IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of applications resource consent by SWDC for discharge of treated wastewater from the FWWTP to Donald's Creek (WAR170229).

STATEMENT OF EVIDENCE OF DR OLIVIER MICHEL NICOLAS AUSSEIL (FRESHWATER QUALITY AND ECOLOGY)

ON BEHALF OF GREATER WELLINGTON REGIONAL COUNCIL

1 March 2019

---

1. INTRODUCTION

1.1 My name is Olivier Michel Nicolas Ausseil (pronounced "O-Say").

1.2 I am Principal Scientist – Water Quality at Aquanet Consulting Ltd, a water quality and ecology consultancy based in Palmerston North and Wellington.

1.3 My evidence is given in relation to the application for resource consents for the discharges from the Featherston WasteWater Treatment Plant ('**FWWTP**') lodged by South Wairarapa District Council ('**SWDC**').

2. QUALIFICATIONS AND EXPERIENCE

2.1 I have the following qualifications and experience relevant to my evidence.

2.2 I hold a PhD of Environmental Biosciences, Chemistry and Health from the University of Provence, France. I also hold a Master of Science Degree of Agronomical Engineering from the National Higher Agronomical School of Montpellier, France, and a DEA (equivalent Masters Degree) in Freshwater Environmental Sciences from the University of Montpellier II, France.

2.3 I have over 15 years' experience in New Zealand as a scientist working in local government and as a private consultant working for regional councils and local authorities, central government and government agencies, and the private sector. Prior to that, I worked as a Research Engineer between 1998 and 2001 for the French Atomic Energy Commissariat during my PhD studies.

2.4 Prior to forming Aquanet Consulting Ltd, I was employed by the Regional Planning Group of Horizons from July 2002 to June 2007, where I held the positions of Project Scientist, Environmental Scientist- Water Quality, and Senior Scientist - Water Quality.

2.5 My responsibilities at Horizons included leading the water quality and aquatic biodiversity monitoring and research programme, providing technical support to policy development and reporting on resource consent applications. I was the primary author of three technical reports underpinning the river classification, river values framework and water quality standards in the notified version of the Proposed One Plan for the Manawatu-Wanganui Region.

2.6 Since July 2007, I have been Principal Scientist at Aquanet Consulting Limited. In this position, I have been engaged by 17 different regional, district or city councils, the Ministry for the Environment, a number of iwi/hapū, the Department of Conservation, Fish and Game New Zealand, and various private companies/corporations to provide a variety of technical and scientific services in relation to water quality and aquatic ecology.

2.7 I am a certified Commissioner under the Ministry for the Environment "Making Good Decisions" programme. I was a Hearing Commissioner appointed by Horizons to hear New Zealand Defence Force's consent applications to discharge treated wastewater from the Waiouru wastewater treatment plant to the Waitangi Stream, in June 2011 and February 2012.

2.8 I have worked as a technical advisor on behalf of the consenting authority, the applicant and/or submitters on well over 150 resource consent applications, compliance assessments and/or prosecution cases for a wide range of activities.

2.9 My work routinely involves providing assessment of effects on water quality and/or aquatic ecology, recommending or assessing compliance with, resource consent conditions, and designing or implementing water quality/aquatic ecology monitoring programmes. I have designed and implemented a large number of monitoring programmes both at the scale of a specific activity and at a wider catchment or regional scale. As part of my previous role at Horizons I redesigned the state of the environment water quality monitoring programme. I also undertook a detailed review of Environment Southland's water quality monitoring programme in 2010 and of Environment Bay of Plenty's in 2012.

2.10 I am currently the Project Manager for the development of the National Environmental Monitoring Standards (NEMS) for discrete water quality monitoring. This particular Standard encompasses all sampling and field measurement procedures, laboratory methods as well as data management and quality control for water quality monitoring in rivers, lakes, groundwater and coastal waters.

2.11 I have authored or co-authored numerous catchment- or region-wide water quality reports for Greater Wellington Regional Council (whole region), Hawke's Bay Regional Council on 7 catchments (2008 and 2016), and for Environment Canterbury on the Hurunui catchment and Pegasus Bay.

2.12 I have authored various reports making recommendations for water quality limits for regional plan change processes, for Horizons Regional Council, Hawke's Bay Regional Council and Greater Wellington Regional Council. I am currently involved in the Gisborne District Freshwater Plan on behalf of the Mangatu/Wi Pere Trusts, and in the Waikato Regional Plan Change 1 on behalf of the Five Waikato River Iwi.

2.13 With regards to municipal wastewater treatment plants I have worked as a technical advisor on behalf of consenting authorities, applicants and submitters on over 35 resource consent applications for discharges of treated domestic wastewater to land and/or water.

2.14 I have specific experience assessing the effects on water quality and ecology of “dual” land/water wastewater discharge regimes (i.e. where the effluent is discharged to land at times and to water at other times). I undertook the modelling and assessment of effects of the proposed discharge regimes for the Feilding WWTP, Shannon WWTP and AFFCO Feilding discharges. I am currently involved in the Best Practicable Option assessment for the Palmerston North City WWTP discharge to the Manawatu River (specifically tasked with water quality and periphyton modelling), the Manawatu wastewater centralisation project and the Marton/Bulls wastewater centralisation project, all of which involve assessment of “dual” land/water discharge systems, not dissimilar to that proposed at Featherston in Stages 1B onwards.

2.15 I am a member of the New Zealand Freshwater Sciences Society (NZFSS) and the Resource Management Act Law Association (RMLA).

2.16 I was the co-recipient of the New Zealand Resource Management Law Association 2016 Chapman Tripp Project Award for an ongoing consultation process associated with the re-consenting of wastewater treatment plant and community water supplies in the Ruapehu District.

2.17 I confirm that I have read the ‘Code of Conduct' for expert witnesses contained in the Environment Court Practice Note 2014. My evidence has been prepared in compliance with that Code. In particular, unless I state otherwise, this evidence is within my sphere of expertise and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

BACKGROUND AND ROLE

2.18 I was engaged by Greater Wellington Regional Council (‘**GWRC**’) in 2012 to provide technical review, on matters relating to surface water quality and ecology, of the consent applications made by SWDC in relation to the FWWTP. Over the last 6 years or so, I have

(a) Reviewed, and provided comments on 3 sets of consent applications (2012, 2014 and 2017). My understanding is that the 2017 (thence referred to as “the Application”) version and associated documents replaces the previous iterations;

(b) Visited the site;

(c) Contributed to S92 requests for further information (2012, 2017), and the review of responses (2012, 2014, 2017)

(d) Participated in a number of technical discussions with SWDC’s representative and consultants.

(e) In April 2018, I produced a technical memo, addressed to Shaun Andrewartha (GWRC), which provides a high-level summary of water quality and aquatic ecology issues

(f) In September and October 2018, I participated in expert conferencing with Mr Keith Hamill and Ms Emma Hammond (visual clarity aspects only). We were tasked with answering a list of questions related to water quality and aquatic ecology provided jointly by GWRC and SWDC. The outcomes of this conferencing are recorded in a Joint Witness Statement ('**WQJWS**') dated 1 November 2018, appended to this report as Appendix A. I can confirm my full agreement with the statements made in that document.

(g) This evidence expands on my April 2018 memo and the WQJWS.

(h) I note that I have not undertaken any additional monitoring or field investigations and my review relies on the data and information provided by SWDC and their advisors.

2.19 I am familiar with the FWWTP, the receiving environment and the south Wairarapa area in general.

3. SCOPE OF EVIDENCE

3.1 My evidence addresses the following matters:

(a) A high-level description of the receiving environment;

(b) A high-level summary of the proposed activities, including proposed stages;

(c) An analysis of the current effects of the FWWTP discharge to Donald Creek, based on existing water quality and ecological data;

(d) An assessment of the potential future effects of the discharge during each of the proposed stages, on the basis of the proposed changes to the current discharge quality and location;

(e) Importantly, my assessment only relates to the effects of the direct discharge from the FWWTP to the surface water of Donald Creek. It does not include the potential effects of the discharges to land on surface water quality, due to insufficient information. These potential effects will need to be considered once the land discharge/ groundwater work is completed;

(f) I have been asked to provide specific comments on whether the discharge meets a number of planning provisions, including RMA S107(1), PNRP Policies 71 and Objective 85. I specifically comment on each of these planning provisions in relation to each proposed stage.

(g) It is important to note that the assessment of the effects of future/proposed stages (1B, 2A and 2B) presented in the WQJWS and in this evidence was conducted on the basis of modelling outputs (discharge quality, quantity and timing, synthetic stream flow and predicted in-stream concentrations) provided by SWDC or their agents. This assessment of effects is subject to change should any of these modelling outputs change. This proviso is particularly relevant given the Groundwater Joint Witness Statement ('**GWJWS**') states that changing management of the discharge to avoid unacceptable effects on groundwater mounding could lead to higher wastewater volumes being discharged to the stream[1].

4. RECEIVING ENVIRONMENT

4.1 The FWWTP currently discharges oxidation pond-treated wastewater to Donald Creek. Donald Creek is a small, spring-fed stream, which takes its source in the foothills of the Tararua Ranges to the north of Featherston township. It flows for approximately 6 km before combining with Abbotts Creek (Otauira Stream). It then runs for approximately 2.5 km before flowing into the Northern end of Lake Wairarapa.

pNRP classifications, and relevant Objectives and Policies

4.2 With regards to the PNRP classifications:

(a) Donald Creek is classified as Class 5 (Lowland, large, draining plains and eastern Wairarapa) and Abbott Creek / Otauira Stream is classified as Class 4[2] (Lowland, large, draining ranges) (pNRP Map 21c).

(b) Abbotts Creek/Otauira Stream and all its tributaries (thus including Donald Creek) are classified as rivers with significant indigenous ecosystems for high macroinvertebrate community health and as habitat for indigenous threatened / at risk fish species under pNRP Schedule F1;

(c) Abbotts Creek is also identified as Important trout spawning water under pNRP Schedule I.

(d) Lake Wairarapa is classified as a lake with outstanding indigenous ecosystem values (pNRP Schedule A2), a regionally significant primary contact recreation body (pNRP Schedule H1)

---

[1] GWJWS, dated 20 December 2018, in response to question 8, p7 of 11.
[2] The WQJWS incorrectly states that the Otauira Stream is class 5 (WQJWS, p11)

4.3 It is noted that the maps contained in the pNRP do not appear to show Donald Creek as a "Significant" stream for either high macroinvertebrate community health (Map 13a) or as habitat for indigenous threatened / at risk fish species (Map 13b). This inconsistency is noted in the WQJWS (p11).

4.4 Advice from the GWRC Policy team is that the maps are not 100% accurate and do not capture all tributaries, and that the words in the schedule take precedence over the maps. On that basis, it is my understanding that both Abbott Creek/ Otauira Stream and Donald Creek are classified as "significant" under Schedule F1.

4.5 pNRP Objective O25 sets (among other things) numerical objectives for periphyton biomass and macroinvertebrate Community Index (MCI) scores. For class 5 rivers (Donald Creek), Table 3.4 sets the following numerical objectives:

(a) Periphyton ≤ 50 mg/m^2 chlorophyll a (not to be exceeded by more than 17% of samples);

(b) MCI ≥ 120 (as a rolling median based on a minimum of 3 years of annual samples collected in summer or autumn)[3].

4.6 pNRP Objective O24 sets that, as a minimum

(a) Significant contact recreation fresh water bodies (thus applicable to Lake Wairarapa) meet the primary contact recreation objectives, including *E.coli* concentrations ≤ 540 *E.coli*/100mL (expressed as a 95th percentile in September to April inclusive);

(b) All other rivers and lakes (thus applicable to Donald Creek and Abbotts/Otauira Stream) meet the secondary contact recreation objectives, including *E.coli* concentrations ≤ 1,000 *E.coli*/100mL (expressed as a median).

4.7 Policy P71 sets water quality standards applicable downstream of point source discharges after the zone of reasonable mixing, including:

(a) A decrease in the Quantitative Macroinvertebrate Community;

(b) A change in pH of no more than ±0.5, and

(c) a decrease in water clarity of no more than 33% in River classes 2 to 6 (thus applicable to Donald Creek and Abbotts/Otauira Stream) at flows less than median flows, and

(d) a change in temperature of no more than 2°C in any river identified as having high macroinvertebrate community health in Schedule F1 (thus applicable to Donald Creek and Abbotts/Otauira Stream)

---

[3] For rivers/ streams not identified as significant under Schedule F1, the periphyton biomass objective is ≤ 120 mg/m^2 chlorophyll a and the MCI objective is ≥ 100.

(e) a 7-day mean minimum dissolved oxygen concentration of no lower than 5mg/L (November to April inclusive), and

(f) (c) a daily minimum dissolved oxygen concentration of no lower than 4mg/L (November to April inclusive).

Donald Creek

4.8 The hydrology of Donald Creek is detailed in a technical report (Butcher, 2016 – Appendix 6A of the Application). With regards to my assessment, the key points are:

(a) Upon leaving the hills, Donald Creek loses flow to groundwater, and reaches in the vicinity of SH2 are often dry in summer;

(b) Further downstream (but still upstream of the FWWTP) Donald Creek gains water from groundwater.

(c) The reach contiguous to the FWWTP does not gain nor loses water from or to groundwater (conservative reach). Stream flow is permanent in this reach, and most of the base flow is derived from groundwater (spring-fed).

(d) Tables 1, 2 and 3 in Butcher (2016) provide estimated flow statistics for Donald Creek, including:

(i) A median flow of 241 l/s

(ii) A 1-day mean annual low flow of 45 l/s;

(iii) An annual minimum flow varying between 24 and 96 l/s.

4.9 The stream reach contiguous to the FWWTP is dominated by hard substrate (gravel and cobble), although with patches of fine sediment in the slower parts of the stream. The substrate in Donald Creek is generally suitable for periphyton attachment and growth.

4.10 Being a spring-fed stream, Donald Creek is expected to present relatively more stable flow, clearer water and more diverse macroinvertebrate communities than a typical similar-sized rain/runoff fed catchment.

4.11 Based on available data, visual clarity in Donald Creek upstream of the discharge is greater than the recreational guideline of 1.6m[4] 58% of the time, and often above 2m (48% of the time).

4.12 Riparian habitat along Donald Creek is patchy. A small bush remnant provides shade and good quality riparian habitat along the reach directly adjacent to the FWWTP. Further upstream, riparian cover is generally absent, whilst reaches with and without riparian cover alternate

[4] ANZECC (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Page 5-3, Table 5.2.2

downstream to the confluence with Abbott Creek/Otauira Stream; bank erosion and direct stock access to these reaches of the stream have been reported (Hamill 2017, Appendix 11A of the Application).

4.13 The following paragraphs describe the ecology and water quality of Donald Creek upstream of the FWWTP discharge. Downstream water quality and ecology are described in Section 6, which describes the current effects of the discharge.

4.14 Based on available data, macroinvertebrate communities in Donald Creek upstream of the FWWTP discharge are generally in moderate to poor condition in summer (Coffey, 2010 and 2013), and in moderate condition in spring (Hamill, 2017). Fingernail clam (*Shaperium sp*.) were found in Donald Creek, both upstream and downstream of the discharge. freshwater mussels (kākahi) were not found at any of the sites, although they are present in Lake Wairarapa and, given the habitat characteristics, they would be expected to be naturally present in Donald Creek.

4.15 Macroinvertebrate Community Index (MCI) scores in Donald Creek upstream of the FWWTP ranged between 69 and 93 in summer and 87 to 98 in spring and were always below the numerical objectives set in Objective 25 for class 5 “significant” rivers (an MCI score of 120).

4.16 Only limited data exists for periphyton biomass. Although the few existing measurements available upstream of the discharge (4-48 mg/m^2) all met the Objective 25 threshold (50 mg/m^2), data is too limited to assess whether Objective 25 is met upstream of the discharge.

4.17 Three fish species were caught during the Spring 2016 survey (longfin eel, shortfin eel and common bully).

4.18 The natural characteristics of Donald Creek would, in its natural state, make it highly sensitive to the potential effects of a point-source discharge. This is tempered by the current, somewhat degraded state of the stream and its margins, making it, in its current state, moderately to highly sensitive the potential effects of a point-source discharge. Specifically:

(a) The small size of the stream means that limited dilution is available

(b) The relatively high water clarity make the stream sensitive to changes in water clarity and/or colour;

(c) The stable flow regime, hard substrate and lack of riparian shading make the stream sensitive to algae growth (caused by nutrient inputs) and heterotrophic/sewage fungus growth (caused by organic matter);

(d) Freshwater clams (*Sphaerid spp*) are known to be particularly sensitive to the toxic effects of ammonia, a contaminant typically present in wastewater discharges.

Abbott Creek/ Otauira Stream

4.19 The Otauira Stream (also called Abbott Creek) also takes its source in the Southern Tararua Range foothills. Upon leaving the hills, it flows for approximately 7 km before flowing into Lake Wairarapa. Its channel along most of this reach has been straightened and heavily modified, with little to no riparian cover. Stream bed substrate is predominantly gravel.

4.20 Only limited data are available on the state of macroinvertebrate communities in the Otauira Stream above the Donald Creek confluence. Macroinvertebrate community indices (MCI and QMCI) were indicative of poor to moderate community health.

4.21 Abbotts/ Otauira Stream supports populations or large longfin eel, as well as shortfin eel , giant kokopu, Cran's bully common smelt and common bully. Longfin eel and giant kokopu have a conservation status of "At Risk".

Lake Wairarapa

4.22 A 2012 GWRC technical report[5] describes Lake Wairarapa as follows:

> *"Lake Wairarapa is the largest lake in the Wellington region (~7,850 ha) and it is the only lake that has had its water quality routinely monitored to date. It is typically very shallow – only around 2.5 m at its deepest point – and is considered to be isothermal (ie, does not thermally stratify). The lake is situated towards the bottom end of the Ruamahanga River catchment, south of Featherston township."*

4.23 With regards to its values, the report notes the following:

> *Lake Wairarapa is part of the largest wetland complex in the southern North Island. It is considered to be of both national and international importance due to its significant cultural, ecological, recreational and natural character values (Airey et al. 2000). A National Water Conservation Order was placed on Lake Wairarapa in 1989 recognising the high ecological values of the area (Robertson 1991).*

> *Historically, Lake Wairarapa and the surrounding wetlands were an important source of mahinga kai and even today the area still has significant traditional and spiritual values and is considered a taonga.*

[5] Milne, J and Perie, A. (2012). Lake water quality and ecology in the Wellington region: State and trends. *Greater Wellington Regional Council, Environmental Monitoring and Investigations Department. ISBN: 978-1-927217-04-7 (print) ISBN: 978-1-927217-05-4 (online).*

The lake and its surrounding wetlands are used for many recreational activities including hunting, fishing, motor boating, yachting, windsurfing, kayaking, camping, picnicking, walking, and nature studies

4.24 With regards to water quality, Lake Wairarapa is described as follows

"Lake Wairarapa has degraded water quality, characterised by elevated concentrations of nutrients and algal biomass and poor water clarity. Application of the TLI for monitoring data collected over 2006–2010 results in the lake being classed as supertrophic, indicative of 'very high' nutrient enrichment. Lake Wairarapa can be considered to be in a poorer than average condition when compared to other similar lakes in New Zealand (ie, lakes in pastoral catchments and other shallow coastal lakes). However, this classification (supertrophic) is heavily influenced by low water clarity and high total phosphorus concentrations which are, in turn, both adversely affected by wind suspension of bottom sediments in this shallow lake. Trophic state is traditionally used as a measure of lake productivity, and for this purpose the trophic state of Lake Wairarapa may be better defined simply in terms of its mean chlorophyll a and total nitrogen concentrations – which both indicate a eutrophic state. Overall then, it may be more appropriate to classify Lake Wairarapa as being eutrophic/supertrophic (K. Hamill pers. comm. 2011)."

5. PROPOSED DISCHARGE AND STAGES

5.1 The activity under consideration is the discharge of treated wastewater from the FWWTP to Donald Creek and (in stages) to land. The application is structured in 4 stages involving different proportions of the effluent being discharged to the stream and to land. Table 1 of the Application (copied below) provides a short description of each stage.

Table 1: Summary of proposed discharge stages (based on Table 1).

Stage Name	Stage Description	Stage to commence (time from commencement of consents):
Stage 1 (1A and 1B)	Plant Optimisation and minor capital works; Discharge of treated effluent to 8ha of Site A and 70 ha of Site B; and commencement of Sewerage Network Rehabilitation Programme	2 years (commencing November of that year)
Stage 2A	Discharge of treated effluent to up to 116ha of Site B (without deferred storage) and completion of Sewerage Network Rehabilitation Programme	5 years
Stage 2B	Discharge of treated effluent to up to 116ha of Site B with deferred storage	13 years

5.2 The implementation of Stages 1A and 1B is detailed in page 86 of the Application. Stages 1A and 1B will be developed in parallel during the first two years of the consent and will be complete within two years of commencement of the consent.

5.3 Effluent quantity and quality are summarized in Section 2 of the Water Quality Assessment report (Mott MacDonald, 2017, Appendix 8). These are not repeated here.

5.4 It is important to bear in mind that my assessment and review of the potential effects during each of the proposed future stages rely fully on the modelling and assumptions described in the Water Quality Assessment report. The predictions made with regards to the potential effects of the river discharge on water quality and aquatic ecology are heavily dependent on the amount and frequency of discharges to the stream, which are in turn dependent on the total amount of wastewater, and the proportion that can be discharged to land.

5.5 It is my understanding that assumptions made in the water quality report with regards to the quantity, frequency and timing of discharges to the stream are in turn based on a modelling assessment undertaken by LEI (2017), involving daily time-step predictions of wastewater volumes, storage, discharge to land and discharge to the river.

5.6 Typically in dual land/water discharge regime, there is a high level of dependency between the wastewater storage (if any), land discharge and river discharge components. In simple terms, it means that if less wastewater than anticipated can be applied to land, then more wastewater will have to be discharged to the river (unless of course more land is made available for wastewater application, or more storage is provided).

5.7 My understanding of the GWJWS is that a range of information and assessments (groundwater mounding, wet year scenario, lower I&I reduction scenario, Stage 1B mounding) are yet to be produced and/or reviewed. Managing discharge to land to manage these effects could lead to increased volumes being discharged to the stream. I cannot comment on land discharge aspects, or on I&I mitigation, as they are outside of my field of expertise, but note that the assessment of effects on water quality and ecology will need to be reviewed if the predicted amounts, frequency or timing of discharges to the stream change materially from those assumed in the Water Quality Assessment report.

6. CURRENT EFFECTS

Mixing

6.1 Hamill (2016) reports that the discharge from the FWWTP was fully mixed across Donald Creek within 45m downstream of the discharge on 10

October 2016, noting that the mixing is likely to be different during summer low flows.

6.2 Given the Stream bed's characteristics downstream of the discharge, it is highly likely that full mixing is achieved well within 100m downstream of the discharge point under all stream flow conditions. It seems reasonable to maintain the existing Zone of Reasonable Mixing of 100m.

Effects on Aquatic Life /macroinvertebrate communities

6.3 The information available includes ecological surveys and associated reports by Coffey (2010 and 2013) and Hamill (October and November 2016, April 2018).

6.4 The surveys undertaken by Coffey (April 2010 and March 2013) were conducted during late summer/autumn following a period of low stream flows, and provide a good representation of effects of the discharge on in-stream biota in summer/autumn. The April 2018 survey was conducted shortly after a flood and should be given little weight. Both the 2010 and 2013 surveys concluded that all macroinvertebrate metrics indicated significantly compromised water quality downstream of the discharge during summer /autumn low flows. There were also indications of small amounts of heterotrophic growths (sewage fungus) and increased periphyton downstream of the discharge.

6.5 Using the state of macroinvertebrate communities as an overall indicator of aquatic life health, these results are, in my opinion, clearly indicative of a significant adverse effect on aquatic life i.e. not meeting the standard set in RMA S107(1)(g) or PNRP Policy 71(a)(i). In my opinion, Objective O25 is also not met with regards to aquatic ecosystem health. These conclusions are applicable to summer/autumn low flow conditions.

6.6 Hamill (2016) undertook two surveys during spring 2016.

(a) The first survey was conducted just over three weeks after a large flood, with stream flows remaining elevated right until the 10 October survey. Conditions leading to the survey were thus not conducive to detecting effects of the discharge (e.g. dilution rates were unusually high, periphyton had insufficient time to establish and organic matter was less likely to deposit), and results of this survey should be seen as a "best case" situation.

(b) The second spring survey (1 November 2016) was undertaken following a longer period of settled stream flows, and is likely to be representative of typical (but not worst-case) spring base flow conditions. Macroinvertebrate results during that survey indicate a significant reduction in QMCI at the first downstream site compared with the two upstream sites. The reduction from 4.3 to 3.2

corresponds to a 26% reduction, i.e. is in excess of the 20% reduction standard set in PNRP Policy 71(a)(i)). It is noted however that other indices (such as MCI and % EPT taxa) only showed small reductions. QMCI scores had recovered to upstream levels at the 650 m downstream site, and there was no evidence of detrimental effects in the Otauira (Abbot) Creek.

Effects on periphyton and sewage fungus

6.7 The information available on periphyton cover, abundance and/or biomass includes ecological surveys and associated reports by Coffey (2010 and 2013), Forbes (February and April 2013) and Hamill (October and November 2016, April 2018).

6.8 Available data clearly indicate that the discharge from the FWWTP causes a significant increase in periphyton biomass and cover in Donald Creek in reaches were periphyton growth is not suppressed by shading (Coffey 2010 and 2013, Forbes 2013 and Hamill 2016 during the November survey).

6.9 Periphyton biomass was measured on only five occasions (February and April 2013, October and November 2016 and April 2018). Of these surveys, two were conducted shortly after a significant fresh and, unsurprisingly, show low periphyton biomass at all sites and should be given little weight

6.10 A formal assessment against the NPSFM (2017) periphyton biomass Attribute or the periphyton component of Objective 25[6] is not possible due to insufficient data. However, results available indicate that the 50 mg/m^2 threshold (Objective 25 and threshold between NPSFM Band A and Band B) was exceeded downstream of the FWWTP discharge in all surveys conducted following a period of stable stream flow (November 2016, February and April 2013). The 120 mg/m^2 threshold (threshold between NPSFM Band B and Band C) was approached in spring 203 and 2016 (Hamill, Forbes) and exceeded in summer 2013.

6.11 Coffey and Forbes also reported the presence of heterotrophic growths (sewage fungus) downstream of the discharge, an indicator of organic enrichment.

Fine sediment/organic matter deposition

6.12 Significant deposition of fine organic matter was noted downstream of the discharge by Forbes (2013) and Coffey (2013), leading to increased embeddedness of the gravel substrate downstream of the discharge (Coffey, 2013).

[6] Both the NPSFM periphyton Attribute and Objective 25 rely on a proportion of samples not exceeding a given threshold on the basis of a minimum of three years of monthly monitoring data. Periphyton biomass was measured on only five occasions (February and April 2013, October and November 2016 and April 2018). Of these surveys, two were conducted shortly after a significant fresh and, unsurprisingly, show low periphyton biomass at all sites and should be given little weight.

6.13 In my opinion, this is clearly caused by the high particulate organic (algae, cyanobacteria and/or bacteria) content of the discharge from the FWWTP, which deposits on the stream bed downstream of the discharge points.

6.14 Deposition of particulate organic matter downstream of oxidation pond discharges is a well-documented mechanism of detrimental effect on macroinvertebrate communities[7]. As a result, a number of regional plans set limits/targets of no more than 5 g/m^3 of Particulate Organic Matter (POM) downstream of wastewater discharges to avoid significant adverse effects on aquatic life.

6.15 It is likely that the deposition of organic matter on the stream bed is a contributing cause of the significant degradation in macroinvertebrate community health noted downstream of the FWWTP discharge.

Dissolved oxygen

6.16 Only daytime spot measurements of dissolved oxygen are available. This only provides a very limited understanding of the effects of the discharge on DO, given that DO fluctuates during the course of a day, with, typically, daily maxima in late afternoon and daily minima at dawn. What data are available indicate a degree of reduction in DO concentrations and saturation in Donald Creek downstream of the discharge, compared with upstream. Summer DO concentrations below 6 mg/L and saturations below 60% have been recorded. Whilst these concentrations are not of direct concern and meet guidelines/NPSFM bottom line (as pointed by Mott MacDonald), they are relatively low for daytime measurements. Given the regular decrease between upstream and downstream, the presence of substantial amounts of deposited organic matter, and the presence of sewage fungus, some degree of oxygen depletion can be expected at night. However, as noted in the WQJWS, data are too limited to quantify this effect[8].

6.17 The NPSFM (2017) DO Attribute and PNRP Policy 71(b) and (c) specifically relate to daily minima DO concentrations, and, in my opinion, the conclusions reached by Mott MacDonald in Section 4.7 (that downstream concentrations were consistently above national bottom line) or in in Appendix 13 B (that PNRP Policy 71b. and 71c. standards are currently met) cannot be reached on the basis of the data available. Night-time, or continuous, DO data would be required to reach such conclusion.

6.18 In my opinion, data available are insufficient to draw any robust conclusions on whether the DO standards in Policy 71(b) or (c) are met downstream of the discharge. Similarly, it is not possible to assess which

[7] For example in Quinn, J. and C. M. Hickey (1993). "Effects of sewage waste stabilisation lagoon effluent on stream invertebrates." Aquatic Ecosystem Health 2: 205-219.
[8] WQJWS, p16.

NPSFM "band" the usptream and downstream sites fall into for the DO attribute.

Water clarity and colour

6.19 The direct effects of a point source discharge on water quality and/or colour are generally assessed by measuring a degree of change in visual clarity or colour. Relevant thresholds and standards include R

(a) RMA S107(1)(d): no conspicuous change in water clarity or colour;

(b) PNRP Pol 71(a)(iii) sets a water clarity change standard of no more than 33% reduction in water clarity for river classes 2 to 6, applicable at river flows below the median flow.

6.20 The 33% reduction in water clarity standard set in Pol 71 is a commonly used numerical translation of a "conspicuous" change in water clarity. Visual clarity changes of no more than 30% to 35% are used as targets/ limits/ standards in a number of regional plans as a numerical translation of S107(1)(d) (e.g. Tukituki Plan Change 6, Horizons One Plan, Canterbury Regional Plan).

6.21 The key difference between S107(1)(d) and Pol 71(a)(iii) is that Pol 71(a)(iii) only applies only at flows below median flow, whilst S107(1)(d) does not mention any time, duration or river flow exclusions. For this reason, I have assessed the effects of the discharge against S107(1)(d) at all stream flows and against Pol 71(a)(iii) at stream flows below median flow.

6.22 I note that the reasons for the flow exclusion in Pol 71(a)(iii) remain unclear: they do not appear to have been documented in the S42A reports produced in relation to the pNRP, queries to the GWRC Policy team were not able to clarify these reasons. I also note that the flow exclusion in Pol 71(a)(iii) is inconsistent with the technical advice supporting the development of these standards[9].

6.23 Data available clearly indicates that the discharge in its current form causes a significant decrease in visual water clarity, as also reported by Coffey (2013) and Forbes (2013). The effects on water clarity are primarily caused by the particulate content of the discharge, as evidenced by the significant increases in turbidity and Total Suspended Solids ('TSS') reported by Forbes (2013) and Mott MacDonald (2017).

6.24 The effects of the discharge on visual water clarity was the subject of a further information requests and responses, and a number of discussions with the Applicant's technical experts. Additional investigations and

[9] E.g. Ausseil (2013). Recommended water quality limits for rivers and streams managed for Aquatic Ecosystem Health in the Wellington Region. Table A: Visual clarity change standards applicable year round, at all river flows.

modelling were undertaken, as summarised in the Mott McDonald letter dated 11 October 2017[10]. The data available was further considered and analysed in expert caucusing with Mr Hamill and Ms Hammond.

6.25 It is estimated that the discharge currently causes reductions in visual water clarity of 33% or more (and thus breaches S107(1)(d)) approximately two thirds of the time, or 242 days per year (Table 1).

6.26 PNRP Pol 71(a)(iii) only applies below median flows, and is estimated to be exceeded approximately half of the year (179 days/year on average).

6.27 The degree of change is regularly well in excess of the 33% change standard, commonly in excess of 50% reduction and, on occasion, in excess of 80% reduction. In my opinion, these changes in water clarity can be considered major, and would be very conspicuous to any observer, and associated with a water colour change.

6.28 The scale of effects on water clarity is expected given the relatively high background water clarity in Donald Creek, the relatively elevated TSS content of the discharge and the very low dilution available under stream base flow conditions (regularly less than 1:10).

6.29 Based on available data, water clarity upstream of the discharge meets the ANZECC (2000) recreational guideline of 1.6m 58% of the time and exceeds 2.0m 48% of the time. Downstream of the discharge, the 1.6m guideline is met 29% of the time, and clarity exceeds 2.0m only rarely (6% of the time).

Ammonia toxicity

6.30 As noted in the WQJWS (p14), it is sensible to use a 95% species protection level for Donald Creek. This corresponds to the NPSFM Band B for ammonia toxicity, and is also the "default" protection level in the ANZECC Guidelines (2000). This corresponds to in-stream total ammoniacal-nitrogen concentrations of less than 0.24 mg/L (as an annual median concentration) and less than 0.40 mg/L (as an annual 95th percentile concentration).

6.31 These concentrations would provide long-term protection for freshwater fingernail clams (*Sphaerium sp.*), but would only be paritally protective of chronic effects on kākahi. A 95th percentile concentration of less than 0.24 mg/L would be required to be fully protective of kākahi.

6.32 Sensitive freshwater bivalve species were specifically searched for in Donald Creek by Hamill. Freshwater fingernail clams (*Sphaerium sp.*) were found, but kākahi (freshwater mussel) were not (noting however that one would expect kākahi to be naturally present in lowland streams in the area).

[10] Mott McDonald, Featherston WWTP Resource Consent Applications - Further Points of Clarification Response to Request for Further Information (s92) 11 October 2017

6.33 In its current form, the discharge causes substantial increases in ammoniacal nitrogen concentration in Donald Creek, causing a shift from NPSFM Band A to Band C. Chronic toxic effects due to ammonia exposure are expected on a range of aquatic life under the current situation.

Nutrients (nitrogen and phosphorus)

6.34 The discharge in its current form causes a substantial increase in the concentration of various forms of nitrogen and phosphorus (as reported in Mott MacDonald and Forbes), leading to a risk of excessive periphyton growth in unshaded reaches of Donald and Abbott Creek, and contributing to nutrient loads exported to Lake Wairarapa from the Abbotts Creek catchment.

6.35 The stable, groundwater derived, flow regime, and hard stream bed substrate makes the Donald Creek particularly sensitive to the risk of excessive periphyton growth due to nutrient addition.

6.36 As noted in paragraph 4.24, Lake Wairarapa is currently in a eutrophied (eutrophic/supertrophic) state, and is below (i.e. worse than) the NPSFM (2014, amended 2017) NPSFM national bottom line.

6.37 A 2012 technical report produced by GWRC[11] provides an assessment of the impact of discharges to Lake Wairarapa on its water quality. This identifies the diffuse nutrient inputs from the extensive agricultural land use in the catchment as the most likely source of nutrient inputs to the Lake. It also identifies a range of significant consented discharges with the potential to contribute to nutrient loadings (section 3.1.3).

> *"The most significant point source discharge is treated municipal wastewater from the township of Featherston; this discharge enters the lake indirectly via Donald and Abbotts creeks. Other significant consented wastewater discharges in the catchment are applied to land and include piggery wastewater from the Windy Farm piggery (supporting approximately 550 pigs) and dairyshed washdown water from 48 dairy farms".*

6.38 The report specifically considers the potential contribution of the FWWTP discharge on the nutrient loading in Lake Wairarapa (section 3.4.2).

> *"There are other sources of nutrients to the lake that also need to be quantified such as treated wastewater from Featherston, which discharges into Donald's Creek, a tributary of Abbott's Creek, approximately 4 km upstream of its confluence with Lake Wairarapa. Milne (2009) demonstrated that this discharge is having a measurable impact on water quality in Donald's Creek and, based on median effluent flows and nutrient concentrations, conservatively estimated the discharge contributes in the order of 5 tonnes/yr and*

[11] Lake water quality and ecology in the Wellington region: State and trends (Feb 2012)

1.25 tonnes/yr of total nitrogen and total phosphorus to the creek respectively (Milne 2009). By way of comparison, mean total nitrogen and total phosphorus loads entering Lake Wairarapa from the Tauherenikau River are estimated to be in the order of 14.7 and 1.5 tonnes/yr respectively. While these load estimates are coarse and the disproportionately higher nutrient loads during flood events are not accounted for, they do suggest that, relative to the largest riverine input to the lake (estimated by Thompson (in prep) to account for around 20% of the surface water input during low flows), the Featherston WWTP is not an insignificant source of nutrients to the lake, particularly during low to moderate flows."

Microbiological water quality (*E. coli*)

6.39 The discharge from the FWWTP has been UV disinfected since 2011, and does not appear to have had a material effect on in-stream microbiological water quality since that time. Specifically, the discharge does not affect the degree to which Donald creek meets Objective O24(b)(ii) in relation to *E.coli*. I do not discuss microbiological water quality further in this evidence.

Benthic cyanobacteria

6.40 Based on the ecological surveys available, benthic cyanobacteria (*Phormidium spp*.) have only been reported occasionally and in very small amounts in both Donald Creek and the Otauira Stream. There are no indications that the discharge from the FWWTP causes any increase in the abundance of cyanobacteria in either stream. Based on these surveys, it seems likely that Objective O24(b)(ii) in relation to benthic cyanobacteria is met both upstream and downstream of the FWWTP discharge.

Temperature and pH

6.41 Policy 71 of the pNRP sets standards relative to pH (Pol71(a)(ii)) and temperature (Pol71(a)(iv)) change caused by point-source discharges. Data presented in Figure 15 of the MottMcDonald water quality report does not indicate any material effect of the discharge on in-stream temperature or pH. I do not discuss effects on temperature or pH further in this evidence.

Additional comments on effects and causes

6.42 In my opinion, the discharge from the FWWTP currently causes significant adverse effects on macroinvertebrate communities in Donald Creek. Effects during summer/early autumn are relatively well documented (Coffey 2010 and 2013). Effects during spring time appear to be less pronounced and less certain.

6.43 These effects are likely to be attributable to a number of well documented key mechanisms of effects on macroinvertebrate communities, which are caused, or "activated", by the discharge, including:

(a) increased deposition of organic matter (smothers interstitial habitat, reduces interstitial DO concentrations),

(b) increased periphyton growth (smothers interstitial habitat)

(c) increased ammonia concentrations (direct toxic effect and nutrient for periphyton growth)

(d) decreased dissolved oxygen concentration/saturation

(e) increase heterotrophic (sewage fungus) growth.

6.44 Reductions in water clarity also have the potential to cause flow-on ecological effects on periphyton and macroinvertebrate communities, by reducing the depth at which sunlight can penetrate the water column (the euphotic depth). For example, in lakes or relatively deep rivers, a change in water clarity can cause a reduction in the depth at which plants are able to grow. However, I do not think the reduction in water clarity is a likely direct cause, or major contributor to, the adverse effects on macroinvertebrate communities, Donald Creek being too shallow to be sensitive to a reduction in euphotic depth. The key direct implication of the water clarity changes is an effect on the aesthetic/ amenity and recreational values of Donald Creek.

6.45 However, the two types effects are, to some extent linked, as they are both caused (in full or in part) by the particulate organic matter content (i.e. algae/cyanobacteria) of the discharge in the stream's water column (effects on water clarity/colour) or deposited on the bottom of the stream (effects on macroinvertebrates, sewage fungus, dissolved oxygen).

6.46 The stable, groundwater derived, flow regime the stream particularly sensitive to the deposition of particulate matter, and the TSS concentration increase measured between upstream and downstream of the discharge are expected to result into significant of deposition of organic matter on the stream bed (on the basis that the TSS in the discharge are predominantly organic matter), and this is confirmed by visual observations reported in the ecological survey reports. In my opinion, the deposition of organic solids from the discharge on to and into the stream bed is probably a leading cause of the effects on macroinvertebrates currently measured, particularly during summer.

6.47 The stable flow regime, lack of riparian shading, hard stream substrate also make the stream sensitive to periphyton growth. The discharge results in significant increases in the concentrations of both nitrogen and phosphorus, and results in increased periphyton growth downstream of the discharge.

6.48 The discharge also results in significant increases in ammoniacal-nitrogen concentrations in Donald Creek, resulting in a shift from NPSFM Band A upstream to Band C downstream, and expected chronic toxic effects on a range of aquatic life.

6.49 In my opinion, most issues arise from the simple fact that the receiving environment is a very small stream compared with the discharge, with a relatively stable flow regime. Dilution factors generally range from 1:5 to 1:20, with most discharge events around 1:10. In my experience dilution factors regularly less than 1:20 for an oxidation pond effluent represent a significant risk of effects.

6.50 Table 1 of the WQJWS provides a summary of current effects (and during subsequent stages).

7. EFFECTS DURING FUTURE /PROPOSED STAGES

Stage 1A

7.1 In my opinion, the effects during Stage 1A will essentially be similar to those described above in relation to the current discharge.

Stage 1B

7.2 During Stage 1B, effluent will be discharged to Donald Creek approximately 51% of the time.

7.3 Compared with the current discharge regime, discharges to the stream are predicted to be relatively minimal in the November to March period, substantially reduced (by two thirds to half) in April, May September and October, and remain unchanged in June, July and August (based on Table 19 of the AEE). Discharges during low stream flows (less than median flow) will be substantially reduced.

7.4 It is my understanding that, when they occur, the discharges will be similar in quality and quantity to the current discharge regime, as there will be no storage.

7.5 As indicated in p22 of the WQJWS, the risk of water quality and ecological effects will be intrinsically linked with the timing of the discharges in relation to the stream's hydrological regime. Put simply, discharges to the stream during wet and unsettled periods (high stream flow, high frequency of freshes/floods) are much less likely to result in adverse effects than discharges during periods of stable and/or low stream flows.

7.6 This is because discharges during stable flow conditions are more likely to result in one or several mechanisms of effects on macroinvertebrate communities (e.g. deposition of organic matter, increased periphyton growth) being present for longer periods of time. Discharges during low stream flows will also be more likely to lead to higher ammonia toxicity and greater effects on water clarity.

Effects on macroinvertebrates and periphyton (Stage 1B)

7.7 The proposed discharge regime is likely to substantially reduce the risk of water quality and ecological effects arising as a result of discharges to the stream during the November to March period, to the point where they are not likely to be more than minor.

7.8 The question is whether the remaining discharges, during the April to October period, are likely to give rise to significant effects on aquatic life. This is addressed in paragraphs 7.9 to 7.11.

7.9 The 2016 spring survey (Hamill, 2016) provides some useful insight. It was undertaken on 1 November, i.e. any effects would have been caused by discharges during October, and the stream flows in the weeks leading to the survey were greater than the median flow. In other words, conditions leading to the survey are likely representative of conditions during which significant discharges to the stream are predicted to occur during stage 1B. This survey indicated that periphyton increased significantly and there were indications of adverse effects on macroinvertebrate and periphyton communities downstream of the discharge (notably exceeding the pNRP Pol 71(a)(i) standard of 20% QMCI reduction, and largely exceeding Objective 25 periphyton biomass threshold of 50 mg/m^2). Effects on macroinvertebrate and periphyton/aquatic life in spring are expected to be more than minor (detectable and of ecological relevance), but probably not over a “significant adverse” threshold. The only way to address this uncertainty is via monitoring during Stage 1B.

7.10 Autumn (April to early June) is identified as presenting the highest risk of effects on aquatic life (WQJWS p23). Adverse effects of the discharge during that period are expected to be more than minor, and possibly significant. The actual risk of effect on any given year will depend to a large extent, on the rainfall/ stream flow regime.

7.11 In winter (Mid-June to Mid-September), effects are expected to generally be no more than minor, although they are expected to be more than minor (detectable and of ecological relevance), but probably not over a “significant adverse” threshold, during a particularly stable/ dry winter (as was 2007).

Effects on visual water clarity

7.12 As indicated in p24 of the WQJWS, the risk of the discharge causing a conspicuous change in visual water clarity will depend on the ratio of discharge rate vs. stream flow, i.e. the dilution available.

7.13 It is estimated that, during Stage 1B, the discharge will cause a conspicuous reduction in visual clarity (taken as a more than 33% reduction) approximately 21% of the time (75 days per year) on average.

7.14 With specific reference to POL 71(a)(iii), it is expected that it will be breached up to 29 days per year on average (8% of the time), noting that this estimate is likely conservative.

Table 2: Estimated frequency of conspicuous reduction in visual clarity (more than 33% reduction) caused by the FWWTP discharge in Donald Creek after reasonable mixing.

Stage	% time discharge to stream (from S92 Table 6)	Days discharge to stream per year	Proportion of the timewhen the discharge will cause a conspicuous change in water clarity	Average number of days per year when the discharge will cause a conspicuous change in water clarity
Current	99%	361	66%	242
1A	90%	329	60%	220
1B	51%	186	21%	75
2A	40%	146	11%	42
2B	4%	14	<1%	2

Ammonia

7.15 Based on the assessment provided by Mott MacDonald (Table 36 of the MottMcDonal WQ report), the discharge during stage 1B is predicted to cause ammoniacal-nitrogen concentration to shift from NPSFM Band A upstream, to NPSFM Band C downstream. Although Stage 1B will lead to a significant reduction in the risk of toxic effects to aquatic life due to ammonia, the risk of chronic toxic effect on sensitive species (freshwater clams and mussels cannot be excluded (WQJWS, p24).

Conclusions on Stage 1B

7.16 The discharge regime proposed for Stage 1B results in substantial reductions in discharge to water during the times when streams are typically most sensitive to the effects of point-source discharges, i.e. low stream flows and summer period. In my experience of similar situations, this is generally enough to ensure that no significant adverse effects occur, or at least that the risk of these effects occurring is assessed as relatively low. However, the very low dilution rates available in Donald Creek, and its relatively stable low are such that:

(a) Conspicuous changes in water clarity are predicted to still occur about one third of the time (21%, 75 days/year). The discharge will not meet S107(1)(d) during that time;

(b) The discharge will also not meet POL 71(a)(iii) when the discharge occurs below median flow;

(c) Ecological effects are not expected to be more than minor in summer, but adverse effects on periphyton, and macroinvertebrates cannot be discounted during the remainder of the year, as follows:

   (i) Significant increases in periphyton growth are likely to occur when flow conditions a sufficiently stable (noting flow does not need to be particularly low, just stable), particularly in spring and autumn;

   (ii) Deposition of particulate organic matter from the discharge is similarly likely to occur when flow conditions are sufficiently stable;

   (iii) Nutrient concentrations (nitrogen and phosphorus) will be elevated downstream of the discharge when it is operating;

   (iv) Based on the above, a risk of detrimental effects on periphyton and macroinvertebrate communities remains during the shoulder periods (spring /autumn) and/or winter during Stage 1B. In my opinion, the effects on aquatic life during these periods is likely be more than minor (i.e. measurable) at times, but it is not possible to say with the information at hand whether significant adverse effects (exceeding POL 71(a)(i) and S107(1)(g) for macroinvertebrates and Objective 25 for periphyton) will actually occur. This uncertainty is typically only able to be addressed through monitoring.

Stage 2A

7.17 Stage 2A will result in further reduction in the frequency of discharge to water compared with Stage 1B, particularly during the shoulder seasons and at flows below median flows.

7.18 Conspicuous effects on water clarity (in excess of a 33% reduction) are still predicted to occur about during Stage 2A, such that

(a) S107(1)(d) will be exceeded about 11% of the time (42 days/year);

(b) POL 71(a)(iii) will be exceeded up to 15 days per year (4% of the time).

7.19 With regards to ecological effects, the type of potential effects (e.g. detrimental effects on macroinvertebrates, periphyton growths) and their key drivers remain essentially the same as described above in relation to Stage 1B.

7.20 However, by further removing the discharge from the stream during the “shoulder” and baseflow periods, stage 2A provides significant additional mitigation of key mechanism of ecological effects (e.g. increased nutrient concentrations, deposition of organic matter, ammonia toxicity risk, etc.), to a point where significant adverse ecological effects seem unlikely, although some measurable effects may still occur during period of stable flows in Donald Creek.

7.21 Ammonia toxicity risks will be further reduced compared to Stage 1B, although chronic toxic effects on sensitive species (freshwater clams and mussels) cannot be fully excluded.

7.22 In my opinion, it is likely that POL 71(a)(i) and/or S107(1)(g) will be met during Stage 2A.

7.23 The MCI component of Objective 25 (MCI>120) will not be met upstream or downstream of the discharge, but this is due to the relatively degraded state of macroinvertebrate communities upstream of the discharge, rather than the effects of the discharge itself. It is uncertain whether the periphyton component of Objective 25 (biomass < 50 mg/m^2) will be met; again this uncertainty is due a lack of data and the discharge itself is unlikely to significantly affect whether Objective 25 is met in Donald Creek during Stage 2A.

7.24 Importantly, the modelling of Stage 2A is based on the assumption that I/I remediation works will completed, and achieve a 35% reduction in Average Daily Flow prior to Stage 2A. Commenting on the likely success of I/I remediation measures in outside my field of expertise; however I note that the assessment undertaken in the WQJWS is entirely dependent on the modelling provided by SWDC, and would have to be revised should the I/I remediation target not be achieved. It may be wise to include a requirement to meet the I/I reduction target in the consent conditions and/or actions to be implemented (e.g. more land or storage) should the target not be met, to ensure that the volume and frequency of discharges to the stream are not greater than described in the application.

Stage 2B

7.25 Stage 2B will result in a near elimination of discharges to water, and the effects of the FWWTP on Donald Creek will be no more than minor during that stage.

8. SUMMARY OF CONCLUSIONS

8.1 Table 2 below provides an overall summary of conclusions with regards to the effects of the FWWTP discharge to Donald Creek, and compliance with various planning provisions.

8.2 It is clear that the current discharge clearly does not meet S107(1)(d) and (g), and also gives rise to significant effects on periphyton growth, deposition of organic matter, dissolved oxygen and the risk of ammonia toxicity.

8.3 It is equally clear that Stage 2B as proposed will ensure that effects on water quality and freshwater ecology will be no more than minor.

8.4 It is also clear that stages 1B and 2A will progressively reduce the frequency and severity of effects. However:

(a) Conspicuous changes in water clarity will still occur a proportion of the time during stages 1B and 2A;

(b) Some more than minor effects on aquatic life are still likely to occur during periods of stable stream flows. The possibility of these effects being significant (in the sense of exceeding107(1)(g) and/or, Pol 71(a)(1)) cannot, in my view be discounted during Stage 1B.

(c) Stage 2A further removes (in comparison with Stage 1B) the discharge from the stream during the “shoulder” periods, and, in my view is unlikely to give rise to significant adverse effects on aquatic life. However, a degree of uncertainty remains;

(d) Uncertainty relative to the significance of effects on aquatic life during stages 1B and 2A will only be able to be lifted via monitoring. This is not an uncommon situation and, in my experience is able to be adequately addressed through consent conditions.

8.5 The above assessment is subject to two important limitations:

(a) The potential effects of future stages were assessed on the basis of effluent quantity and quality, land discharge and storage modelling. The modelling was, as I understand, based on a number of assumptions relative to the capacity of the land to receive wastewater, the success of I&I reduction measures, and future effluent quality and quantity. I understand that these assumptions and associated modelling are still being reviewed. The assessment of effects presented in this evidence (and indeed in the WQJWS) is subject to change should this review lead to any changes in the quality, quantity, or timing of discharges to Donald Creek.

(b) The assessment of effects presented in this evidence (and in the WQJWS) only relates to the effects of the direct discharge from the FWWTP to the surface water of Donald Creek. It does not include the potential effects of the discharges to land on surface water quality, due to insufficient information.

8.6 It may be wise to set consent conditions that require that the assumptions made in the AEE (e.g. degree of I/I reduction target, discharge quality targets, volume and frequency of discharge to the stream during each stage, etc) are met, or that mitigation measures (e.g. additional storage, land, or treatment) are required should the assumptions or targets not be met.

Table 3: Summary of effects of the FWWTP discharge and compliance with various planning provisions during the various proposed stages.

Stage	Macroinvertebrates (controlling factors: periphyton, dissolved oxygen, ammonia, organic matter deposition)			Periphyton	Water clarity	
	RMA 107(1)(g), Significant adverse effects on aquatic life	Pol 71(a)(1) (QMCI reduction less than 20%)	Objective 25 (MCI score >120)	Obj 25 (biomass not exceeding 50 mg/m^2 in more than 17% of samples)	107(1)(d),	POL 71(a) iii
1A	Breached Significant adverse effects in summer and autumn, and possibly in spring. Ammonia toxicity to a range of species	Breached	Not met upstream or downstream, but with significant degradation downstream compared with upstream	Unknown upstream (insufficient data) Likely not met downstream (regular exceedances caused by the discharge	Breached most of the time Often very conspicuous reductions in clarity (>50% reduction) and color changes.	Breached when policy is applicable
1B	Mostly met, except in autumn (for limited periods of time) and possibly in spring. Possible chronic ammonia toxicity to sensitive species	Mostly met, except in autumn (for limited periods of time) and possibly in spring.	Not met upstream or downstream (but effect of the discharge reduced compared to currently)	Unknown upstream Uncertain downstream (likely temporary exceedances caused by the discharge during shoulder seasons)	No effect when not discharging Minor in summer Breached in shoulder seasons and winter (125 days/year)	Minor in summer Breached in shoulder seasons and winter when discharges occur below median flow (up to 29 days per year)
2A	Likely met Possible chronic ammonia toxicity to sensitive species	Likely met	Not met upstream or downstream (but effect of the discharge reduced compared to Stage 1B)	Unknown upstream Uncertain downstream (temporary exceedances during shoulder seasons)	No effect when not discharging Minor in summer Breached when discharge occurs in shoulder seasons and winter (42 days/year)	Exceeded up to 15 days/year (4% of the time)
2B	Met	Met	Not met upstream or downstream (but effect of the discharge minor)	Unknown upstream or downstream (minor difference between upstream and downstream) Uncertain downstream (temporary exceedances during shoulder seasons)	Less than minor/ rare Only occasional exceedances (2 days/year)– Minor overall	Met (no discharges below median flow)