



## **1. Introduction | Submission & Evidence**

- 1.1. On 28 February 2017 submissions were filed with the Waikato Regional Council in response to Plan Change 1 by **Charion Investment Trust (Submitter 71344) and Fletcher Trust (Submitter 73848)**.
- 1.2. On 3 May 2019 a Synopsys of primary evidence was filed for both submitters by Charles Fletcher and Dr John Bircham.
- 1.3. Both Charles Fletcher and Dr John Bircham appear today (10 July 2019) to complete the presentation of evidence for the Hearing Commissioners and to answer any questions.
- 1.4. Our evidence is being given in respect of the whole of Plan Change 1, to cover:
  - a. Block 1 – Overview, values, uses, science & economics
  - b. Block 2 – Policies & Rules
  - c. Block 3 – Vegetables, FEP, Wetlands, misc, alternatives incl sub-catchment planning
- 1.5. Within each block issues have been addressed by topic.

## **2. PC1 – What is this all about?**

- 2.1. Water quality for our rivers and lakes in the Waikato, with a focus on the control of Sediment, Phosphorus, E.coli & Nitrogen, so as to govern the water quality for swimming and fishing.
- 2.2. Ultimately, it is about the curtailing the flow of contaminants from the farm to the sub-catchments and catchments that feed the Waikato and Waipa rivers.
- 2.3. Last week's event in Taupo highlights the both the complexity and the criticality of the infrastructure required to support modern society, and in particular the consequences of its failure.

## **3. Expertise of Dr. John Bircham B.Agr.Sc; M.Agr.Sc.(Hons); Ph.D.**

- 3.1. Research Scientist 1969-84 with expertise in:
  - a. Soil Conservation & Land Management
  - b. Grazing Ecology,
  - c. Farm Systems
  - d. Farm Systems Modelling
  
- 3.2. Systems Development & Implementation – since 1985
  - a. Risk assessment, mitigation & management
  - b. Compliance, self-assessment & incident/breach management
  - c. Business Continuity & Disaster Recovery
  - d. Credit Union and Not-For-Profit Board Governance Review
  - e. Temperate Grassland Dairy-Farm Simulator
  
- 3.3. Author of Journal & Conference Papers (Appendix 1 attached) including:
  - a. One published book
  - b. 37 Conference presentations on all aspects of Risk & Resilience
  - c. 25 journal articles and conference papers on a range of agriculture-related topics.
  
- 3.4. In reviewing the perspectives and views of many submissions for this hearing, in particular the “expert evidence” presented to this hearing, I realised that I have expertise, which is almost certainly unique, and which may be of assistance at this stage of the hearing.
  
- 3.5. Not only do I have first-hand experience in the modelling of agricultural systems: soil moisture, dynamics of pasture growth, ruminant grazing behaviour and whole farm systems (dairy, sheep & Beef and deer), I also have first-hand experience in the development, implementation and operation of:
  - a. Risk assessment & risk management systems;
  - b. Compliance self-assessment and breach management systems;
  - c. Business continuity and disaster recovery systems;

d. Critical Infrastructure Assessment Systems.

3.6. I have been an invited speaker on Risk, Resilience and indeed Anti-Resilience in Australia, Europe and Canada and have conducted numerous workshops on organizational resilience, what it is and how to create and enhance it.

**4. Models, Systems & Modelling**

4.1. Perhaps what struck me most, when I reviewed some of the PC1 materials and some of the supporting technical papers, was the reliance of the policy analysts and regulators responsible for the development of PC1 on models that included expert “best-guesses” in their inputs.

4.2. Moreover, it seems the authors have little understanding of the limitations and errors embedded in these models, and in particular that they are linear in nature

4.3. The system they seek to regulate with PC1 is non-linear.

4.4. Farms are a “Complex-Adaptive-System” with characteristics that often cannot be modelled until they emerge, because they are hidden. And emerge they will, when situations and circumstances whatever they are, align and the behaviour of the system changes.

4.5. For example:

- a. the recent failure of waste-water infrastructure in Taupo;
- b. the emergence of the bacterium “*Bermanella macondoprimitus*” to destroy the oil plume consequent to the Deep-Water Horizon disaster;
- c. the failure of many “Climate Models” to predict global temperature as carbon dioxide levels have risen, etc.

- 4.6. Most climate models predict rising global temperatures as carbon dioxide levels increase, whereas the reality is that in recent times they have remained relatively stable. Ultimately, it is the non-linearity of the system, that carbon dioxide is not the principal driver of global temperature; i.e. it's something else.
- 4.7. "Complex Adaptive Systems" (CAS) are complex in that they are dynamic networks of interactions, and their relationships are not aggregations of the individual static entities; i.e. the behaviour of the entire system is not predicted by the behaviour of its components.
- 4.8. CAS's have characteristics that, in my opinion, need to be embedded in PC1, for the realistic objectives of PC1 to be realised.
- 4.9. A full description of attributes of CAS's is beyond this submission, but there are few that need to be mentioned:
  - a. they are in state of flux, on the edge of chaos and equilibrium;
  - b. they exhibit emergence/innovation; i.e. interactions between actors generate new behaviour;
  - c. they are Self-ordering and exhibit negative entropy;
  - d. they are "Shut-Down" by outside control
- 4.10. When the ideas and thoughts of science are transposed into models, humanity in general heaves a sigh of relief because the human brain understands models and patterns; indeed, it craves them.
- 4.11. The problem, as the noted researcher and writer Ian McGilchrist puts it, is that western society has been "hijacked by its left-brain".
- 4.12. Western culture wants the peace and tranquillity of the known and all too often will attempt to conform the complexity of reality as perceived by the right-brain, into the bounded simplicity of an already formed left-brain generated pattern/model.

4.13. Moreover, when reality cannot be slotted into a known pattern/model, then instead of modifying the model/pattern to meet the newly perceived reality, all too often the reality is discarded in favour of the existing and known model/pattern.

4.14. I have the greatest respect for those researchers and others who use modelling techniques to learn and to gain understanding and knowledge that would otherwise not be possible. And, I am reminded of a mentor in my early days as a scientist, who at a modelling conference made the following observation.

*“Modelling techniques will help average scientists to better understand how the system they are investigating work. Modelling techniques will do little to add to the work of good scientists, because they are already modelling in their heads. And heaven help us when modelling techniques are in the hands of below-average scientists.”*

## **5. Risk**

5.1. Prior to the promulgation of the Revised Schedule 1, Requirements for Farm Environment Plans”, the objectives of a Farm Environment Plan were to include:

- a. Identification of sources of diffuse discharge of sediment, nitrogen, phosphorous and microbial pathogens;
- b. Assessment of the risk of diffuse discharge of sediment, nitrogen, phosphorous and microbial pathogens to water bodies;
- c. Prioritisation of risk having regard to their severity and likelihood and to sub-catchment targets;
- d. Implementation of actions in accordance with the priorities, having regard to sub-catchment targets.

5.2. In my submission to this hearing, I was critical of the absence of any definitions of risk other than the “discharge of sediment, nitrogen, phosphorous and microbial pathogens to water bodies.

- 5.3. ISO 31000 2018 defines risk as: **“the effect of uncertainty on objectives.”**
- 5.4. So far, so good. It is possible to identify the existence of risk, but when it comes to prioritisation, which requires classification of the severity of the risk and the likelihood of the risk occurring, there is no guidance in the schedule.
- 5.5. In the June 2018 Farm Environment Guide I found the following:
- a. *“There is an expectation that the Certified Farm Environment Planner will utilise their **professional judgement** and work with the land owner to better understand their property when making the required assessments, using Figure 1 alongside the Farm Environment Plan template as a guide.”*
  - b. *“The matrix assesses the potential impact of losses of contaminants in comparison with the likelihood that these losses occur. For example, a stream crossing at the bottom of a slope might be considered to have moderate impact of contaminant loss, but the likelihood of contaminant loss is often and therefore the overall assessment is high risk.”*
- 5.6. I pointed out that in the absence of realistic (not just subjective) measures and estimates of likelihood, prioritisation of risk treatment actions is problematic and, subject to amongst other things, the limitations and bias of “bounded rationality. Longitudinal assessments of risk, which are critical to the ongoing assessment progress or lack of progress, are jeopardised in the absence of realistic and repeatable measures of risk severity and likelihood.
- 5.7. Moreover, that the prioritisation is to include consideration of sub-catchment targets irrespective of the location (distance from water bodies inclusive of wetlands, etc.) of the farm and its hydrological relationship (there could well be “none”) to the sub-catchment outflows.

- 5.8. I guess my principal concern with the first version of Schedule 1 is its unsaid, but nevertheless implicit assumption, that all farm properties, irrespective their distance from water bodies as defined in Schedule C and indeed whether or not there is net discharge of contaminants by overland flow from their farms, contribute to the contamination of water bodies, the Waikato or the Waipa rivers.

## 6. Critical Infrastructure

- 6.1. Recent events in Taupo have brought to the attention of all, both the criticality and vulnerability of infrastructure, indeed infrastructure that with the benefit of hindsight will be considered by many to be “critical infrastructure.”
- 6.2. When I read the below comment, by officers of the Waikato Regional Council (at para 187 on page 36 of the Block s.42 Report), I recalled a major project that I undertook for the “Prime Minister & Cabinet’s Department” for the State of Victoria, Australia a few years ago.
- 6.3. The officer’s words were:  
*“While the cost in developing and implementing FEPs is acknowledged, there do not appear to be viable alternatives set out in the submissions and officers are unaware of a better and less costly way of achieving the same ends.”*
- 6.4. The project in Victoria involved the development of “Infrastructure Criticality Assessment” methodology, the construction and implementation of a web-based “Infrastructure Criticality Assessment” tool, which was named “VicCat”, an acronym for Victoria’s Criticality Assessment Tool.
- 6.5. The link below provides more information on this project.

[https://www.igem.vic.gov.au/sites/default/files/embridge\\_cache/emshare/original/public/2018/04/fe/dc29d4026/Critical%20Infrastructure%20Resilience%20-%20Implementation%20Progress%20Report%202017.PDF](https://www.igem.vic.gov.au/sites/default/files/embridge_cache/emshare/original/public/2018/04/fe/dc29d4026/Critical%20Infrastructure%20Resilience%20-%20Implementation%20Progress%20Report%202017.PDF)

- 6.6. A key objective of the project was to get different infrastructure groupings (i.e. Energy, Transport, Water, Health, Communications, Finance, Food etc.) to assess their infrastructure assets in terms of their criticality to the society they serve, to assess the consequences of the failure of their assets to deliver the services society requires of them and their vulnerability to the failure of external services upon which they are dependent, and other external events.
- 6.7. A Criticality, rather than Risk approach to the discharge of contaminants has some potentially significant advantages, not the least of which that it is possible to include all rural, urban and other infrastructure and in the same approach; i.e. all sectors of society are on the same page.
- 6.8. In the rural context, infrastructure assets would include:
  - a. major land classes (flat, rolling, steep)
  - b. soil types,
  - c. effluent ponds,
  - d. feed pads/herd homes,
  - e. permanent and transient water bodies,
  - f. wetlands,
  - g. points of discharge inflows or outflows, etc.
  - h. Etc.
- 6.9. Using the Criticality of Infrastructure approach, the vulnerability of an asset to a risk event (intense rainfall event during cultivation, breakage of effluent pipe, breach of an effluent pond, discharge of contaminant into a water body, overland discharge of contaminant to a neighbouring farm, etc.) is assessed.

- 6.10. The vulnerability of an asset, and the likelihood of a risk event triggering an asset's vulnerability, is used to assess its criticality.
- 6.11. Once Criticality has been established, any actions required to mitigate the vulnerability and/or to improve the resiliency of an asset can be agreed.
- 6.12. A major advantage of the Critical Infrastructure approach is that with the exception of the consultation required in respect of any required or agreed actions, the system would be web-based.
- 6.13. Farmers and their advisors would be responsible for inputting the information using a question-based methodology, which would be audited both online and on site.
- 6.14. It is beyond the scope of this submission to explain in detail workings of a Critical Infrastructure approach to the Farm Environment Plan, but it is a solution which the authors of PC1 have failed to consider.
- 6.15. The Critical Infrastructure approach outlined above, can with modification can be used for all infrastructure.

## **7. Sediment, P and E.coli**

- 7.1. P attaches itself to the soil and moves with the soil. It does not leach.
- 7.2. Sediment is soil and other particles which move across the land surface.
- 7.3. E.coli is bacteria normally live in the intestines of healthy people and animals. Most varieties of **E. coli** are harmless or cause relatively brief diarrhea. In the context of PC1, E.coli is bacteria found in the environment excreted by animals and birds onto land or directly into waterways.

- 7.4. PC1 has failed to address the simplest and most sensible means of controlling the movement of sediment, P and E.coli across land.
- 7.5. Trees, plants and wetlands are the most effective barriers to the movement of sediment, P and E.coli across land and into waterways.
- 7.6. The Waikato Regional Council should identify the locations most critical to curtailing the flow of contaminants from farmland to the sub-catchments and catchments that feed the Waikato and Waipa rivers. It should then buy the appropriate land in those locations and plant those sites with trees and plants and establish wetland barriers to trap the movement of sediment, P and E.coli across 'upstream' farmland.
- 7.7. As the owner of such sites, the Waikato Regional Council will provide the best management systems to protect the Waikato and Waipa rivers at a cost that will be considerably less than the costs being incurred to establish and manage PC1.
- 7.8. As this option has not been considered or addressed by the Waikato Regional Council, it constitutes a fundamental flaw to proceeding with PC1 as the only means of controlling the overland movement of sediment, P and E.coli.
- 7.9. I have no doubt that many current farm owners will have, or be happy to establish, strips of land retired and planted with trees and plants to establish wetland barriers to trap the movement of sediment, P and E.coli at their 'downstream' farm boundary.
- 7.10. But, the Waikato Regional Council must also acknowledge that such barriers cannot contain and prevent the movement of some sediment, P and E.coli into our lakes and rivers in extreme rain events.
- 7.11. Storms and extreme rain events will occur, but the huge water volumes usually flush through the water networks within a relatively short space of time and harmony is quickly restored.

7.12. As such our communities accept that our rivers, streams and lakes will not be safe to swim in nor prudent to fish during such adverse weather conditions and their aftermath.

## **8. N leaching**

8.1. As a scientist I have seen so many improvements to our environment and farming operations in my lifetime.

8.2. PC1 has a target of 80 years (two lifetimes in work years), so it is reasonable to assume that many more changes will occur in the future.

8.3. The leaching of nitrogen is a short-term problem. Its detrimental affects have only been acknowledged in recent years and, with a proper focus on the problem, it will in time almost certainly be resolved without long term detriment.

8.4. Nitrogen is an essential nutrient for plant growth. It occurs naturally in the environment and is the major element of the air we breathe. N leaching is a naturally occurring process and occurs when nitrate leaves the soil in drainage water.

8.5. Nitrate is soluble and mobile. It is no problem when it is within the root-zone, but once it gets into the ground water and other fresh water bodies it is an environmental pollutant.

8.6. PC1 seeks to control N leaching, identified as originating on farms (dairy farms in particular).

8.7. Recent scientific efforts suggest that N leaching can be significantly reduced by better exploiting N in the root zone (plant genetics, fertiliser developments) and a better understanding how and when fertiliser with nitrogen content is applied.

8.8. For example Dr Malcolm McLeod, a soil scientist at Landcare Research, has found nitrogen leaching from cut and carry lucerne (where the leafy high protein forage is harvested and baled into hay or silage) is 5kg per hectare per year.

8.9. A focus on research, which the farming community has had little benefit from in the last 30 years, will provide solutions to the concerns that PC1 is trying to regulate at the economic cost of Waikato farming. Money would be better spent by the Regional Council in promoting research and solutions.

## **9. Revised Schedule 1 - Farm Environment Plans**

9.1. I have a few comments to make on this issue which I will address orally.

Dr John Bircham

10 July 2019

## Publications: Dr John S. Bircham

### Books

Bircham, J.S. & Connolly, H. J. (2013) *Addicted to Performance – Society Demands “More-for-Less.”* Bircham-Global Publishing.

### Conference & Journal Publications: 1969 – 2019

Bircham, J.S. & Connolly, H.J. (2015) *There’s an Elephant in the Room: Anti-Resilience.* 25<sup>th</sup> World Conference on Disaster Management, Toronto, June 8-11, 2015.

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Bircham, J.S. (2014) *Anti-Resilience: A Looming Crisis.* 24<sup>th</sup> World Conference on Disaster Management, Toronto, June 15-18, 2014.

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Bircham, J.S. (2013) *Will Increasing Complexity Lead to the Demise of Organizational Resilience.* Critical Infrastructure Resiliency Conference, Melbourne 18-19 April, 2013

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Bircham, J.S. (2011) *The Future Beyond Our Control.* Australian Journal of Emergency Management 26(1), 66.

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- Bircham, J.S. (2010) ***Never to be Found in a Risk Register or Displayed on a Dashboard, the Risks Implicit in Our Decisions, Actions and Mindsets are Hidden... Until Their Time.*** 3<sup>rd</sup> International Disaster and Risk Conference IDRC Davos 2010, May 30 – 3 June, 2010
- Bircham, J.S. (2010) ***Provisioning for Resilience – Starting With a Holistic View of Risk.*** The 5<sup>th</sup> Annual Business Continuity Conference, Wellington, 24<sup>th</sup> February, 2010.
- Bircham, J.S. (2010) ***Building a Resilient Organization.*** The 9<sup>th</sup> Annual Emergency Management Conference, Wellington , 22-23 February, 2010.
- Bircham, J.S. & Connolly, H.J. (2010) ***Never to be Found in a Risk Register or Displayed on a Dashboard, the Risks Implicit in Our Decisions, Actions and Mindsets are Hidden...Until Their Time.*** 20<sup>th</sup> World Conference on Disaster Management, Toronto, June 6 - 9, 2010
- Bircham, J.S. & Gibson, C.A. (2010) ***A Speed Bump on the Risk Highway to Resilience.*** Building Continuity Conference 2010, Wellington 5 May, 2010.
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