17 April 2020

Dave Owens APM,
Former Deputy Commissioner of NSW Police,

Professor Mary O'Kane AC,
Independent Planning Commission Chair and former NSW Chief Scientist and Engineer

NSW Independent Bushfire Inquiry

Dear Prof O'Kane and Mr Owens,

Thank you for the opportunity to make this public submission to the NSW Independent Bushfire Inquiry.

This submission relates specifically to the following aspects of bushfire impacts, risks and future planning:

- Impacts, risks and planning for municipal **water supply safety and continuity**
- Long-term **water quality** impacts from bushfires in drinking water catchments

This submission addresses the following item from the Inquiry Terms of Reference:

- The preparation and planning by agencies, government, other entities and the community for bushfires in NSW, including current laws, practices and strategies, and building standards and their application and effect.

Furthermore, it provides information that will assist the Inquiry in making recommendations on the key identified topic:

- Preparation and planning for future bushfire threats and risks.

Background information collection

The information presented in the submission was acquired by the following means:

- Previous **international research** collaboration on water quality impacts of extreme weather events including bushfires (Stanford *et al.*, 2014)
- Previous **Australian-focused research** on water quality impacts of extreme weather events including bushfires (Khan *et al.*, 2015; Deere *et al.*, 2017; Khan *et al.*, 2017)
- An Australian water industry **workshop** "Drinking water quality management in bushfire affected catchments" at UNSW CBD Campus, 3 February 2020.
- An Australian water industry **survey**, undertaken in cooperation with the Australian Water Association (AWA), the Water Services Association of Australia (WSAA) and the NSW Water Directorate during February 2020.

Impacts, risks and planning for municipal water supply safety and continuity

During the 2019/2020 bushfires, impacts to water supply safety and continuity were observed in conjunction with many of the major fire fronts. The most immediate impacts were to water treatment plants that lost the ability to continue to provide reliable safe drinking water.

On the far south coast of NSW, in the Bega Valley Shire Council area, the towns of Eden and Boydtown were impacted by a loss of power supplies to chlorination facilities used to treat water from the local reservoir, Ben Boyd Dam. Customers in these towns were advised to boil drinking water for a few days until the power supply could be restored.

Also within Bega Valley Shire Council, disinfection infrastructure was impacted on the Brogo River water supply. This led to a Boil Water Notice to the townships of Quaama, Cobargo, Bermagui, Beauty Point, Fairhaven, Wallaga Lake, Wallaga Lake Heights, Wallaga Lake Koori Village and Akolele, as well as trunk main customers in these areas.

In some cases, untreated water, straight from a river supply was fed directly into drinking water systems in order to maintain adequate water supply volumes for firefighting. Water treatment plants were bypassed due to an inability to keep pace with high volumes of water required. This occurred in a number of southern NSW towns including Batlow, Adelong, Tumbarumba, and the southern region of Eurobodalla Council, stretching from Moruya to Tilba. Residents of these areas were also urged to boil their drinking water.

The Victorian towns of Buchan and Omeo in the East Gippsland region were similarly affected, resulting in "do not drink" alerts in these towns. The Victorian government elected to impose "do not drink" alerts, rather than "boil water alerts" on the assumption that many households would also be without that power that would normally be required to boil water.

In the Shoalhaven region, hundreds of properties were without water for a number of hours due to loss of power to critical sites and no access due to fires. No communications were available due to loss of power to communications towers. Numerous motorised valves and water pumping stations experienced power outages which caused major issues as access to remote sites was limited by the fire activity. Many service reservoirs came under threat. Communications towers also lost power and back-up batteries ran flat, generators were difficult to deploy to remote locations. The Bamarang Water Treatment Plant, which supplies the city of Nowra, also lost power, but it was restored prior to any customer impact.

In northern NSW, the City of Grafton lost pumping ability from a major water storage, Shannon Creek Dam. This loss of access forced Clarence Valley Council to immediately impose stringent (Level 4) water use restrictions on the city, even as bushfires burned nearby.

On South Australia's Kangaroo Island, the Middle River Water Treatment Plant, which supplies more than 1500 customers was rendered temporarily inoperable after sustaining damage by an intense bushfire front that went through the area on the night of 3 January. Residents were urged to conserve water as the defence force delivered an emergency water purification system. Some supplies were also made available from the Island's other water source, a seawater desalination plant, which was not affected.

There are a number of ways in which a community can lose water pressure during bushfire. This can be a consequence of high water demand (to fight fires and from sprinklers left running) exceeding the normal ability of the system to supply water. However, loss of power or direct damage to pumping stations and supply reservoirs is also a high risk during fires.

In a particularly dangerous scenario, communities may be left with insufficient water available for firefighting needs. The fact that these fires came after sustained period of extreme drought meant that running short of water was a real risk for a number of communities. Systems like the Brogo River system (Bermagui/Cobargo) went into a serious bushfire situation with only 10% storage in their dam. At that level, there are risks as to not being able to gravity-release that water, hence possibly not being able to supply it.

From the survey undertaken as background research for this submission, it is clear that were there many service interruptions and many close-calls for serious supply shortages.

Long-term water quality impacts from bushfires in drinking water catchments

Many of the fires burned in forested areas that are also important drinking water catchments for urban centres, including some of Australia's largest cities. Among the most severely damaged was the Warragamba Dam catchment, providing essential drinking water supply for 5 million residents of Sydney. Approximately 30 per cent of the 9000 square kilometre catchment was impacted by two major fires, known as the Green Wattle Creek and Ruined Castle fires. The burnt areas from these fires completely surrounded the Lake Burragorang water storage, formed by Warragamba Dam, as well as the two main inflows, the Wollondilly and Coxs rivers.

Further damage to water catchments occurred just south of Sydney in the Shoalhaven region, with large areas burned in the catchment to the Shoalhaven River and its main water storage Tallowa Dam. Further south again, around the NSW/Victorian border, forests were destroyed in the catchments of Lake Dartmouth and Lake Hume, the two major storages in the upper-Murray River system that maintain water for towns and agriculture along the River Murray, from the Snowy Mountains to Adelaide.

Other important drinking water catchments that sustained damage included The Brogo River (Bermagui, Cobargo), Dungowan Dam (Tamworth), The Orara River (Coffs Harbour), The Nymboida River (Grafton), The Tweed River (Lismore, Kingscliff, Murwillumbah, Tweed Heads), Supplies operated by Rous Water (Byron Bay, Lismore, Ballina), the Central Coast, East Gippsland (Vic) and parts of the Cotter River and Murrumbidgee River catchments for Canberra.

Damage sustained to drinking water catchments presents risks of longer-term impacts to raw drinking water quality in the systems they serve. As forests burn, they produce ash, which accumulates on the forest floor. Both the quantity and composition of this ash is dependent upon the intensity of the fires in the particular location.

For relatively low temperature fires (less than 450ºC), the combustion of organic substances is largely incomplete and the remaining ash is organic-rich, with organic

carbon being the main component (Bodi *et al.*, 2014). At higher temperatures (exceeding 450ºC), most organic carbon is volatilised, producing mineral ash, which has an elevated pH when in solution. It is composed primarily of inorganic carbonates of calcium, magnesium, sodium, potassium, silicon and phosphorous, whereas at temperatures exceeding 580ºC the most common chemical forms are oxides (Bodi *et al.*, 2014). Depending on burn severity, the organic carbon released from some types of wildfire ash can have significantly increased aromaticity, compared to non-burned forest floor detritus (Wang *et al.*, 2015).

It was previously known that major water quality impacts of wildfires are typically experienced after catchment bushfires, during subsequent heavy rainfall events (Stanford *et al.*, 2014). Runoff from burnt areas carries considerable quantities of sediment (Moody & Martin, 2009; Silins *et al.*, 2009; Emelko *et al.*, 2011; Smith *et al.*, 2011), as well as soluble nutrients contained in the ash, which can lead to problems for potable water supplies.

Elevated concentrations of nutrients, most notably nitrogen and phosphorus, are the commonly reported bushfire-derived water quality contaminants (Emelko *et al.*, 2011; Smith *et al.*, 2011). Previous Australian bushfires have been shown to increase catchment nitrogen and phosphorus exports by around 5 to 6-fold, peaking at 15 kg ha^{-1} of total combined nitrogen and 2 kg ha^{-1} of phosphorous (Lane *et al.*, 2008). Nutrients transported as particulate matter have previously been reported to dominate the first post-fire year, with the particulates transporting around 70% of the total combined nitrogen and 90% of the phosphorus.

In addition to water, fire suppressant and retardant chemicals are commonly used to fight large wildfires (Plucinski & Pastor, 2013; Song *et al.*, 2014). Fire retardant formulations may contain a variety of chemical constituents, including ammonia, phosphorus, and cyanide. While these are all naturally-occurring in ash, and detectable in streams from recently-burnt catchments, a relatively minor contribution of these chemicals in streams may also originate from fire retardant use (Crouch *et al.*, 2006; Blake *et al.*, 2012).

Heavy rainfall, beginning on the weekend of 8/9 February immediately followed (even extinguished) some of the most intense bushfires. As predicted, this rainfall caused considerable concerns for many drinking water supplies and observed impacts to a number of them.

Contaminated runoff (high sediment and organic carbon load) was observed to be washed from many drinking water catchments to rivers and reservoirs. Some systems were able to successfully manage these water quality impacts, partially be virtue of the following system attributes:

- Some include very large reservoirs, providing time for sedimentation prior to water reaching drinking water offtakes;
- In some cases, the use of floating silt curtains was able to hold back stratified water layers, providing additional opportunity for sediment to become water-logged and sink;
- Many have the ability to adjust the levels from which water is taken, enabling the best quality water to be targeted and the worst quality water to be avoided;
- Some systems (such as Sydney) are able to draw from multiple sources, thus being able to select sources that were un-impacted and avoid impacted sources for some period of time;
- Some systems draw water from rivers and store it in off-river storages prior to treatment. This provides flexibility to only draw water from the river when the quality is satisfactory and to cease pumping when the quality is poor.

All of these attributes were used to advantage in a number of examples in NSW. In most such cases, significant water quality impacts were avoided. However, not all systems have the attributes listed above, and thus the capacity to effectively manage water quality impacts from bushfire-damaged drinking water catchments.

One system that suffered very significantly was the Brogo River supply in Bega Valley Shire. The Brogo River catchment sustained extreme bushfire damage during the first week of January. With no trees, or other vegetation to stabilise the catchment, sediment, ash and other organic debris washed into Brogo River following more than 150mm of rainfall. The Brogo Dam is an on-river impoundment, thus provides no opportunity to bypass poor water quality.

Raw water from the Brogo Dam varies in quality, but is typically drawn with a turbidity of 5 NTU or less. Immediately following the rainfall and flooding event, raw water turbidity reached 600 NTU, and then remained above 20 NTU for a number of weeks. This water supply system does not have filtration capacity and the water is only treated by chlorination. These high turbidity levels do not comply with the necessary critical control points for safe and effective chlorine disinfection. Thus safe drinking water could not be satisfactorily guaranteed under these operational conditions.

Consequently. Bega Valley Shire Council was required to truck water from Bega (in the north of the Shire) for towns such as Bermagui, Cobargo and Quaama. Furthermore, the Australian Defence Force set up a mobile water treatment plant to filter some of the water supply at the Brogo Dam. In addition to carting water in – which cost more than $300,000– and the mobile treatment plant, the council was pumping water from a creek that it hadn't used to supply the water system for 20 years.

Plans and funding for upgrades, including filtration, to the Brogo Dam supply were in place prior to these events and are expected to proceed, largely funded by the NSW Government's Safe and Secure Water Program.

Recommendations from these experiences

Following these experiences and observations of 'near-misses' to water supplies, I wish to make the following recommendations:

- A key lesson from the recent drought is that we need to reassess the quantities of water that we put aside in storage for "critical human needs". When doing that, these critical human needs are normally focused on regular consumptive needs, such as for drinking water. However, **the need for water for emergency situations, such as fighting bushfires should also be factored into the 'critical human needs'**.

- **A bench-marking system for assessing water supply systems for "resilience" in the face of emergencies**, such as bushfires should be developed so that those which are most vulnerable, or not meeting a satisfactory level of resilience, can be identified. The term 'resilience' in this case, refers to the ability of a water supply system (as a whole) to reliably maintain continuous supply of safe drinking water, and water for other essential purposes, during challenging circumstances such as bushfires.

- All NSW water supply systems should be assessed in accordance with a water supply resilience benchmark and **those identified as not meeting minimum acceptable levels should be identified and addressed**.

- Specific **guidance should be developed for all water supplies to follow and comply with, in order to ensure that they are appropriately prepared for major incidents** including (but not limited to) bushfires. Demonstrated compliance with these Guidelines could become a requirement of the operating licence for catchment managers and drinking water providers.

- A **NSW state-wide regime of "plan, prepare, practice"** should be developed to ensure that water supply managers are appropriately trained, equipped and prepared to respond to emergency situations as they arise.

- Any new requirements on Local Government operated water supplies, including treatment upgrades or additional planning and management will require appropriate **funding support** from the NSW Government.

I would be very happy to provide further explanation of any of the issues that I have raised in this submission. Furthermore, I would have happy to provide copies of any of the references cited.

Yours sincerely,

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