10 August 2016 ID: 1636

Johan Thiart
National Regional Business Sewerage Unit (NRSBU)
Senior Asset Engineer - Solid Waste
Nelson City Council

REQUEST FOR FURTHER INFORMATION - RESOURCE CONSENTS 165114, 165115, 165116

Dear Johan,

Cawthron Institute has been contracted by the Nelson Regional Sewerage Business Unit (NRSBU) to provide further information relating to their application for Resource Consent(s) (165114, 165115, 165116) regarding the environmental effects of accidental wastewater overflows into the Waimea Estuary. The following assessments address questions arising from AEE reports:

- **Cawthron Report No. 2588** (Johnston 2014) Assessment of environmental effects from accidental wastewater overflow on Waimea Estuary receiving environments. Prepared for Nelson Regional Sewerage Business Unit (NRSBU). 31 p. plus appendices.
- **Addendum to Cawthron Report 2588:** (Johnston 2015) Marine water quality classifications and mixing zone determination. Prepared for the Nelson Regional Sewerage Business Unit. 17 p. plus appendices.

Pursuant to section 92(1) of the Resource Management Act (RMA 1991[1]) the following information was requested by the consultant planner (F. Lojkine) to better understand the nature of the activity being proposed, the effects of the activity on the environment, and the way in which any adverse effects of the activity may be mitigated. As such, this letter addresses the following topics:

- Appropriateness of limits and guidelines
- Assessment of ecological effects
- Reasonable mixing zone and dilution factors
- Effects of climate change.

The information requests have particular focus on the assessment criteria specified in New Zealand Coastal Policy Statement (NZCPS 2010[2]), the Resource Management Act (RMA 1991), the Nelson Resource Management Plan (NRMP 2004[3]) and Rutherford et al. (2004[4]). These requests, and my responses, are provided in the following sections.

[1] RMA 1991. Resource Management Act; New Zealand Public Act No: 69. Ministry for the Environment.
[2] NZCPS 2010. New Zealand Coastal Policy Statement. Department of Conservation. 29 pp.
[3] NRMP 2004. Nelson Resource Management Plan (01/09/04) Nelson City Council.
[4] Rutherford K, Zuur B, Race P 1994. Resource Management Ideas: No. 10: "Reasonable Mixing" A discussion of reasonable mixing in water quality management: 15.

Appropriateness of limits and guidelines

"Please comment on the relevance of the Bell's Island coastal permit limits to this particular application and discharge into the Waimea Inlet (given that Bell's Island is required to discharge only on the ebb tide to allow for assimilation and dispersion into the wider coastal environment)."

The Bell island trigger limits were included because:

- they were adopted by Tasman District Council
- Bell Island wastewater discharge characteristics were readily available
- there were no other intermittent wastewater guidelines available for comparison.

While Bell island discharges are treated prior to discharge on the ebb tide, they are chronic (occurring twice daily). The pump station accidental overflows are untreated discharge, but they are likely to occur infrequently (e.g. average three overflows per year: Figure 5 of main application, NRSBU pers. comm.). In general, compared with continuous treated-effluent discharges (such as Bell Island), the overall impact of a one-off untreated discharge is likely to be small (GDSDS 2005[5]).

"Please outline the Trade Waste Bylaw standards that are stated to have been exceeded at times in the effluent inflows to the Saxton pump station (please also include information on BOD as part of this). Please provide information on what is being done to address exceedances of trade waste limits in waste entering the NRSBU system."

Please find attached a table (1) with the pump station data, and trade waste bylaw limits.

[5] Greater Dublin Strategic Drainage Study 2005. Regional Drainage Policies - Volume 3; Environmental Management. Pp 157-189.

Table 1. Median (+/- 1 s.d. of mean) physical and chemical concentrations from eight NRSBU wastewater contributors (1994–2014), with comparable limits and concentrations in grey. Bolded figures = concentrations higher than median Bell Island effluent concentrations. Figures marked with an * are above TW bylaw limits.

		Median effluent concentrations (mg/L)				
Pump stations	Pump station contributors	BOD	COD	SS	TKN	TP
Saxton	NPI	**2100***	**4900***	**750***	31	**13**
	Richmond	180	430	250	42	7
	Alliance	**570**	**1300***	**470***	**100**	**18**
	Wakatu	210	510	190	51	7
	ENZA	**630**	**1800***	**560***	22	3
	Saxton	260	610	290	**61**	**11**
Airport	Airport	280	590	260	49	8
Songer	Songer	**2500***	380	190	34	5
Bell Island median concentrations (1)		450	990	415(5)	54	9
Trade waste (TW) bylaw No.214(6)		1000(2)	>1000 (3)	1000(4)	150	50
NRSBU Water Asset Management Plan (2007) (7)		200-300	400 - 600	260-400		10-20

(1) Median concentrations were obtained from the NRSBU monitoring dataset, ranging from 1994-2014 (most recent sample was November 2013).
(2) Derived from section 2.11.2 of the trade waste bylaw No.214 (1) – 'Where there is no Council treatment system for organic removal of BOD_5, the level shall not exceed 1000 g/m^3 (mg/L), for significant industry this may be reduced to 600 g/m^3 (mg/L)'.
(3) Derived from the trade waste bylaw No.214 (1) discharge application form, which describes this as a 'high' COD concentration. However, this parameter was not listed in the maximum concentrations table (A.1), or elsewhere in the bylaw.
(4) Derived from section 2.3.2 of the trade waste bylaw No.214 (1). The suspended solids content of any wastewater shall have a maximum concentration which shall not exceed 1000 g/m^3 (mg/L).
(5) Due to a typographical error, this figure was incorrectly reported as 990 mg/L in Johnston (2014; Table 3)
(6) Maximum concentrations table (A.1), NCC 2007. Nelson City Council (NCC) Bylaw No.214: Trade Waste. Council NC, ed. pp 47.
(7) Normal domestic waste concentrations. Nelson Regional Sewerage Business Unit Wastewater Asset Management Plan 2007 (WAMP 2007). Prepared by Andrew Iremonger, Rep. No. 64-042-1002. pp. 130.

<u>**Assessment of ecological effects**</u>

"Provide a citation for the framework used to determine the persistence and risk level of effects (Table 8). If this was based on expert opinion please state this".

Table 8 in Johnston (2014), provides a conceptual overview according to expert opinion based on existing information. Risk and likelihood levels were also based on expert opinion, comparing the pump stations relative to each other.

"Please explain what the terms 'temporary/moderately persistent', 'tolerable' and 'moderately persistent edge-effects' mean in specific terms. For example, is persistence of effect over hours, days or weeks? Does 'tolerable' include mortality, relocation or community change effects to some taxa or communities in the estuary? What are the anticipated edge-effects? Do these effects include sedimentation, eutrophication, in-fauna community shifts or toxicity? To what degree? Over what spatial and temporal scale? Please ensure this is discussed with reference to the definition of effect in section 3 of the RMA."

Each of the terms used in Johnston (2014) are based on the specific effects that are listed and described in Table 8. Explanations of individual terms are presented below:

Persistence: Persistence/duration of an effect is described in each cell in Column 4, Table 8. For example:

- 'Temporary' duration, is defined in Table 8 as 'unlikely to persist beyond one tidal cycle'. Tides in New Zealand occur at regular cycles of 12.4 hrs (Heath 1976).
- 'Moderately persistent' is any effect that is considered to be potentially of longer duration where tidal circulation is partially restricted. Some discharge components (e.g. litter) may be manually removed and much of the discharge will reduce overtime due to natural biodegradation; however, some components of the discharge might persist for a sequence of tides or until the next extreme high-tide (king/spring-tide) occurs to flush the area. Tides of this scale typically occur within a monthly time frame. For predicted timing of tides in Nelson see: https://www.niwa.co.nz/natural-hazards/physical-hazards-affecting-coastal-margins-and-the-continental-shelf/storm-tide-red-alert-days-2016

Edge-effects: The edge effects can include all the possible effects listed in Table 8. This includes sedimentation (Row 5), eutrophication (Row 7), and infauna community shifts/toxicity (Row 8). All the effects listed in Table 8 are ***potential*, *adverse, temporary, future***[6] effects (Section 3a, b and c, RMA 1991), and to what degree these effects are likely to occur is based on 'likelihood' and 'risk-levels', which are described in the following paragraphs.

Likelihood of an effect: The terms **'unlikely', 'likely', and 'certain,'** are used to broadly classify the potential of an effect occurring **–** '***Any potential effect of high probability***' (Section 3e and f, RMA 1991) are defined as **'likely'**. Effects considered certain to occur are defined as **'certain'** in Table 8.

Risk levels: The terms **'low, negligible, tolerable, and intolerable'** were used to define the level of 'potential impact' (Section 3e and f, RMA 1991), in Table 8 of Johnston (2014). A

[6] Possible future effects, not occurring all the time.

sliding scale was used based on the spatial scale of effects, number of affected discharge locations, persistence of effects and likelihood of effects. A low risk effect might be considered small scale (e.g. within approximately 10 m of the outfall), and temporary, whereas an intolerable risk would likely be large scale (e.g. further than approximately 100 m from the outfall), with persistent adverse effects. No effects were defined as intolerable in this assessment.

Tolerable: This term was used as a risk level (described above). 'Tolerable' identifies any conditions within the receiving environment that are altered due to the discharge but are likely to recover within a short-time frame (e.g. 1–2 tidal cycles), with no longer lasting or follow-on effects. The specific effects are described in Table 8 (Johnston 2014). The risk is based on evaluating the frequency of an accidental discharge (e.g. a one-off event), persistence, spatial extent and likelihood of an effect occurring, using expert opinion. For example:

- Table 8, row 1[7]: One-off visual effects from increased turbidity, at all outfall locations, in the water column persisting for one tidal cycle is considered a tolerable effect.
- Table 8, row 6: Possible impacts on fish, such as relocation or avoidance, caused by increased turbidity is considered a negligible effect, as it is unlikely to persist beyond cessation of discharge and is likely to be limited to the high tidal zone adjacent to the outfall (until the next extreme-tide).
- Table 8, row 8: Possible mortalities (including community changes), associated with discrete occurrences of high chemical oxygen demand (COD) or toxicity due to elevated concentrations of ammonia, metals or pesticides are expected to be limited to the communities observed inhabiting the edges of the overflow pipe, and where/when there is low tidal circulation (until the next extreme-tide). This was also considered a tolerable risk as estuarine communities are generally tolerant to intermittent environmental fluctuations, and biodegradation of the discharge will gradually reduce possible adverse effects overtime.

Please note: All of the effects defined in Table 8 were based on professional judgement and very limited information (see limitation section, Johnston 2014). However a more accurate assessment would be possible if there were data available from regular receiving environment monitoring.

"Please provide information on whether adverse effects are likely to occur with respect to īnanga or estuarine/marine fish spawning and migrations of freshwater fish (e.g. whitebait and elvers)? Consider occurrence of discharges during critical times for these ecological processes and the relevance of Policy 11 of the NZCPS to any effects on indigenous biodiversity and threatened or at-risk species and habitats (e.g. saltmarsh).
Are there sessile fauna or indigenous flora and fauna that could suffer more than minor effects under low tide scenarios (e.g. at the Wakatu pump station discharge site and high tide areas around the Songer pump station) or in the immediate vicinity of each discharge outfall? If so what is the likely spatial area of these effects and their expected duration and scale?"

[7] Row numbers relate to each effect listed in Table 8. Top row = 1, bottom row = 10.

The Nelson regional plan's 'fisheries, fish spawning, aquatic ecosystems and aesthetic purposes' (FEA) classification standards were specifically designed for the purpose of managing fishing, fish spawning, aquatic ecosystems and aesthetic purposes in the Nelson Coastal management area. Each of these classification standards in relation to the emergency discharges were addressed in Johnston (2015) e.g. temperature, pH, conductivity, dissolved oxygen, and visual effects. Results indicated that emergency discharges of wastewater would be unlikely to have any significant adverse effects on indigenous or threatened aquatic life (as described in Johnston 2014).

Policy 11 of the NZCPS relates to protecting indigenous biological diversity in the coastal environment, by avoiding adverse effects on unique, valued, ecologically significant, vulnerable, threatened, rare indigenous ecosystems, habitats and vegetation types. Appendix 1 of Johnston (2014) specifies the noteworthy flora, fauna, activities, and current ecological threats in Waimea estuary. While there are a number of important habitats and threatened and vulnerable species in the Inlet (listed in Appendix 1), only some are in the vicinity of the outfall locations. Further details on the indigenous biodiversity and threatened or at-risk species and habitats is presented below, with particular focus on migratory and wading birds, saltmarsh habitats, sessile invertebrates and fish spawning.

Saltmarsh

Saltmarsh is a coastal ecosystem in the upper estuary intertidal zone, and is regularly flooded by tides. Salt marsh habitats have been shown to be capable of mitigating adverse effects of nutrient enrichment through experimental applications of sewage sludge (Valliella et al. 1973[8]). Saltmarsh habitat was identified at the Songer Street discharge site, with some patchy non-indigenous/and indigenous saltmarsh flora in the vicinity (a small headland ~10 m north of the Wakatu site), and above the high tide mark to the north and south of the airport discharge site.

If contaminants associated with an accidental discharge were able to reach these upper intertidal marsh flats, they would either be fully diluted via tidal flushing, or restricted to within the high tide zone, reducing with each subsequent tidal exchange until fully flushed with the next springtide (within a 1 month time frame). During this time frame, there are some possible effects to the high tide zone of the saltmarsh listed in Table 8 of Johnston (2014), in particular; litter, nutrient enrichment (increased P and N), unpleasant odour, smothering and increases in potential toxicity. However these effects are considered to be short-term and minor—given that larger visible discharge components (e.g. litter) may be manually removed, concentrations will reduce with each subsequent tidal exchange, and that salt marsh habitats are capable of mitigating nutrient enrichment.

Spawning fish

In general estuaries provide valuable refuge for fish spawning. As specified in Appendix 1 of the AEE, the Waimea Inlet provides habitat for the giant kokopu *Galaxias argenteus*, which has a conservation status of 'At risk—declining' (Goodman et al. 2013[9]). This fish is an uncommon whitebait species, usually running late in the season. Little is known of its

[8]Valliella I, Teal JM, Sass W 1973. Nutrient retention in salt marsh plots experimentally fertilized with sewage sludge. Estuarine & Coastal Marine Science 1: 261-269.

[9] Goodman J, Dunn N, Ravenscroft P, Allibone R, Boubee J, David B, Griffiths M, Ling N, Hitchmough R, and Rolfe J. 2014. New Zealand Threat Classification Series 7. Conservation status of New Zealand freshwater fish, 2013. New Zealand Department of Conservation.

spawning habits. It is thought that the adults migrate to a common spawning site, but spawning has never been observed or any eggs discovered[10]. Galaxiid species (like the giant kokopu) are usually associated with coastal streams and slow flowing waters and pools, preferring some form of instream cover like overhanging vegetation, undercut banks, logs, or debris clusters. The main breeding season for white bait is autumn, where they migrate downstream to estuaries and lay their eggs among plants and grasses. They hatch when re-immersed, either by spring tides or floods, then the larvae float out to sea where they grow over winter, migrating back up stream in spring (DOC 2015[11]).

If a discharge happens to occur during a spawning event which was triggered by a spring tide or flood event, the discharge plume would likely be sufficiently diluted so that any contact would be short-lived as the fish migrates out to sea.

Additionally, as none of the discharge sites have this sort of stream-like habitat in the immediate vicinity, discrete accidental discharges are considered unlikely to have adverse effects on whitebait spawning and/or associated habitats.

Sessile invertebrates

The only invertebrates observed at the discharge sites were mobile crabs and mud snails observed at Wakatu. Appendix 1 of the AEE states that over 112 species of marine invertebrates have been reported in the Inlet. Sessile fauna (immobile) such as mussels, coral or sponges usually require a hard substrate to adhere to, and therefore are not common within the soft, tidally-affected estuarine sediments at these sites. However there were barnacles and isolated clusters of Pacific oysters encrusting the loose rocks surrounding the Saxton Rd outfall. Both of these shellfish are filter feeders, but are also able to close (seal shut) when fresh water inputs are too high (such as would be the case during a wastewater discharge event) or during tidal cycles (when exposed to air). Despite this adaptation, sessile invertebrates (especially in chronic exposure situations) are vulnerable to nutrient over-enrichment, bioaccumulation of wastewater contaminants, and sedimentation (e.g. smothering). However the short discharge exposure time frames and the lack of sessile invertebrates in the high-tide zones where the discharge occurs, means that there are unlikely to be any adverse effects on these organisms. With regards to human health effects, it is recommended that consumption of shellfish in the inlet is banned following a discharge overflow. This can potentially be managed with existing signage, as there is already a permanent advisory (NMDHB) against the consumption/collection of shellfish from the Inlet.

Migratory and wading birds

Waimea Inlet is specified in Appendix 4 of the NRMP (2004) as an area of nationally significant conservation value (ASCV). This is specifically because it has ‘high biological values’ and supports a number of wader species as well as various threatened or endangered species including white heron, banded rail, royal spoonbill and Australasian

[10] https://www.niwa.co.nz/freshwater-and-estuaries/nzffd/NIWA-fish-atlas/fish-species/giant_kokopu
[11] DOC 2015. The whitebaiter’s guide to whitebait. Brochure. Published by: Department of Conservation. Whakatū / Nelson Office

bittern. As indicated in Appendix 1 of the AEE, according to the Fauna Survey Unit of the New Zealand Wildlife Service (DOC 2009[12]):

> "Waimea Inlet is an outstanding site of special wildlife interest, particularly for Anatidae (ducks, geese and swans etc.) and wading birds. Fifty species of waterfowl have been recorded at the estuary."

In addition, 15 migratory species (including those listed in NRMP 2014) that frequent the area were also listed.

Field observations of the Wakatu discharge site, noted birds (tentatively identified as the variable oystercatcher *Haematopus unicolor*) congregating to the west of the outfall (approximately 500 m away). There was also evidence (i.e. track marks) of waterfowl in the soft sediments surrounding the Airport discharge site.

Potential effects relating to the bioaccumulation of chronic wastewater constituents from the food web (i.e. invertebrates to fish to birds) include thinning of eggs, reduced egg hatchability, increased tissue concentrations of metals/hydrocarbons, etc. and even direct mortality. No known studies of tissues concentrations of contaminants in birds from Waimea Inlet have been performed to date. However, the short discharge exposure timeframes, and ability for mobility and avoidance, suggests that there are unlikely be any adverse effects associated with these organisms.

"What are likely concentrations of BOD in the vicinity of the discharge during, immediately following and after 'temporal mixing'? What are the potential ecological effects on estuarine in fauna? Please assess the risks for the Saxton pump station discharge separately."

Dissolved oxygen (DO) is a basic requirement for healthy aquatic ecosystems. However, as no DO concentration data of the wastewater was available, five-day biochemical oxygen demand (BOD_5) has been used to indicate potential impacts of DO reduction over time (see page 10 of Johnston 2015). Direct wastewater DO measurements are recommended to be indicative of immediate short term receiving water impacts.

There are no recommended limits for BOD_5 concentrations in marine receiving waters in ANZECC (2000)[13]. This is likely due to the fact BOD_5 varies with temperature, nutrient concentrations, and the enzymes available to indigenous microbial populations. However, introducing large quantities of biodegradable organic materials, such as sewage or food processing wastes, into surface waters can rapidly consume available oxygen. Some examples of adverse effects of reduced dissolved oxygen concentrations are:

- Marine fauna suffer if dissolved oxygen concentrations fall below 3 to 4 mg/L. Larvae and juvenile fish are more sensitive, requiring even higher concentrations of dissolved oxygen. Prolonged exposure to low dissolved oxygen conditions can

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[12] DOC 2009. Directory of Wetlands in New Zealand: Nelson / Marlborough Conservancy. http://www.doc.govt.nz/Documents/science-and-technical/nzwetlands09.pdf. 155-171 p.

[13] ANZECC 2000 - Australia and New Zealand Guidelines for Fresh and Marine Water Quality. In National Water Quality Management Strategy. Canberra: Australia and NZ Environment and Conservation Council.

suffocate adult fish or reduce their reproductive survival by suffocating sensitive eggs and larvae.

- Fish can become food limited when invertebrate prey decrease in response to reduced oxygen availability.
- Complete lack of dissolved oxygen favours the anaerobic (without oxygen) bacterial activity that produces toxic gases and foul odours often associated with over enriched water bodies.

As specified in Johnston (2014), typical untreated wastewater BOD_5 ranges from 200-300 mg/L (Table 3-7, WAMP 2007[14]), Bell Island median effluent concentration was calculated to be 450 mg/L (over the past nineteen years) , and the Trade Waste bylaw limit is 1000 mg/L (Table 3-7, WAMP 2007). In contrast, typical unpolluted, natural estuarine water BOD_5 concentrations are reported to have BOD_5 concentrations of <5 mg/L (Johnston 2015).

Based on the high BOD_5 concentrations reported in Johnston (2014) for the Songer and Saxton wastewater (Nelson Pine Industries is a contributor to the latter) it may be that the waters of these discharge locations could potentially be susceptible to lower DO concentrations, if adequate dilution was not available. However, according to the calculations in Johnston (2014) a 1:5.6 dilution (wastewater: receiving water) could decrease BOD_5 levels to that of the Bell Island BOD_5 median (treated sewage) concentrations. Given the calculated available dilution of the estuary, and almost complete tidal exchange, dilution is thought to be achievable in the estuarine waters in 1–2 tidal cycles (after the discharge has ceased). Therefore, given this short exposure timeframe, any possible risk to estuarine fauna is likely to be minor. See Table 8 of AEE and pages 10-11 of addendum.

[14] Nelson Regional Sewerage Business Unit Wastewater Asset Management Plan 2007. Prepared by Andrew Iremonger, Rep. No. 64-042-1002. pp. 130.

<u>Reasonable mixing zone and dilution factors</u>

"Please provide additional comment on why a reasonable mixing zone should allow for dispersal time to ensure contaminant concentrations are below Coastal Permit limits or ANZECC guideline values? How does this assist in managing the effects?"

As we can't accurately predict the discharge rate or volume, timing with respect to tidal influences (i.e. flushing and dilution) or composition of an accidental overflow, it was not possible to identify an appropriate spatial mixing zone. This is because the area of a mixing zone will vary greatly depending on these factors. Given this, a temporal mixing zone comprising tidal flushing and dilution is considered an appropriate method to assess, monitor and manage any adverse effects of an accidental overflow. For more detail please refer to Johnston 2015, Section 2.2.

"Please provide comment on effects within the zone of reasonable mixing proposed as '1-2 tidal cycles following the cessation of the discharge' relative to the general requirements of mixing zones by Rutherford et al., 1994 noted in Appendix 2 of the Cawthron report."

Appendix 2 of the Cawthron report (Johnston 2014) states the general requirements for a zone of reasonable mixing in water quality management to be minimising the size of the zone of reasonable mixing (ZRM), confining adverse effects to the ZRM and ensuring the effect within the ZRM are no more than minor.

Rutherford et al. (1994[15]) also describes the size of a mixing zone as being reliant on the conditions within the receiving waters and that the discharges can be controlled (to some extent) by the discharger. However, as the discharges are unplanned), and there is no accurate modelling data available to determine concentrations of contaminants in the receiving water, no spatial mixing zone can be determined in this instance.

According to Norton and Snelder (2003[16]) the exact interpretation of words and phrases such as 'beyond reasonable mixing', can be defined during the consent process on a case-by-case basis and included as a condition on the consent. Given this, as an alternative to a spatial mixing zone, Johnston (2014) suggested relating 'reasonable mixing' to a specified time frame for wastewater contaminant levels to dilute and disperse to concentrations below the 95% level of protection or LoP (ANZECC 2000). Therefore, for the purposes of this discharge application, 'reasonable mixing' in the receiving environment was suggested to be defined as '1-2 full tidal exchanges'. For more detail please refer to Johnston 2015, Section 2.2.

"Please explain the potential ecological effects that could occur within the proposed reasonable mixing zone of '1-2 full tidal cycles following the cessation of discharge' under various high and low tide scenarios".

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[15] Rutherford K, Zuur B, Race P 1994. Resource Management Ideas: No. 10: 'Reasonable Mixing' A discussion of reasonable mixing in water quality management: 15.

[16] Norton N, Snelder T 2003. Options for numeric water quality objectives and standards for lakes and rivers of Canterbury. NIWA Client Report CH2003-026 for Environmental Canterbury and Ministry for the Environment.

While the discharge occurs, and goes through subsequent mixing and dispersal there could temporarily be an occurrence of all the effects listed in Table 8. After 1–2 tidal cycles, these same effects would be expected to be restricted to the high tide zone areas in the immediate vicinity of the outfall.

The discharge scenarios used in Johnston (2014) are worst-case already; i.e. the 24 hr discharge scenario would include discharge over two low tide situations (and two high tide situations).

"The Cawthron report uses the entire estuary volume as a dilution factor to determine cumulative effects of contaminants e.g. BOD, TN, TP, TSS on the estuary as a whole. However, this does not address the potential site specific effects of these contaminants, particularly the Saxton pump station outfall in relation to elevated BOD, metals and other contaminants."

Site specific effects at Saxton are listed in Section 4.3.2 (Johnston 2014[17]), summarised in Table 8. It is very difficult to compartmentalise an intrinsically connected system, particularly without site specific water flow modelling or dye studies to refer to. However, Waimea Inlet experiences almost full tidal flushing, so while using the entire inlet to determine the dilution has its limitations (listed in Johnston 2014, Section 1.1.1), it provides some assurance that overall estuary health would not be compromised.

"Please provide a recommendation for spatial and temporal monitoring in relation to the proposed 1-2 tidal cycle mixing zone following a discharge event."

Ecological monitoring plan (EMP) recommendations have been provided to the applicant and I understand these are presented in the Landmark Lile further information response.

"Please advise the relationship between the diagrams in the Cawthron addendum of potential discharge plumes and the temporal reasonable mixing zone of '1-2 tidal cycles following cessation of the discharge' and how risks to public health and ecology should be managed, given this paradigm."

Public health risk is outside my area of expertise, however it is my understanding that public health will be managed using an application specific public health risk plan (from the Nelson Marlborough District Health Board), and an emergency procedures plan (from Nelson City Council).

Risks to ecology and discharge characteristics can be determined more accurately and managed more effectively using a defined EMP. Recommendations for the EMP have been provided to the applicant, and I understand these are presented in the Landmark Lile further information response.

[17] Johnston O 2014. Assessment of environmental effects from accidental wastewater overflow on Waimea Estuary receiving environments. Prepared for Nelson Regional Sewerage Business Unit (NRSBU). Cawthron Report No. 2588. 31 p. plus appendices.

Effects of climate change

"Please consider the use of climate change predictions, including those produced by MfE to determine the potential increase in frequency and magnitude of further overflow events and plume propagation estimates. Please consider the effects of predicted sea-level rise (resulting from climate change) on the assessment of ecological effects and the functioning of pump stations and the risk of their failure."

Any increases in the frequency and intensity of storm events accompanied by sea-level rise (e.g. predicted mean sea level rise of at least 0.5 m and up to 0.8 m by 2090; MfE 2016[18]) will alter the ecological effects of accidental overflows. It is expected that climate change will likely result in a moderate stress on the Waimea Inlet, where the wetter, warmer, windier climate may contribute to increased runoff and greater nutrient, sediment, and pathogen loads to at-risk coastal waterbodies. These increased loads could increase the vulnerability of Nelson estuaries to eutrophication and its associated nuisance conditions (e.g. low DO, algal blooms). However, if because of climate change, storm events, winds and rainfall do increase, the likely effects of emergency wastewater discharges are likely to be minor, due to the subsequent increases in available dilution/dispersion.

As stated in the Cawthron report (Section 4.1):

"Wet weather events are considered a likely time for pump station malfunction. However, they are also considered likely to result in significant dilution of wastewater strength, effectively increasing the assimilative capacity (via dilution) in the receiving environment. For example, a Christchurch City Council report (URS 2008[19]) estimated the in-pipe dilution of wet weather wastewater into the treatment plant (prior to discharge), to be approximately 4 - 10 times more dilute for faecal coliforms, than during dry weather flows. This dilution was extrapolated to reflect the behaviour of other wastewater constituents.

Dry weather events are considered more likely to have higher relative contaminant loads compared to the more diluted wet weather events. However, the rate of dilution will vary with each location, circumstance and event. Depending on when wastewater is discharged, there will be normal day-to-day variations to the pump station flow rates. Peaks in daily flow for municipal wastewaters occur mid to late morning and early evening."

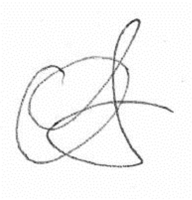
[18] MfE 2016: http://www.mfe.govt.nz/climate-change/how-climate-change-affects-nz/how-might-climate-change-affect-my-region/nelson-and

[19] URS 2008. Assessment of Effects on the Environment: Discharge of overflows from the Christchurch wastewater network to the Avon and Heathcote catchments. Prepared for Christchurch City Council (Network Planning and Asset Management Unit). By URS Corporation New Zealand. 131 p.

I trust these responses address the ecological effects components of the application queries. If you have any further requirements, or would like any more clarification, do not hesitate to contact me directly.

Kind regards,

Scientist



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