AIR QUALITY – WHERE DO ECOSYSTEMS FIT?

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1. ABSTRACT

When people discuss Air Quality the topics that immediately come to the fore are human health effects, odour, nuisance effects and climate change. The key drivers for these aspects are associated with effects on people via human health and amenity impacts. What is not commonly discussed are the effects to the natural environment. This is also further highlighted through CASANZ itself where the mission is to work towards 'achieving clean air for everyone' and the Special Interest Groups are focused on aspects that impact on humans.

The lack of linking air quality to natural systems is further highlighted through guidance provided on Nature Based Financial Disclosures, which provides future direction to sustainability reporting, where the atmosphere is listed as one of the four natural realms, but no specific biomes are linked to the atmosphere.

Does that mean there are no effects on ecosystems and the natural environments or are we missing an important contribution to environmental management?

Air quality can have effects on natural ecosystems through deposition of contaminants onto land and washing into water and impacts on plant and animal health. Research undertaken by the University of Canterbury (Dominique O'Sullivan et al and Murphy LU et al) has identified that wet and dry deposition of air pollution is a contributor to contaminant loads of stormwater runoff.

The Ministry for the Environment states that air pollution can settle out onto land and water bodies and they can wash into and concentrate in waters or be taken up by plants and animals. Air pollutants can also impair plant growth and have impacts on health in the same way as humans.

But what is the state of knowledge in the New context?

At a national level, the most recent review of effects of air pollutants on ecosystems in New Zealand was prepared in October 2000 to support the 2000 review of the Ambient Air Quality Guidelines (Stevenson et al, October 2000).

The review focused on a number of specific contaminants which were known to have effects on ecosystems and critical loads and levels could be established. The approach followed that developed by the United Nation Economic Commission for Europe as part of the Convention on the Long Range Transboundary Air Pollution. The approach was also adopted by the World Health Organisation in the second edition of the WHO Air Quality Guidelines.

The focus at the time was on the ecological effects of sulphur dioxide, nitrogen dioxide and other nitrogen compounds including ammonia, fluoride and ozone. At the time of the development of the guidelines, effects associated with metals and persistent organic pollutants from air pollution was acknowledged but methods to link atmospheric concentrations or deposition with effects on ecosystems were not yet developed. This is reflected in the 2000 review by Stevenson et al, which focuses on the same contaminants as the WHO guidelines.

Since the NZ Ambient Air Quality Guidelines were issued in 2002, there have been numerous studies on air quality focused on monitoring methods and human health impacts but no further studies on ecological effects.

The NZ experience similarly matches the World Health Organisation, with updates to the WHO Guidelines in 2005 and 2021 focusing on health effects of pollutants including particulate matter, ozone, nitrogen dioxide and sulphur dioxide, with no examining of ecosystem effects.

Even though the UNECE, WHO and MfE in New Zealand have acknowledged that there are likely to be ecological effects associated with Air Pollution, no formal studies have been published to increase

the understand and develop the methods that could be used to establish an understanding of potential ecological effects.

At first glance, the lack of air quality research on ecosystem impacts is not unsurprising considering the significant health effects associated with air pollution and the significant societal cost as evidenced by the findings of the recent HAPINZ Study (Kuschel et al 2022), which estimated that air pollution was responsible for approximately 3,300 premature deaths per year and social costs of $15.6 billion per year.

But looking deeper, over the last 20 years there is a large focus on freshwater from both an ecological perspective as well as a cultural perspective. This focus on improving our waterways throughout New Zealand led to the development of the National Policy Statement for Freshwater Management (NPS-FW) which was first published in 2014. This set out a policy directive to among other things to safeguard the life-supporting capacity, ecosystem processes and indigenous specifics including their associated ecosystems of freshwater.

The NPS-FW also required every regional council to establish freshwater objectives to give effect to the objectives in the national policy statement. Since the NPS-FW was issued in 2014, it was updated in 2017, replaced in 2020 and most recently amended in January 2024. The latest version extends beyond the first version and places the consent of Te Mana o te Wai as the fundamental concept, which sets the health and well-being of water bodies and freshwater system at the top of the hierarchy of obligations.

Therefore, understanding the role of air pollution on freshwater environments is important to achieving the outcomes sought through the implementation of the NPS-FM. There is a wealth of knowledge and science within the Air Quality community that could be applied to an increased understanding of the contribution and variability of air pollution on stormwater and freshwater ecosystems, including the following:

- the understanding of the spatial variability and movement of airborne pollutions within our airsheds including the role that meteorology, terrain, land-use and sources.
- The development of the National Air Particulate Speciation Database based on over 40,000 air samples.
- Air shed modelling and pollution inventories to understand the significance of sources within different airsheds.
- Monitoring of roadways to understand the contribution from major roads on air pollution.
- Ambient air shed monitoring, especially in areas with significant winter biomass burning.

Applying this knowledge and skills to understanding the contribution from both airborne contaminants as well as the role of resuspended road dust to other environment and ecological outcomes has the potential to shorten the curve in terms of knowledge and science and enable a greater understanding of the role that Air Pollution makes on not just humans but the whole ecosystem.

Research in New Zealand undertaken by Dominique O'Sullivan et al and Murphy LU et al at the University of Canterbury School of Engineering on the contribution for wet deposition and particulate matter as well as the nature of the surface within the Christchurch AirShed identified a clear link between air pollution in particular matter and accumulation of copper, zinc and lead in stormwater runoff. But further work is needed to understand the significant of the contribution and variability throughout New Zealand.

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