Emissions reduction plan consultation
Ministry for the Environment
climateconsultation2021@mfe.govt.nz

Kia ora,

Thank you for the opportunity to comment on: ***Te hau mārohi ki anamata, Transitioning to a low-emissions and climate-resilient future.***

Our submission addresses the many opportunities and intersections between water and climate. Considering the climate implications of our water systems has the potential to enable a number of the co-benefits sought in the consultation document; better jobs, new industries, sustainable business models, resilient communities and a healthy environment.

6. Which actions to reduce emissions can also best improve our ability to adapt to the effects of climate change?

Reduction of urban water use. The urban water cycle embodies both greenhouse gases and energy in various forms. Energy is used in the treatment and conveyance of both drinking water treatment and wastewater, and greenhouse gas emissions are produced during the treatment of wastewater following use.

Our urban water system is inefficient in relation to international standards. Approximately 20% of water supplied to networks is lost before making its way into homes[1]. Residential efficiency also lags best practice. Current average water use in New Zealand is 229 litres/person/day[1]. This significantly exceeds the ambitious 75 litres/person/day final cap for 2035 outlined in MBIE's "Transforming operational efficiency framework" in the Building for Climate Change Programme.

Reducing water loss and improving water use efficiency of our urban networks can improve drought resilience, whilst reducing greenhouse gas emissions.

23. Is there anything else you wish to share in relation to government accountability and coordination?

Urban water management in New Zealand is undergoing major reforms. With estimates of between $125 billion and $185 billion of capital expenditure flagged for the years ahead, the associated embodied carbon will have a large impact if not addressed. It is vital government agencies with responsibility for climate change work with their water counterparts to ensure that both climate change mitigation and adaptation are addressed during water reforms.

[1] Water New Zealand 2019-2020 National Performance Review: https://www.waternz.org.nz/NationalPerformanceReview

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There is a need for governments around the world to co-ordinate efforts to address wastewater process emissions. Water industry trade bodies around the world have joined forces in a call for investment to tackle the emissions associated with processing wastewater. Information on the call to action is available here: https://www.water.org.uk/news-item/water-industry-joins-forces-in-global-call-for-investment-to-tackle-process-emissions/.

35. Are there any other views you wish to share in relation to planning?

Availability of urban water supplies needs to be considered when planning for urban intensification. Urban form and building design are large determinants of water use. As urban areas grow, we are beginning to approach the maximum available headroom of conventional water supplies, most notably in Auckland.

Conventional urban water supplies have relatively low associated greenhouse gas emissions. Alternative supply sources such as desalination or importation from distant regions all have significantly higher associated greenhouse gas emissions. For these reasons planning needs to factor in water supply considerations.

A variety of demand management opportunities exist, such as introduction of volumetric water pricing (only used in some areas of New Zealand), strengthening of water efficiency building standards, and urban rainwater harvesting. Rainwater for domestic hot water and non-potable use is gaining momentum overseas. This also offers resilience benefits.

33. In addition to resource management reform, what changes should we prioritise to ensure our planning system enables emissions reductions across sectors? This could include partnerships, emissions impact quantification for planning decisions, improving data and evidence, expectations for crown entities, enabling local government to make decisions to reduce emissions.

Improving data and evidence for methane and nitrous oxide generated by our wastewater networks is needed to enable wastewater service providers (currently local councils) to reduce these emissions. Both the quantum of these emissions and their drivers are not currently understood.

Emissions monitoring equipment for wastewater treatment is expensive, with monitoring equipment ranging from $100,000 upwards. The cost and know how is beyond the reach of council run water supplies to access on their own. Research partnerships and centralised funding are needed to improve data and evidence for assessing these emissions.

Measurement of these emissions is a necessary first start towards understanding how wastewater emissions can be reduced. This knowledge is increasingly important as a significant transformation of our wastewater sector is expected in response to freshwater standards, and water sector reform. A sound evidence base of greenhouse gas emissions associated with wastewater treatment is needed to ensure that future developments in wastewater treatment plants do not add to emissions.

37. How can the research, science and innovation system better support sectors such as energy, waste or hard-to-abate industries?

In the consultation document it is noted, that "For waste sector emissions the quantification and abatement options for wastewater treatment and farm fills require further work, and we welcome feedback on how best to reduce emissions from these activities."

A necessary first step to reducing wastewater emissions is to better understand their quantum and drivers. For this reason, research and technology road maps must have criteria that allow for urban water research to obtain funding. Research questions on understanding and reducing existing emissions have been listed in Carbon Accounting Guidelines for Wastewater Treatment: CH4 and N2O[2] and are outlined in the appendix of this letter.

Equipped with the right understanding, the opportunity to reduce emissions will be extensive. This could include adoption of energy efficiency initiatives and process control changes. For example, in San Francisco a trial is underway using fuel cell technology to create aeration zones in Wastewater treatment plant, negating the need for blowers. Early indications suggest an 85% reduction in electricity required for aeration processes, the largest component of energy use in most plants. Closer to home the Annamox process being trialled by Watercare uses a quarter to a third of the energy required by conventional bugs to achieve the same levels nitrogen treatment[3].

Further opportunities to unlock latent energy contained in our wastewater exist through technologies such as hydrogen fuel, algal farming, and extension of existing biogas facilities. These technologies are at various stages of development internationally and further research and development is needed to accelerate uptake in Aotearoa.

Research is also needed to reduce barriers to the application of biosolids to land discussed in question 49.

38. What opportunities are there in areas where Aotearoa has a unique global advantage in low emissions abatement?

Aotearoa's municipal wastewater treatment plants have a uniquely high proportion of pond-based systems, compared to other developed countries. Better understanding of how methane from these systems can be managed would lead to developments which could

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[2] Water New Zealand, Carbon Accounting Guidelines for Wastewater Treatment: CH4 and N2O https://www.waternz.org.nz/Article?Action=View&Article_id=2078

[3] https://www.stuff.co.nz/environment/climate-news/126901911/homegrown-pooeating-bugs-that-will-make-wastewater-treatment-greener

support less developed countries where this type of wastewater treatment is more widespread.

44. Are there other views you wish to share in relation to behaviour change?

Shifting consumer behaviours in relation to water use has co-benefits for greenhouse gas emissions reductions and future resilience. Current levels of inefficient water use mean there are significant gains to be made in this area. The capacity to easily identify and action water saving behaviours has the additional benefit of empowering individuals to play their part in protecting the environment. Water New Zealand would welcome further engagement with Ministry for Environment to promote the value of water and associated behaviour change.

45. Recognising our strengths, challenges, and opportunities, what do you think our circular economy could look like in 2030, 2040, and 2050, and what do we need to do to get there?

By 2030 we will have a sound understanding of organic waste material flows around New Zealand. Robust trade waste controls will be in place to prevent the contamination of liquid waste streams. Pilot trials of various energy and nutrient recovery will be in place at wastewater treatment plants around New Zealand. This will include co-digestion of organic wastes with wastewater. A robust standards and accreditation will be in place to provide the agricultural community to use agricultural amendments generated from wastewater with confidence.

By 2040 Biogas capture and reuse will have been implemented at all New Zealand's large municipal wastewater treatment plants. Full scale pilots of liquid vehicle fuels from wastewater will be operational. Partnerships between operators of wastewater facilities, fertiliser providers and energy companies will be established to reuse products.

Wastewater treatment plants will have transformed into resource recovery facilities. They will no longer be greenhouse gas emitters, but carbon sinks. Treating a combination of sewage and organic waste materials to generate electricity, liquid fuels and agricultural products.

By 2050 pilots will have moved to full scale commercial operations. Partnerships between operators of wastewater facilities, fertiliser providers and energy companies will be embedded and be providing resources extracted from wastewater back into the circular economy.

46. How would you define the bioeconomy and what should be in scope of a bioeconomy agenda? What opportunities do you see in the bioeconomy for Aotearoa?

Replacement of imported agriculture amendments with products generated from liquid organic wastes. For example, struvite recovered from wastewater, vermicompost such as the products produced by mynoke[4] from wood waste and wastewater sludges, and expansion of the bio boost fertiliser[5] produced in New Plymouth. Water New Zealand estimates that roughly a third of sludges produced from wastewater treatment is currently sent to landfills.

49. What do you see as the main barriers to taking a circular approach, or expanding the bioeconomy in Aotearoa?

Contamination of organic waste is a major barrier to reuse. Both for liquid and solid waste. Prohibition of forever chemical contaminants, and robust trade waste controls are needed to prevent the contamination of liquid waste streams.

Strong source protection controls for organic waste need to be supported by robust consumer accreditation schemes to provide confidence to the agriculture community that recovered organic products will not contaminate soils. This could be achieved through a standards and accreditation scheme based on the Guidelines for Beneficial Use of Organic Materials on Land[6].

Kind Regards,

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[4] https://www.mynoke.co.nz/
[5] http://www.bioboost.co.nz/
[6] Water New Zealand, Guidelines for Beneficial Use of Organic Materials on Landhttps://www.waternz.org.nz/Article?Action=View&Article_id=1212

Appendix: Wastewater emissions knowledge gaps

Item	Subject	Description of knowledge gap
Unquantified GHG sources		
Fraction of influent which is fossil carbon		Currently this is assumed to be '0', but is unknown in NZ. Fossil carbon in the influent would count towards the carbon footprint when converted to CO_2. Further work is recommended to better ascertain the fraction and its relative biodegradability.
Sewer CH_4		IPCC refers to this, but it is excluded. Some allowance is made in the WWTP EF. It is likely to be quite significant according to an Australian Research Council project seeking funding. Further research is recommended to measure, quantify or model in NZ sewer networks.
N_2O emission factors		
N_2O from WWTPs		Recent research indicates that a variable EF for N_2O from WWTP aligns with data. Selecting a single EF (as in these guidelines) is not ideal. Further evidence of this proposed relationship could allow a more accurate, process specific EF to be adopted. It may also help influence future capital expenditure decisions. Further research and data collection is recommended.
N_2O from WWTPs		N_2O plant emissions are influenced by operational conditions and parameters. Guidance describing operational influences and mitigation could influence process control options.
N_2O from non-BNR plants (i.e. BOD only removal plants)		For plants which remove BOD only, the emission factor for N_2O could be lower. However, pathways for N_2O production are still likely present in non-BNR plants. More research is required to develop individual factors for different plant types.
N_2O EF from process models		A detailed review of the suitability, applicability and limitations is needed. For instance, are the process models available (e.g. Biowin)? Are they sufficiently predictive? For different plant types? For the complexity of how plants are operated?
Receiving environments EFs		Specific emission factors for NZ receiving environments. Some research is underway for NZ rivers, but more is needed.
Treatment systems relevant to NZ		
Onsite treatment systems		GHG emissions from small onsite treatment systems are uncertain and there are a range of systems used in NZ, not covered by the IPCC guidance. Given the number of onsite systems in NZ, (1-1.5 million NZr's using onsite systems) more work is necessary. Further work to quantify emissions from these systems is recommended.
Wetlands		It is unclear whether the IPCC EFs for CH_4 and N_2O are meant to be used for wetlands that are used as tertiary systems (which is common in NZ). Further research into the emission factors is needed. There are some differences to Foley's (2010) review e.g. VSSF looks low forN_2O. Processes in wetlands are potentially complex to model. Additional BOD inputs occur which makes it difficult to determine how much of the CH_4 release is attributable to wastewater-derived BOD.
Ponds - Fixation of CO_2 by algae in ponds		Measurement of BOD in effluent where significant algal growth has occurred will also include the carbon assimilated by algae, and therefore not reflect the influent BOD removed through typical pond treatment processes. The same could apply where significant algal content is removed in the solids stream. More research is needed to better understand the complexity here.
Composition data		

Item	Subject	Description of knowledge gap
Maximum methane potential (B_0) of wastewater		B_0 of wastewater heavily influences the CH_4 emissions. This could be better established experimentally in NZ and would provide a more refined measurement.
Maximum methane potential (B_0) of sewage sludge		B_0 of sewage sludge influences the CH_4 emissions from all the sludge treatment and disposal processes in the guidelines. Refining this value through experimental data.
Degradable component of sludges and screenings		Opportunity to improve knowledge in this space.
BOD degradability		Data on how the degradability of BOD and CH_4 potential changes through wastewater treatment processes.
Landfill emissions		Questions around IPCC values for sludge to landfill. DOC and DOCf values for different sludge types are not well described in the default methods available. It is not obvious how these are derived experimentally. Further work with waste industry to determine better values.
IPCC methodology		
CH_4 emissions for combined process plants		In lieu of interstage BOD and sludge data, whole of plant EFs for CH_4 are required. Research into what this should be for various combinations of processes would aid in this.
K_{rem} (sludge removal)		The guidelines propose using the IPCC K_{rem} method at this stage (despite its challenges). Knowledge of BOD removal in the sludge mass is highly uncertain and highly unlikely to be measured. A COD mass balance approach is an alternative (particularly for plants without AD, as it makes the COD mass balance easier). Future area of interrogation or research could be to back calculate values from COD based models to verify or otherwise the suitability of K_{rem} for NZ example treatment processes.
CH_4 emissions		Methane correction factors (MCF) based on BOD removal would align with the 'sequential stages' method adopted in these guidelines. The potential for an alternative approach to more accurately account for CH_4 emissions from aerobic plants (whole plant EFs used currently, where is methanogensis occurring), as well as anaerobic and facultative ponds should be considered.
Anaerobic digestion		
Leakage rates from anaerobic digesters		IPCC defaults may not be representative of the actual leakage rates from anaerobic digesters in New Zealand.
CH_4supersaturation		Supersaturation in digesters, and then fugitive emissions from centrates etc. How do these apply? Is it well reflected in the IPCC values? Further investigation
Other sludge treatment processes		
Aerobic digestion		No data on GHG emissions from this process. This is an omission as these plants exist in NZ.
Sludge treatment		Vermicomposting - Several of the large NZ vermiculture plants are more of pile it up and add a few worms rather than a dedicated plant with controlled worm conditions. Two styles of vermiculture, so probably widely differing values. . The result from these is a leachate entering the ground which will be high in N. there should be low CH_4 as worms are intolerant of anaerobic conditions, but N_2O can be significant. I am concerned that this is a BIG gap in knowledge.
Sludge treatment		Composting - data is currently highly variable. Difficult to recommend the process based on GHG estimate. More data needed.

Item	Subject	Description of knowledge gap
Sludge liming		Consideration of pH when storing and landfilling sludge - what about the effect of liming. How long does the inhibitory impact of high pH last, and is the ultimate CH_4 potential eventually realised in landfill?
Benchmarking		
International EF benchmarking		Literature assessment of identified global EFs, and how these were derived. IPCC or field measurements? Review the most recent literature and studies overseas. Incorporate latest data into future iterations of these guidelines.
Standards alignment		
Anthropogenic biogenic CO_2 emissions		ISO 14064:2018 requires that 'anthropogenic biogenic CO_2' emissions and removals shall be quantified and reported separately from other anthropogenic emissions. Recommend that further guidance be developed to help account for biogenic CO_2 emissions.
Other issues		
Potable water		Sludge landfilled from WTPs. From reservoirs and polymer. Is this covered anywhere? Further guidance required.
Trade / Industrial Wastes		There is little understanding about how industrial wastewaters with characteristics significantly different to municipal wastewaters will emit when compared to the IPCC and proposed NZ guidelines. Measurement of GHG from industrial processes is recommended.
Direct measurement protocols		Protocols to undertake direct measurement of CH_4 and N_2O are not available for New Zealand. If this activity becomes more routine a set of measurement protocols would ensure consistency and robustness of the measurements.