but my point is that the context within which last century's dams were built, has changed.

Dams are one cheap option, but they no longer offer the control over water quality, that they once did. Environmental, climatic, and social expectations have changed. Furthermore, I have deliberately not mentioned the vulnerability of dams to the threat of terrorist activity[lxxxvii]. Having all your eggs in one basket (or most your water in one dam), might appear affordable, but it's not wise.

Your *Water Strategy* needs to provide for CONTROL over future bulk water supply. Desalination is the premier example of the most reliable, highest quality bulk water supply on-demand. If Rous cannot achieve supply-demand balance, the best way we can control our future bulk water supply is by taking a known and boundless source (such as sea water) and filtering it (desalination) to the consistent quantity and quality that we require.

Regards,

[redacted]

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References

[i] https://www.pmc.gov.au/sites/default/files/publications/planning-for-australia%27s-future-population.pdf
[ii] Lismore Growth Management Strategy 2015-2035
[iii] https://rous.nsw.gov.au/page.asp?f=RES-AHA-08-73-54
[iv] https://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/3222.0Main%20Features62017%20(base)%20-%202066?opendocument&tabname=Summary&prodno=3222.0&issue=2017%20(base)%20-%202066&num=&view=
[v] This is derived from your "predicted" increase in connections from 46982 to 66922 on page i of your *Demand Forecast* Final Report: https://rous.nsw.gov.au/page.asp?f=RES-AHA-08-73-54
[vi] This projection is derived via Factsheets pertaining to your four constituent LGAs averaged over 20 years, then doubled for equivalency comparison: https://www.planning.nsw.gov.au/Research-and-Demography/Population-projections/Projections
[vii] http://www.data360.org/dsg.aspx?Data_Set_Group_Id=757
[viii] https://www.statista.com/statistics/263156/water-consumption-in-selected-countries/
[ix] https://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/1370.0~2010~Chapter~Water%20consumption%20per%20person%20(6.3.3)
[x] https://www.environment.gov.au/land/rangelands
[xi] https://database.ib-net.org/country_profile?ctry=103&years=2019,2018,2017,2016,2015&type=report&ent=country&mult=true&table=true&chart=false&chartType=column&lang=en&exch=1
[xii] https://rous.nsw.gov.au/cp_themes/default/page.asp?p=DOC-MHV-33-17-88
[xiii] https://abcdiamond.com.au/average-water-use-in-australia/
[xiv] Page I: file:///C:/Users/User/AppData/Local/Temp/Regional_Demand_Management_Plan_2019_2022.pdf
[xv] http://www.fao.org/nr/water/aquastat/data/query/results.html See also: https://www.worldometers.info/water/australia-water/#water-use
[xvi] https://www.echo.net.au/2020/09/rous-county-council-chair-keith-williams-responds-to-annie-kia-and-nan-nicholson/
[xvii] Stuart White 2020: https://www.dropbox.com/s/38zqnfbnwobj6k8/20200904%20Rous%20Water%20RSWP%20v3.pdf?dl=0
[xviii] The Rous Regional Water Efficiency Program 1997, Final report of the Rous Regional Demand Management Strategy: preferred options, Rous County Council, Lismore. See also: Watson R., Turner A and Fane S 2018, Water Efficiency and Demand Management Opportunities for Hunter Water, Institute for Sustainable Futures, Sydney.
[xix] Metropolitan Water Plan 2006, NSW Government. Exec Summary: https://www.dropbox.com/s/pu9898oq6kocrph/NSW%20Govt%202006%20MWP%20summary.pdf?dl=0
[xx] Stuart White, Institute for Sustainable Futures, University of Technology Sydney, 4 Sep 2020 https://www.dropbox.com/s/rak6y23t53kukh6/20200904%20Rous%20Water%20augmentation%20v2.pdf?dl=0
[xxi] Richard Swinton 2020, Clunes, Masters in Ag. & Rural Development: https://www.echo.net.au/2020/07/looking-deeper-into-recycled-water/
[xxii] $220 million dollars - the estimated cost of the Dunoon Dam - could provide more than 73,000 rain water tanks (22,700L) at $3,000 each including installation. That is 1.66GL storage with no evaporation and much increased community resilience for future climate risks. This more than covers the 0.9GL extra water needed by the 12,720 new people predicted to come to our area based on 194L/person/day average water use (Rous).
[xxiii] https://www.industry.nsw.gov.au/water/water-utilities/best-practice-mgmt/pricing
[xxiv] Aither 2017, Urban water pricing reform, Aither Pty Ltd.
[xxv] https://www.smh.com.au/environment/sustainability/sydney-residents-to-pay-less-for-water-until-next-drought-hits-20200615-p552s8.html
[xxvi] Page15: file:///C:/Users/User/AppData/Local/Temp/Rous_County_Council_meeting_agenda_15_April_2020.pdf
[xxvii] https://www.researchgate.net/publication/253778531
[xxviii] https://www.ipart.nsw.gov.au/files/sharedassets/website/trimholdingbay/waternsw_greater_sydney_2015_price_submission_to_ipart_-_frontier_economics_-_scarcity_pricing.pdf

[xxix] https://theconversation.com/why-sydney-residents-use-30-more-water-per-day-than-melburnians-117656
[xxx] https://www.abc.net.au/news/2020-06-19/indigenous-heritage-dam-concerns/12373680 See also: Ainsworth Heritage, Cultural Heritage Impact Assessment, 2011
[xxxi] https://www.echo.net.au/2020/07/opponents-of-proposed-dunoon-dam-speak/ See also: SMEC Australia, Terrestrial Ecology Impact Assessment, 2011
[xxxii] Note Page 5: https://www.nsw.gov.au/sites/default/files/2020-05/Northern%20Rivers%20REDS%C2%A0.pdf
[xxxiii] https://www.parliament.nsw.gov.au/researchpapers/Documents/the-richmond-tweed-region-an-economic-profile/E-BriefRichmond-Tweed2.pdf
[xxxiv] Page 26: https://www.researchgate.net/publication/253778531_Water_Pricing_as_a_Demand_Management_Option_Potentials_Problems_and_Prospects
[xxxv] NSW Department of Planning, Industry and Environment 2019, 'Delivering the plan', Sydney, viewed 03 August 2020: https://www.planning.nsw.gov.au/Plans-for-your-area/Regional-Plans/North-Coast/Delivering-the-plan Direction 2: Enhance biodiversity coastal and aquatic habitats and water catchments
[xxxvi] Consider for example: Kahn, Stuart and Branch, Amos 2019, Potable water reuse: What can Australia learn from global experience?, Water Research Australia Limited, Adelaide: https://www.waterra.com.au/publications/document-search/?download=1806 See also storm water harvesting: https://www.yourhome.gov.au/water/rainwater and groundwater only where environmentally safe: https://www.environment.gov.au/water/publications/what-are-the-ecological-impacts-of-groundwater-drawdown See also this promising example of AWG: https://www.zeromasswater.com/
[xxxvii] https://greengarageblog.org/12-biggest-pros-and-cons-of-desalination?fbclid=IwAR39bHj9gNJEH6t6iWSg5pyaeK4dI8YOTuIZ9iWcPY79mAPxAZjRFQ_qsFE
[xxxviii] https://reneweconomy.com.au/world-first-solar-tower-powered-tomato-farm-opens-port-augusta-41643/
[xxxix] file:///C:/Users/User/AppData/Local/Temp/Desalination_Investigation-1.pdf
[xl] https://www.miragenews.com/rous-brings-in-level-1-water-restrictions-for-byron-shire-from-7-dec/
[xli] Page 23: file:///C:/Users/User/AppData/Local/Temp/Byron-Shire-Drinking-Water-Quality-Management-System-Rev-3.pdf
[xlii] https://iwa-network.org/desalination-past-present-future/
[xliii] https://www.dni.gov/files/documents/Special%20Report_ICA%20Global%20Water%20Security.pdf
[xliv] https://www.nationalgeographic.com/environment/2019/01/desalination-plants-produce-twice-as-much-waste-brine-as-thought/
[xlv] https://www.smh.com.au/national/desalination-plants-are-a-critical-part-of-our-future-20200128-p53vc3.html
[xlvi] http://watertech.com.au/modelling-brine-dissipation-from-the-proposed-adelaide-desalination-plant/
[xlvii] file:///C:/Users/User/AppData/Local/Temp/Desalination_Investigation-1.pdf
[xlviii] https://www.osmoflo.com/en/markets/water-treatment-for-drinking-water/environment-a-key-priority-at-agnes-water-desalination-plant/
[xlix] https://www.cordellconnect.com.au/public/project/ProjectDetails.aspx?uid=761934 See also: https://www.abc.net.au/news/2013-03-15/council-defends-agnes-water-desal-plant/4575980
[l] https://www.planningportal.nsw.gov.au/major-projects/project/10546 Note as at May 2020 the 'State Significant' Belmont desalination project appears to have made application for a doubling of its capacity: https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=RFI-3467%2120200520T052937.821%20GMT
[li] file:///C:/Users/User/AppData/Local/Temp/Belmont_Drought_Response_Desalination_Brochure_FINAL_WEB_ACCESSIBLE.pdf
[lii] Page 51: file:///C:/Users/User/AppData/Local/Temp/Desalination_Investigation.pdf
[liii] https://wdrc.kaust.edu.sa/Pages/Pub-2020-life-cycle-cost-of-dilution-desalination-in-off-grid-locations.aspx
[liv] http://www.awa.asn.au/AWA_MBRR/Publications/Fact_Sheets/Desalination_Fact_Sheet.aspx
[lv] Table 11: file:///C:/Users/User/AppData/Local/Temp/Rous_County_Council_meeting_agenda_15_April_2020.pdf
[lvi] Page 16 & 92: file:///C:/Users/User/AppData/Local/Temp/Desalination_Investigation.pdf
[lvii] Rous general manager, in response to a question from councillor Ekins.
[lviii] https://www.echo.net.au/2013/06/desal-plants-on-water-agenda/
[lix] https://www.gopani.com/what-is-pp-spun-melt-blown-filter-cartridges/

[lx] Page 187: https://www.planning.vic.gov.au/__data/assets/pdf_file/0026/13499/Desalination_Plant_EES_Inquiry_Report.pdf
[lxi] https://www.intechopen.com/books/plastics-in-the-environment/technological-approaches-for-the-reduction-of-microplastic-pollution-in-seawater-desalination-plants
[lxii] http://theleadsouthaustralia.com.au/industries/manufacturing/filtration-system-launches-titanium-membrane/
[lxiii] https://www.aptaquapure.com.au/new/cross-flow-filters/
[lxiv] https://www.process-worldwide.com/what-is-cleaning-in-place-and-how-does-it-work-a-320588/ See also 9.3.14 Page 90: file:///C:/Users/User/AppData/Local/Temp/Desalination_Investigation-1.pdf
[lxv] https://www.marlo-inc.com/sites/default/files/inline-files/Clean%20In%20Place%20Skid%20Brochure%201-388_0.pdf
[lxvi] Page 92: file:///C:/Users/User/AppData/Local/Temp/Desalination_Investigation-1.pdf
[lxvii] https://athenawater.com.au/reverse-osmosis-cip-cleaning-tasks-and-steps/
[lxviii] https://landartgenerator.org/blagi/archives/5948
[lxix] https://www.nationalgeographic.com/news/energy/2015/02/150202-energy-news-renewable-salt-water-drought/
[lxx] 4.1.2 'Key Issue' on Page 17: file:///C:/Users/User/AppData/Local/Temp/Desalination_Investigation.pdf
[lxxi] https://www.waterworld.com/home/article/14071194/desalination-opportunities-and-challenges
[lxxii] "Solar desalination offers a sustainable solution to growing global water demand due to the geographical coincidence between high solar availability and severe water scarcity": https://wdrc.kaust.edu.sa/Pages/Pub-2020-SSS.aspx
[lxxiii] http://www.awa.asn.au/AWA_MBRR/Publications/Water_e-Journal/SEAWATER_DESALINATION__A_SUSTAINABLE_SOLUTION_TO_WORLD_WATER_SHORTAGE_.aspx
[lxxiv] https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/desalination
[lxxv] https://rous.nsw.gov.au/page.asp?f=RES-BTU-68-43-24
[lxxvi] Page 6: https://rous.nsw.gov.au/page.asp?f=RES-BTU-68-43-24
[lxxvii] Page i: https://rous.nsw.gov.au/page.asp?f=RES-AHA-08-73-54
[lxxviii] 18% panel efficiency & sunlight delivers an "energy content" at 1kw/m2: https://www.rpc.com.au/information/faq/solar-power/pv-modules.html
[lxxix] 4.5 kWh of "solar irradiation per square meter every day, averaged out for the year" delivered by the sun in Byron Bay: https://www.heinzsolar.com.au/the-cost-of-solar-panel-installation-for-a-home-in-byron-bay This has taken into account Byron's 108 clear days/year: https://www.byronbay.com.au/about-byron/climate and Byron's 119 rainy days/year: https://www.experienceoz.com.au/en/weather-and-climate-byron-bay See also: https://www.solarreviews.com/blog/peak-sun-hours-explained And also note 5.3kWh "Average Daily Incident Shortwave Solar Energy": https://weatherspark.com/y/144666/Average-Weather-in-Byron-Bay-Australia-Year-Round#Sections-SolarEnergy
[lxxx] The author acknowledgment is made of some additional space required for panel framework/access and naturally the desalination plant's footprint itself – perhaps an additional ~2 hectares.
[lxxxi] Page i: file:///C:/Users/User/AppData/Local/Temp/Dunoon_Dam_Terrestrial_Ecology_Impact_Assessment.pdf
[lxxxii] Abstract: https://www.nature.com/articles/s41598-019-52582-y
[lxxxiii] https://www.sciencedirect.com/science/article/abs/pii/S0957582017303129
[lxxxiv] https://www.waterworld.com/international/desalination/article/16203428/mft-launches-renewable-desalination-unit-with-battery-storage
[lxxxv] https://e360.yale.edu/features/how-wildfires-are-polluting-rivers-and-threatening-water-supplies
[lxxxvi] https://www.nationalgeographic.com/science/2020/01/australian-fires-threaten-to-pollute-water/
[lxxxvii] Page 5: https://www.waternsw.com.au/__data/assets/pdf_file/0008/68543/REPORT-TO-THE-IPART.pdf See also: https://www.express.co.uk/news/uk/125285/Terror-threat-to-UK-water-supply And also: www.nationalterroralert.com/us-dams-getting-safer-but-still-vulnerable-to-terror-attack/