IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER Plan Change 1 – (Waikato and Waipa Catchments) to the Waikato Regional Plan.

PRIMARY STATEMENT OF EVIDENCE OF DEAN CRAIG MILLER, ON BEHALF OF MERCURY NZ LIMITED (SUBMITTER NUMBER 73182)

HEARING BLOCK 1 – TOPIC B

15 FEBRUARY 2019

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1. EXECUTIVE SUMMARY

1.1 I have been engaged by Mercury NZ Limited (**Mercury**) to provide technical evidence in relation to its submissions on Plan Change 1 (**PC1**) to the Waikato Regional Plan.

1.2 My evidence specifically focusses on technical matters relating to the implementation of PC1 to achieve Objective 3, and primarily to the following points in Mercury's submission:

(a) Seeking that an Upper Waikato Freshwater Management Unit (**FMU**) monitoring site is established at or about the FMU boundary.

(b) Seeking redefined sub-catchment areas in Tables 3.11-1, 3.11-2 and Map 3.11-2 to differentiate tributaries from the main stem of the Waikato River, especially for the Upper Waikato River FMU.

(c) Seeking additional tributary sub-catchment monitoring sites with corresponding short-term and long-term numerical targets.

Objective 3

1.3 Mercury's submission (PC1-9511 and PC1-11312) considered that the short term change in water quality sought by Objective 3 will not be fully achieved based on the current sub-catchment areas and priorities identified in Table 3.11-2. This is particularly the case for sediment losses to tributaries in the Upper Waikato FMU where several sub-catchment monitoring points are on the Waikato River main stem. These monitoring locations mask the scale of any problem in the tributaries.

1.4 I support Mercury's submission point that finer scale sub-catchment approach to targets, priorities and monitoring is needed to support short term (and long term) outcomes as set out in Objective 3 (see below).

Freshwater Management Units

1.5 Mercury has raised concerns (PC1-9594) regarding the location of the Upper Waikato FMU monitoring point that is located at the Narrows Boat ramp. This site is well downstream (23 km) of the Upper Waikato FMU boundary, below several large point source discharges and likely some diffuse discharges.

1.6 This matter is discussed by the Officers at paragraph 486 of the section 42A report that refers to the Technical Leaders Group (**TLG**) advice that there are no particular technical issues with the non-coincidence of FMU boundaries and surface water monitoring sites. The TLG's view was that a correction (calculation) approach can be used to account for contaminant inputs between Karapiro and the Narrows.

1.7 My understanding from other TLG reports and the modelling forum discussion is that a monitoring site at the Karapiro Tailrace has been recommended and that monitoring may have commenced. In my opinion, actual monitoring data for the Upper Waikato FMU are preferable for accounting purposes to a "correction" approach and if monitoring were to commence now, then sufficient data for target/limit development at the new site at Karapiro Tailrace would be available within 5 years. I therefore recommend that a FMU monitoring site is established at or about the downstream boundary of the Upper Waikato FMU and that this monitoring commences immediately if it hasn't already.

Spatial extent of sub-catchments

1.8 Further to Paragraph 1.3 above, Mercury considers that the delineated sub-catchments (in PC1) will make it difficult to reconcile and evaluate actions in those sub-catchments against the desired future state water quality targets. This is particularly the case where a single water quality target / monitoring site is to be used to evaluate actions and water quality trends at two or more sub-catchment areas and where the sub-catchment monitoring point for the tributaries is in the main-stem. Examples of where this situation arises include Sub-catchments 33, 64, 66 and 67.

1.9 An indicative map showing possible additional sub-catchment areas was provided with Mercury's submission. The additional sub-catchments sought by Mercury have not been accepted by the Officers (paragraph 508 section 42A report). In my opinion, the Officers have not sufficiently considered submissions on sub-catchment delineation in their report. My reasoning for this view is in the main body of my evidence (refer to paragraphs 4.12 to 4.14).

1.10 In my opinion, a finer scale sub-catchment management approach (targets and monitoring) is needed to ensure more informed decision making, to efficiently prioritise sub-catchments, and to develop targeted actions and interventions to assist in the improvement in water quality within the Upper

Waikato FMU. I therefore recommend that the scale and extent of sub-catchments is reconsidered. In my opinion, this should include a reassessment of the monitoring programme going forward, the sites included, the timeframe and frequency for monitoring programme and data review and how monitoring and catchment actions will/can adapt to the data generated and associated trends. My recommendations and proposed changes to address this are provided in my evidence (Paragraph 4.18).

Targets and limits (Table 3.11-1)

1.11 Mercury's submission (PC1-9679) opposed the Targets and Limits in part but this was largely related to its view that further sub-catchment delineation is needed. The Officers' view is that it is not appropriate to include water quality targets for sites where there are no current state data and that it is more appropriate to include additional water quality monitoring sites in future planning cycles.

1.12 I agree with the Officers' view that targets for any new sites will not be able to be established following the same methodology as per PC1. However, in my view this should not preclude the development and implementation of an appropriate sub-catchment management regime including targets during the PC1 planning cycle, which should look forward rather than back.

1.13 If monitoring were to commence now, then sufficient data for new sites would be available within 5 years. In my view, an appropriate monitoring regime should commence as soon as possible to facilitate finer scale sub-catchment target development. My recommendations and proposed changes to address this are provided in my evidence (Paragraph 4.18), including an amendment to Method 3.11.4.10 in PC1.

Priorities (Table 3.11-2)

1.14 I support the Officers' recommended amendments to Table 3.11-2 to lift the priority of several Upper Waikato FMU sub-catchments (paragraph 652 section 42A report).

Recommendations

1.15 The key recommendations, including changes to text within PC1, as set out in this evidence are collated in Appendix 1 to this evidence.

2. INTRODUCTION

Qualifications and experience

2.1 My full name is Dean Craig Miller. I hold the qualifications of Bachelor of Science and Master of Science and Technology with First Class Honours in Biological Sciences, from the University of Waikato. I am a Member of the New Zealand Freshwater Sciences Society.

2.2 I hold the position of Principal Environmental Scientist with Tonkin & Taylor Ltd (T+T), a multidisciplinary Environmental and Engineering Consulting company. I have held this position for 17 years.

2.3 I specialise in water quality and aquatic ecology resource evaluation and management work in freshwater environments. I undertake project work for a range of local authority, industry, utility and developer clients throughout New Zealand. My project work typically includes technical advice on water quality and freshwater ecology matters, undertaking small to large scale water quality and ecological evaluations, the design and implementation of monitoring and field assessment programmes, and assessment of environmental effects for small and large projects affecting aquatic environments.

2.4 I have undertaken water quality and ecology project work in various locations throughout the Waikato River Catchment over my professional career, and I am familiar with the Waikato River and its catchment.

2.5 My involvement in PC1 to the Waikato Regional Plan commenced in August 2016 when I was engaged by Mercury to provide technical advice in relation to water quality and ecology technical matters.

Expert witness Code of Conduct

2.6 I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court Practice Note 2014 and that I agree to comply with it. Unless I state otherwise, this evidence is within my sphere of expertise and I confirm that I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

Scope of evidence

2.7 I have been engaged by Mercury to provide technical evidence in relation to its submissions on PC1. My evidence specifically focusses on technical matters relating to the implementation of PC1 to achieve Objective 3, and primarily to the following points in Mercury's submission:

(a) Seeking that an Upper Waikato FMU monitoring site is established at or about the FMU boundary.

(b) Seeking redefined sub-catchment areas in Tables 3.11-1, 3.11-2 and Map 3.11-2 to differentiate tributaries from the main stem of the Waikato River, especially for the Upper Waikato River FMU.

(c) Seeking additional tributary sub-catchment monitoring sites with corresponding short-term and long-term numerical targets.

2.8 I have read the Statement of Primary Evidence of Ms Gillian Crowcroft, also prepared in support of Mercury's submission and addressing planning matters. My evidence should be read in conjunction with Ms Crowcroft's.

2.9 I attended the Economic and Science Modelling Information Forum held on November 21 and 22, 2018.

2.10 I have reviewed Waikato Regional Council's (**WRC** or **WRC's**) Section 42A report, the tracked changes version of PC1 (**track change version**) and selected supporting technical reports and memorandums. I refer to the authors of the section 42A report collectively as 'Officers' in my evidence.

2.11 The parts of the section 42A report that are relevant to Mercury's submission points above (and my evidence) are in regard to PC1 Objective 3 (Section B4.3.3) and Section B5 which addresses FMUs, sub-catchments, Table 3.11-1 (attributes and targets) and Table 3.11-2 (sub-catchment list showing priority). I use this topic structure in my evidence to comment on Mercury's submission points above and whether they have, or have not, been addressed satisfactorily from my perspective.

3. B4 – OBJECTIVES

Objective 3

3.1 Mercury's submission (PC1-9511 and PC1-11312) considered that the short term change in water quality sought by Objective 3 will not be fully achieved based on the current sub-catchment areas and priorities identified in Table 3.11-2. This is particularly the case for sediment (but also nutrient) losses to tributaries in the Upper Waikato FMU where several sub-catchment monitoring points are on the main stem of the Waikato River. These monitoring locations mask the scale of the problem, or potential problem, occurring in the tributaries. I discuss this issue and provide examples in Section 4 of my evidence.

3.2 I support Mercury's submission point that finer scale sub-catchment approach to targets, priorities and monitoring is needed to support short term outcomes (10 % of the 80 year target) and long-term outcomes. Most of the relevant Officer's discussion on sub-catchment targets, catchment priorities and monitoring is in Section B5 of the section 42A report. I expand on this matter in Section 4 of my evidence.

4. B5 – FRESHWATER MANAGEMENT UNITS, SUB-CATCHMENTS AND TABLES 3.11-1 AND 3.11-2

Freshwater Management Units

4.1 Mercury's submission points on PC1 3.11 'Area covered by Chapter 3.11' (PC1-9486) and FMU Map 3.11-1 (PC1-9682) supported the scale at which freshwater management units (**FMU** or **FMU's**) have been delineated and sought to retain them in the same or similar form. The Officers (paragraph 486 and 487 of the section 42A report) considered the setting of FMUs at a finer scale, i.e. sub-catchment but recommend retaining FMUs as notified. I support the Officers' recommendation to retain the scale of FMUs at this point but note that in my view a finer scale sub-catchment management approach is needed to ensure more informed decision making, to efficiently prioritise sub-catchments, and to develop targeted actions and interventions to assist in the improvement in water quality within a FMU. I expand on this point later in paragraphs 4.8 to 4.18 of my evidence.

4.2 In its submission on PC1 Section 3.11.4.10 Implementation Method (PC1-9594) Mercury raised concerns regarding the locations of the FMU monitoring points, and specifically that the Upper Waikato FMU monitoring point is located at the Narrows Boat ramp. This site is well downstream (23 km) of the Upper Waikato FMU boundary, below several large point source discharges and potentially influenced by diffuse discharges over that reach.

4.3 The above concern is discussed by the Officers at paragraph 486 of the section 42A report which states that:

> *"The CSG raised some concern with the location of the downstream boundary of the Upper Waikato FMU and proximity to the nearest downstream surface water quality monitoring site (located 23km downstream). The TLG responded to this concern, concluding that there is no particular technical issue with the non-coincidence of FMU boundaries and surface water quality monitoring sites."*

4.4 Technical issues around a monitoring site at the Upper Waikato FMU boundary (Karapiro) versus the Narrows monitoring site are discussed in the Technical Leaders Group (**TLG**) report on "The non-coincidence of Freshwater Management Unit boundaries and monitoring sites".[1] With respect to the Narrows site the TLG's conclusion above appear to be primarily based on the existing long term flow and water quality monitoring records and that the freshwater accounting requirements of the National Policy Statement for Freshwater Management (**NPS-FM**) can be met by estimating and subtracting contaminant inputs between Karapiro and the Narrows. The TLG considered that corrections can be made and these corrections will most likely be small (of the order of 5%). The TLG note that it would be feasible to start a new record at the Karapiro tailrace, but regard this as being "nice to have, but not essential".

4.5 The TLG report on monitoring of attributes and actions[2] provides advice on the monitoring regime that may be required following implementation of the policy mix contained within PC1. Amongst other things, this report identified that the 80 km stretch on the Waikato main stem from Waipapa to the Narrows was

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[1] TLG Document 3408420: The non-coincidence of Freshwater Management Unit boundaries and monitoring sites. Dated 25 February 2015.

[2] TLG Document 8751223: Healthy Rivers: Wai Ora – Monitoring of attributes and actions. Dated 20 June 2016.

under represented and recommended a monitoring site be established at the Karapiro tailrace measuring the same suite of parameters as the other Waikato River main stem sites.

4.6 Based on the available information, including the discussion at the Economic and Science Modelling Information Forum, it is unclear whether WRC has commenced, or intends to commence, monitoring at a Karapiro Tailrace site. In any case I support the TLG's recommendation[2] for the Upper Waikato FMU monitoring site to be located at or about the Karapiro Tailrace. My reasoning is as follows:

(a) It is good industry and scientific practice to develop and/or adjust monitoring programmes to best suit the objectives of the monitoring rather than make do with an existing monitoring programme.

(b) Taking a 'correction approach' based on modelling or load estimates introduces another level of complexity and potential for error to the accounting system that would be better addressed for the Upper Waikato FMU by actual monitoring data for a Karapiro Tailrace site.

(c) The correction / estimate approach will unlikely provide data for direct comparison to the targets in Table 3.11-1 (annual median, annual maximum, clarity, etc).

(d) The potential correction needed was considered "small" by the TLG and in the order of 5 %. However, this order of correction is high relative to the difference in target concentrations / levels between main river sites. For example, and to put the potential scale of correction into context, the difference in the short term targets between the Narrows and Horotiu for chlorophyll *a*, total nutrients and clarity ranges between 0% and 10%.

4.7 I recognise that it will be several years before an appropriate data-set exists to develop targets for a Karapiro Tailrace Site following the same methodology as used for PC1 and to assess progress against objectives and targets. However, there are alternative methods for deriving targets and if monitoring were to commence now, then sufficient data for the new site at Karapiro Tailrace would be available within 5 years (refer also to Paragraphs 4.21 and 4.22 of my evidence). I therefore recommend that:

(a) A FMU monitoring site is established at or about the downstream boundary of the Upper Waikato FMU to monitor the progress toward long–term water quality objectives.

(b) That this monitoring commences immediately if it hasn't already.

(c) Map 3.11-1 is amended or another map or table is included that identifies the location of FMU monitoring sites.

Spatial extent of sub-catchments

4.8 In its submission Mercury considered that the delineated sub-catchments (in PC1) will make it difficult to reconcile and evaluate actions in those sub-catchments against the desired future state (short term and long term) water targets (see submission points PC1-9511 (Objective 3), PC1-9679 (Table 3.11-1), PC1-9680 (Table 3.11-2) and PC1-9681 (Map 3.11-2)). This is particularly the case where a single water quality target / monitoring site is to be used to evaluate actions and water quality trends at two or more sub-catchment areas and where the sub-catchment monitoring point for the tributaries is in the main-stem. Mercury highlights the issue of sediment loads from the tributaries but this is also true for other contaminants such as nutrients.

4.9 Some specific examples where these situations arise include:

(a) Sub-catchment 33 Waikato at Narrows: under the current PC1 sub-catchment delineation Waikato at Narrows would be the monitoring site for Sub-catchment 33 (Priority 1 Catchment, within the Middle Waikato FMU) as well as Sub-catchment 41: Karapiro (Priority 3 catchment within the Upper Waikato FMU). Sub-catchment 41 includes Lake Karapiro and Lake Arapuni with the main stem of the Waikato River extending some 80 km upstream to the next main stem monitoring site (Waikato River @ Waipapa Tailrace) and numerous un-monitored tributaries joining the main stem over that reach.

(b) Sub-catchment 64 Waikato at Waipapa: This monitoring site captures both Lake Waipapa and Lake Maraetai. Both hydro lake catchments have major tributaries / areas dominated by agricultural or forestry land uses, including extensive recent pasture conversion. However, the monitoring point is located on the main-stem,

downstream of the hydro lakes which would act to attenuate sediment and other contaminants from the tributaries.

(c) Sub-catchment 66 Waikato at Ohakuri. This monitoring site would capture conditions for the main river and several large tributaries draining catchments dominated by forestry on the southern side and agricultural dominated catchments on the northern side. There are some PC1 sub-catchment sites on tributaries on the northern side but for the Whirinaki Stream (Sub-catchment 56) for example, the monitoring site is in an upper catchment location capturing only a small proportion of the overall catchment area. This means the measuring point for the bulk of the Whirinaki catchment is in the main stem at Ohakuri.

(d) Sub-catchment 67 Waikato at Whakamaru: This monitoring site captures both Lake Whakamaru and Lake Atiamuri. Both hydro lake catchments have areas dominated by agricultural and forestry land uses. However, the monitoring point is located on the main-stem, downstream of the hydro lakes which would act to attenuate sediment and other contaminants from the tributaries.

4.10 Mercury is seeking the inclusion of a sub-catchment corresponding to each of the hydro catchments, sub-catchments for each major tributary of the Waikato River within the Upper Waikato FMU and corresponding short term and long-term numerical targets. An indicative sub-catchment map showing possible additional sub-catchment areas was provided with Mercury's submission (see submission points PC1-9679 and PC1-9681).

4.11 The additional sub-catchments sought by Mercury have not been accepted by the Officers (paragraph 508 section 42A report). The section 42A report responds to submissions on sub-catchment delineation (and targets) generically and in several sections. Relevant points from the Officers' analysis are as follows:

(a) Paragraph 143: "*The Officers' preliminary view is that focussing on sub-catchments could have real benefits in terms of implementing local solutions and community commitment, but risks not having an 'eye on the prize', which is the health and restoration of the whole river system*".

(b) Paragraph 503: *"The Section 32 Report (and supporting technical reports) outlines that the boundaries and scale of the sub-catchments, were largely delineated on the basis of water quality monitoring sites in the WRC's river monitoring network…. Utilising the existing monitoring network provided baseline data for analysis and enabled the models to be tested against the data."*

(c) Paragraph 504: "*Essentially, each sub-catchment represents the contributing area draining to its corresponding monitoring site. The Officers note that the scenario modelling that has been undertaken is based on routing of contaminants through the stream and river network, based on these sub-catchments. Any substantial changes or redefining of sub-catchments may mean that the outcomes of the modelling no longer apply and would need to be re-modelled*".

(d) Paragraph 504 (continued): *"As the targets and limits have been developed using existing monitoring data, changing the sub-catchments may lead to changes to the limits and targets set in Table 3.11.1, which is not a simple exercise. On this basis, Officers are hesitant to recommend any changes in the absence of evidence to support revised Table 3.11-1 values."*

(e) Paragraph 506: *"Officers acknowledge there are different physical attributes within many sub-catchments…. The Officers consider that with improvement in monitoring data and information into the future there may be an opportunity to divide catchments in future planning processes. However at this stage Officers do not recommend such changes."*

4.12 I respond to the above points in order as follows:

(a) I disagree with the Officer's view that there is a risk to the whole of catchment approach by focussing on sub-catchments. In my view, from an implementation perspective, improved sub-catchment resolution (as sought by Mercury) and focus will lead to more informed decision making and is needed to most efficiently prioritise sub-catchments, develop targeted actions and interventions and achieve PC1 freshwater objectives from a whole of catchment perspective in an efficient and equitable manner.

(b) Existing long-term WRC datasets were used in both the modelling work to understand potential water quality changes and economic implications of policy and to develop the water quality targets included in PC1. These two exercises were not linked, although the commentary in the section 42A report is not explicitly clear on this point and in some instances confuses the two processes (e.g. Paragraph 504 and again at Paragraph 586 where it is stated that modelling was used in developing Table 3.11-1). In any case, and in my opinion, the fact that existing data were useful for PC1 development is not a valid reason for dismissing a refined sub-catchment approach to implementation moving forward.

(c) I am not convinced as to the requirement for additional modelling if new sub-catchments were delineated and if this would preclude a sub-catchment approach to the implementation of PC1. My understanding of the modelling is that this would only be required if the proposed policy mix, and therefore the economic impacts, were likely to change. The water quality targets in PC1 were calculated based on existing water quality data sets and not as an output of the modelling.

(d) The PC1 sub-catchments and associated monitoring sites where water quality improvements will be measured were determined based on long term WRC monitoring data. In my experience in establishing water management and monitoring programmes (and in my opinion), determining the most appropriate management scale and selecting the location of monitoring sites must primarily align with a programme's objectives. In the case of PC1 this is to enable WRC to manage natural resources in the Waikato and Waipa catchments and measure the effectiveness of actions toward achieving the plan objectives. While there is value in long term series reporting for past trends, going forward monitoring should relate to objectives. In my opinion, the current sub-catchment scale and monitoring site locations proposed in PC1 will not achieve this. Therefore, I do not support the Officers' recommendation to retain the sub-catchments as delineated in Map 3.11-2.

(e) Further to the above and in response to section 42A at paragraph 506 I disagree with the Officers' view that the division of catchments

can be delayed to future planning processes. In my opinion, this could be done now and to delay is potentially detrimental to the objective of achieving the short term water quality targets.

4.13 At paragraph 560 of the section 42A report the Officers note that *"[t]argets set at sub-catchment level, coupled with a robust monitoring regime to track changes and actions on the land was considered by the CSG critical to monitor the effectiveness of the plan*". Earlier in paragraphs 89 and 503 of the section 42A report there are statements to the effect that WRC is reviewing and updating its monitoring programme and changing a number of monitoring sites to "*better align with the PC1 sub- catchments*". Based on the discussion at the Economic and Science Modelling Information Forum, I understand that the additional monitoring may include the additional sub-catchment nodes included in the water quality and economic modelling (i.e. 12 additional sub-catchment sites not currently identified in Table 3.11-1). If this is the case, then the only additional monitoring site proposed in the Upper Waikato FMU is the Karapiro tailrace site discussed earlier in my evidence.

4.14 In my opinion, and leading on from my earlier discussion on sub-catchment resolution, the addition of a single additional monitoring site at Karapiro will not be sufficient for effective implementation of PC1 and to ensure that there is an appropriate and equitable approach to the achievement of water quality improvements between sub-catchments. I acknowledge that in the reasoning for adopting PC1 Objective 3 that due to time lags the measurement of progress to achieving short term goals will rely on measurement and monitoring of action on land. In my view, this should be coupled with water quality monitoring data at appropriate locations.

4.15 Further to the above there are some technical issues with the number and location of existing monitoring sites in the Upper Waikato FMU, in particular where the sub-catchment monitoring point for the tributaries is in the main-stem. For example, it will not be possible to identify specific Whirinaki Stream catchment contributions of sediment and total or dissolved nutrients in the main-stem Ohakuri Tailrace site. These contaminants will have been attenuated in Lake Ohakuri to varying degrees and without water quality data it will be uncertain as to which catchment areas are contributing to improvement and those that are not.

4.16 In addition, where monitoring points are included on tributaries these are often located some distance upstream from the main stem. In my view, these may be better located nearer the main-stem to understand overall sub-catchment contaminant contributions to the main stem. Supplementary monitoring could then identify any sub-catchment specific hot spots and support decisions on subsequent actions.

4.17 Overall, in my opinion further analysis of sub-catchment delineation in the Upper Waikato FMU is needed. In my view, the Officers have not sufficiently considered submissions on sub-catchment delineation in their report and I therefore recommend that this be reconsidered. In my view, this should include a reassessment of the monitoring programme going forward, the timeframe and frequency for monitoring programme and data review and how monitoring and catchment actions will/can adapt to the data generated and associated trends.

4.18 To address the issues of sub-catchment delineation in the Upper Waikato FMU I recommend the following minimum changes:

(a) New sub-catchments are created corresponding to each hydro catchment. This should include:

(i) Sub-catchment 41 Waikato at Karapiro split into two sub-catchments corresponding to Lake Karapiro and Lake Arapuni;

(ii) Sub-catchment 64 Waikato at Waipapa split into two sub-catchments corresponding to Lake Waipapa and Lake Maraetai;

(iii) Sub-catchment 67 Waikato at Whakamaru split into two sub-catchments corresponding to Lake Whakamaru and Lake Atiamuri;

(b) New sub-catchments are created for any large tributaries within the hydro catchments to enable differentiation between issues and actions in tributaries compared to the main stem, particularly where the dominant land uses is production forest or pastoral farming. The indicative sub-catchment map showing possible additional sub-catchment areas attached to Mercury's submission may be a useful starting point for identifying tributary sub-catchments, but it is

acknowledged that further refinement of Mercury's indicative map is likely to be necessary.

(c) That a monitoring point is established for each sub-catchment, including any new sub-catchments created, located as close as practicable to the downstream extent of the sub-catchment to which it corresponds. The monitoring point for any tributary sub-catchments should not be located in the main stem where contaminants will have been attenuated in the hydro lake or by the flow in the Waikato River.

(d) In the case of any new monitoring sites established under clause (c) above, the development of a monitoring programme, including timeframe and frequency, to establish appropriate baseline data and trends in order to set future sub-catchment targets and limits (where sub-catchment targets and limits don't already exist). If considered appropriate by the Hearing Panel, this matter could be incorporated into Method 3.11.4.10 Accounting system and monitoring, as follows (additions underlined):

Waikato Regional Council will establish and operate a publicly available accounting system and monitoring in each Freshwater Management Unit^, including:

a. Collecting information on nitrogen, phosphorus, sediment and microbial pathogen levels in the respective fresh water bodies in each Freshwater Management Unit^ from:

i. Council's existing river monitoring network; and

ii. Sub-catchments that are currently unrepresented in the existing monitoring network; and

iii. Lake Freshwater Management Units^.

b. Using the information collected to establish the baseline data for

i. developing short term limits and targets and long term water quality states for any sub-catchments currently unrepresented in Table 3.11-1;

ii. establishing the priority for any sub-catchments currently unrepresented in Table 3.11-2; and

iii. compiling a monitoring plan and to assess progress towards achieving the Table 11-1 water quality attribute^ targets^; and…

Targets and limits (Table 3.11-1)

4.19 Mercury's submission (PC1-9679) on Table 3.11-1 opposed the Targets and Limits in part. This opposition was largely related to its view that further sub-catchment delineation is needed (as addressed in the previous section of my evidence) and that targets and monitoring are needed at each and every sub-catchment site in Table 3.11-1.

4.20 At Paragraph 552 in the section 42A report the Officers note that WRC is proposing to monitor all 74 sub-catchments (i.e. this includes 12 sites not currently identified in Table 3.11-1) and that it is not appropriate to include water quality targets for sites where there are no current state data as there is no starting point in order to determine the 10 % improvement for the short-term target. The Officers consider it more appropriate to include any additional water quality monitoring sites in future planning cycles.

4.21 In general, I agree with the Officers' view that targets for any new sites will not be able to be established following the same methodology as per the notified version of PC1 (considering existing data). However, in my view this should not preclude the development and implementation of an appropriate sub-catchment management regime including targets during the PC1 planning cycle, which should look forward rather than back.

4.22 I understand that the water quality model that supported the economic modelling included the whole river and tributary network and contaminant loads can be queried at any node (i.e. sub-catchment). Other methods to develop interim targets for additional sub-catchments could therefore be used based on the available models combined with expert opinion. Alternatively, if monitoring were to commence now, then sufficient data for new sites would be available for target development within 5 years. In my opinion, as a minimum, an appropriate monitoring regime should commence as soon as possible to facilitate finer scale sub-catchment target development. I consider that the changes I recommended in paragraph 4.18(d) to Method 3.11.4.10 in PC1 will satisfactorily address this issue.

4.23 I support the Attributes and Attribute States as outlined in Table 3.11-1, including the Officers' recommended amendments made in the track change version. Leaving aside the sub-catchment resolution issue discussed earlier in

my evidence, I agree with the way the Attributes have been applied to the tributaries (and Waipa River) vs the main stem of the Waikato River. That is that Chlorophyll *a*, Total Nitrogen and Total Phosphorous Attributes are applied to the Waikato River only.

4.24 Chlorophyll *a*, Total Nitrogen and Total Phosphorous Attributes are appropriate to the Waikato River from an NPS-FM perspective in terms of its classification as a lake fed river under PC1. However, I would highlight the importance of ongoing monitoring of the tributary contributions of dissolved and total nutrients as well as contaminants affecting the clarity attribute relevant to tributaries (sediment, yellow substance). This is relevant to Mercury's submission and understanding how the various tributaries contribute to water quality in the Waikato River main stem.

4.25 At Paragraphs 84 and 85 of the section 42A report the Officers list the attributes monitored by WRC on a monthly basis at Waikato River and tributary sites respectively. These paragraphs list only the Attributes required by NPS-FM. The list of water quality parameters actually monitored by WRC is much more comprehensive, including dissolved nutrients (dissolved reactive phosphorus and soluble inorganic nitrogen) and measurements of clarity (absorbance and turbidity).

4.26 The total nitrogen and total phosphorous nutrient attributes in the NPS-FM may not be relevant to the tributary values, but an understanding of the tributary contributions to nutrient conditions in the main-stem is necessary to assess progress towards objectives and to inform management actions.

4.27 I consider it important that WRC's current and comprehensive state of the environment monitoring programme should continue for all sub-catchment and main stem sites, with the modifications to the monitoring point recommended in paragraph 4.18(c) of my evidence. In addition, the same or equivalent monitoring programme should be extended to new and or modified sub-catchment site locations as sought by Mercury's submission and as outlined in paragraph 4.18 of my evidence. In my view, this comprehensive state of the environment monitoring is necessary to support the implementation of PC1.

4.28 I support the Officers' recommendations for minor changes to improve the clarity of Table 3.11-1. These include:

(a) Table headings on each page of the table.

(b) Inclusion of catchment numbers.

Priorities (Table 3.11-2)

4.29 I support the Officers' recommended amendments to Table 3.11-2 to lift the priority of several Upper Waikato FMU sub-catchments (paragraph 652 section 42A report). I note that further prioritisation would be required if additional sub-catchment targets and/or monitoring are added in response to Mercury's submission and my evidence.

Dean Craig Miller
15 February 2019

APPENDIX 1: RECOMMENDATIONS AND CHANGES TO PC1 PROVISIONS SOUGHT

Freshwater Management Units, including Map 3.11-1 (submission PC1-9594)

The following changes are recommended:

(a) A FMU monitoring site is established at or about the downstream boundary of the Upper Waikato FMU to monitor the progress toward long–term water quality objectives.

(b) That this monitoring commences immediately if it hasn't already.

(c) Map 3.11-1 is amended or another map or table is included that identifies the location of FMU monitoring sites.

Spatial extent of sub-catchments (Map 3.11-2), Targets and limits (Table 3.11-1) and Sub-catchment priorities (Table 3.11-2) (submissions PC1-9511; PC1-9679; PC1-9680; PC1-9681)

The following minimum changes are recommended:

(d) New sub-catchments are created corresponding to each hydro catchment. This should include:

  (i) Sub-catchment 41 Waikato at Karapiro split into two sub-catchments corresponding to Lake Karapiro and Lake Arapuni;

  (ii) Sub-catchment 64 Waikato at Waipapa split into two sub-catchments corresponding to Lake Waipapa and Lake Maraetai;

  (iii) Sub-catchment 67 Waikato at Whakamaru split into two sub-catchments corresponding to Lake Whakamaru and Lake Atiamuri;

(e) New sub-catchments are created for any large tributaries within the hydro catchments to differentiate between issues and actions in tributaries compared to the main stem, particularly where the

dominant land uses are production forest or pastoral farming. The indicative sub-catchment map showing possible additional sub-catchment areas attached to Mercury's submission may be a useful starting point for identifying tributary sub-catchments, but it is acknowledged that further refinement of Mercury's indicative map is likely to be necessary.

(f) That a monitoring point is established for each sub-catchment, including any new sub-catchments created, located as close as practicable to the downstream extent of the sub-catchment that it corresponds to. The monitoring point for any tributary sub-catchments should not be located in the main stem where contaminants will have been attenuated in the hydro lake or by the flow in the Waikato River.

(g) In the case of any new monitoring sites established under clause (f) above, the development of a monitoring programme, including timeframe and frequency, to establish appropriate baseline data and trends in order to set future sub-catchment targets and limits (where sub-catchment targets and limits don't already exist). If considered appropriate by the Hearing Panel, this matter could be incorporated into Method 3.11.4.10 Accounting system and monitoring, as follows (additions underlined):

Waikato Regional Council will establish and operate a publicly available accounting system and monitoring in each Freshwater Management Unit^, including:

a. Collecting information on nitrogen, phosphorus, sediment and microbial pathogen levels in the respective fresh water bodies in each Freshwater Management Unit^ from:

i. Council's existing river monitoring network; and

ii. Sub-catchments that are currently unrepresented in the existing monitoring network; and

iii. Lake Freshwater Management Units^.

b. Using the information collected to establish the baseline data for

i. developing short term limits and targets and long term water quality states for any sub-catchments currently unrepresented in Table 3.11-1; and

ii. establishing the priority for any sub-catchments currently unrepresented in Table 3.11-2; and

iii. compiling a monitoring plan and to assess progress towards achieving the Table 11-1 water quality attribute^ targets^; and…