BEFORE THE HEARING PANEL

UNDER	the Resource Management Act 1991
IN THE MATTER OF	Hawke's Bay Regional Council's Proposed Plan Change 9 (TANK)

STATEMENT OF EVIDENCE OF THOMAS JAMES KAY
ON BEHALF OF ROYAL FOREST AND BIRD PROTECTION SOCIETY OF NEW ZEALAND INCORPORATED

Geomorphology / Ecology

Introduction

1. My name is Thomas James Kay.

2. I am a Regional Conservation Manager at Forest & Bird. The focus of my role is advocacy for Forest & Bird in the Hawke's Bay, Gisborne, and Bay of Plenty regions. I also provide advice to Forest & Bird on resource management matters in regard to freshwater ecology. This evidence is provided in that expert capacity.

3. Having grown up in the region, I am very familiar with the TANK catchments and water bodies. This includes having kayaked on the 'Oxbow' (Kuripapango) and 'Lower Gorge' (Kuripapango to Whanawhana) sections of the Ngaruroro River; the Tūtaekurī-Waimate Stream; the Karamū Stream/Clive River; and the Ahuriri Estuary. Several of the sites I surveyed for my MSc thesis were also within the TANK catchment and the region.

Qualifications and Experience

4. I have a Bachelor of Science in Environmental Science from Massey University with 'Massey Scholar' endorsement.

5. I have just (May 2021) completed a Master of Science in Ecology at Massey University. My thesis looked at existing methods for assessing physical habitat quality in rivers; whether sediment and substrate composition in rivers/streams could be measured using images taken with a drone; and the further development and application, through a case study, of the 'Habitat Quality Index' (also known as the Natural Character Index) as a measure of change in river habitat quality in response to activities such as flood protection engineering works.

6. As a matter of transparency, given I refer to their work and evidence within this evidence, my thesis was supervised by Professor Russell Death and co-supervised by Professor Ian Fuller.

7. I am a member of the New Zealand Freshwater Sciences Society and the Engineering New Zealand Rivers Group.

8. My experience includes having provided advice to Forest & Bird in regard to freshwater ecological issues on the Ngaruroro Water Conservation Order (WCO) case.

9. I advised Forest & Bird on the use of the NCI/HQI to assess natural character and habitat quality as a tool to achieve the outcomes sought by them for the TANK water bodies. This led to the inclusion of this tool in the submission.

Code of conduct

10. I have read and agree to comply with the Code of Conduct for Expert Witnesses produced by the Environment Court 2014 and have prepared my evidence in accordance with those rules as if this matter was before the Court. My qualifications as a freshwater ecological expert are set out above. I confirm that the issues addressed in this evidence are within my area of expertise, except where I have indicated that I am relying on others opinions. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

Scope of evidence

11. This evidence is prepared for Forest & Bird to address their submission (dated 14 August 2020) on the TANK plan change / Proposed Plan Change 9 (PC9), in particular:

    - The management and protection of physical habitat and natural character through the use of the Natural Character / Habitat Quality Index.
    - Incorporation of the Natural Character / Habitat Quality Index in the plan as (1) a measure of the condition of natural character and physical habitat and (2) a mechanism to prevent their degradation and enable their improvement
    - The addition of an attribute to Schedule 26 to manage physical habitat quality
    - Reference to the NCI/HQI in policies, methods, and/or rules
    - The use of the NCI/HQI for restoration projects, for assessing resource consents, and for integrating into flood management plans or 'codes' for river engineering works
    - Any other consequential amendments to ensure the protection of physical habitat quality is included in the plan

12. Sections of this evidence draw on the evidence provided by Professor Ian Fuller for Forest & Bird's Environment Court proceedings on the Special Tribunal's recommendation for a Water Conservation Order (WCO) on the Ngaruroro River. Professor Fuller's evidence is provided in full in Appendices 1 & 2.

13. This evidence covers:

    i. A comment in regard to the s42A report and amendments to PC9
    ii. A description of river geomorphology and natural character
    iii. Adverse effects on natural character and physical habitat
    iv. The current state and management of the natural character and physical habitat of TANK rivers/streams
    v. An explanation of the Natural Character Index (NCI) and Habitat Quality Index (HQI), and examples of where it has been used
    vi. Application of the NCI and HQI to PC9
    vii. A summary

Section 42A Report

14. As far as I am aware, having reviewed the s42A report and appended schedules, changes to PC9 have not incorporated the NCI and HQI as sought by Forest & Bird's submission.

River Geomorphology and Natural Character

15. In regard to natural character and physical habitat in rivers and streams, the RMA (s6) directs regional councils as a matter of national importance to

> recognise and provide for…
>
> i. the preservation of the natural character of… rivers and their margins, and the protection of them from inappropriate subdivision, use, and development:
>
> ii. …
>
> (c) the protection of areas of… significant habitats of indigenous fauna

16. The NPS for Freshwater Management (2020) has a number of directions relating to natural character and habitat in rivers and streams, in particular:

> **Objective** (1) …to ensure that natural and physical resources are managed in a way that prioritises:
>
> (a) first, the health and well-being of water bodies and freshwater ecosystems…

and

- **Policy 1:** Freshwater is managed in a way that gives effect to Te Mana o te Wai
- **Policy 7:** The loss of river extent and values is avoided to the extent practicable.
- **Policy 9:** The habitats of indigenous freshwater species are protected
- **Policy 13:** The condition of water bodies and freshwater ecosystems is systematically monitored over time, and action is taken where freshwater is degraded, and to reverse deteriorating trends.
- **Policy 14:** Information (including monitoring data) about the state of water bodies and freshwater ecosystems, and the challenges to their health and well-being, is regularly reported on and published.

17. PC9 Objectives (as amended by the s42A report) also includes direction in regard to natural character and habitat quality:

> **OBJ TANK 8**
>
> Riparian margins are protected or improved where necessary to provide for Aquatic ecosystem health and mauri of water bodies in the TANK catchment ~~is improved by appropriate management of riparian margins~~ and to:
>
> …
>
> b) improve aquatic habitat and protect indigenous species including fish spawning habitat;

…

d) enhance natural character and amenity;

OBJ TANK 10

…in the **Ahuriri** freshwater catchments … the mauri, water quality and water quantity are maintained and enhanced where necessary to enable:

b) healthy ecosystems that contribute to the health of the estuary;

OBJ TANK 11

…in the **Ngaruroro River catchment** … the mauri, water quality and water quantity are maintained in the mainstem above the Whanawhana Cableway and in the Taruarau River, and are improved in the tributaries and lower reaches where necessary to enable;

a) healthy ecosystems;
b) healthy and diverse indigenous aquatic plant, animal and bird populations especially …bird habitat on braided river reaches …
c) …
d) protection of the natural character, instream values and hydrological functioning of the Ngaruroro mainstem and Taruarau and Omahaki tributaries;

OBJ TANK 12

…in the **Tūtaekurī River** catchment … the mauri, water quality and water quantity are maintained in the upper reaches of the mainstem and are improved in the tributaries and lower reaches where necessary to enable:

a) healthy ecosystems;
…
d) protection of the natural character, instream values and hydrological functioning of the Tūtaekurī mainstem and Mangatutu tributary;

OBJ TANK 13

… in the **Karamū and Clive Rivers** catchment … the mauri, water quality and water quantity are improved to enable

a) healthy ecosystems;

18. PC9 policies also refer to improving fish spawning habitat (P11); avoiding, remedying, or mitigating the adverse effects of activities on aquatic ecosystems and habitat (P54); and carrying out regular ecosystem habitat assessments (P35); among other direction relating to the health of freshwater ecosystems.

19. In order to achieve these objectives, it is important for decision makers to have a basic understanding of what constitutes river 'habitat' and what defines the 'natural

character' of a river. This means having an understanding of river geomorphology: essentially, how rivers are formed and change.

20. Rivers consist of various combinations of physical features, such as riffles, runs, pools, backwaters, and bars. An example of this is provided in Figure 1.

21. These features, in combination with the characteristics of the channel (straight, sinuous, etc.) and floodplain (wide, confined by terraces, gorged, etc.), as well as flow/discharge regimes and sediment supply, determine a river's unique form. These characteristics vary by catchment, and are restricted by variables such as rainfall and runoff, geology, land cover (e.g. vegetation), gradient, erosion rates, and valley-floor confinement.

22. Rivers and streams are, overall, stable in form and make frequent adjustments to their geomorphology within that form in response to subtle changes in catchment conditions, such as flow or sediment supply, which differ in every drought, storm, or flood.

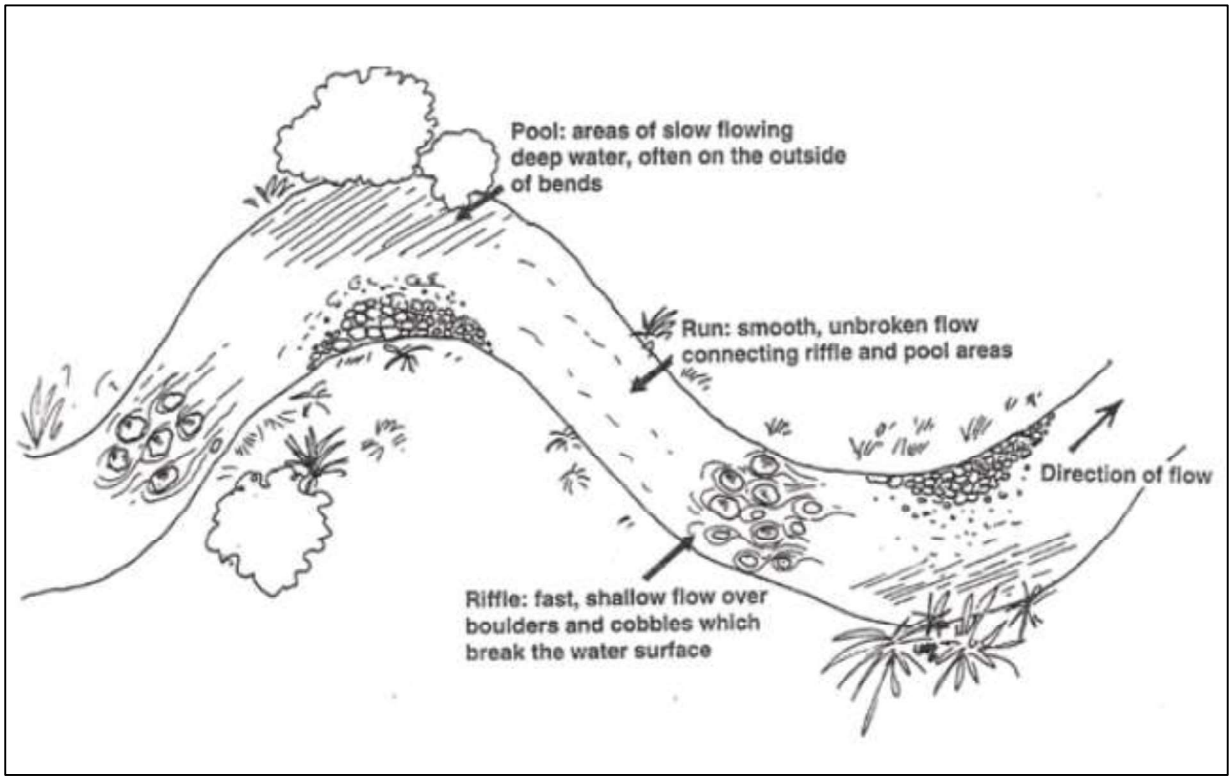

Figure 1: *Riffle, run, and pool habitats. These features provide habitat for invertebrates, fish, and birds, and in combination contribute to the natural character of a river (from Clapcott et al, 2011).*

23. These frequent adjustments mean the arrangement of features (riffles, runs, pools, backwaters, etc.) in a river is constantly changing, though their prevalence and the overall form of the river is likely staying the same. For example, a large flood will often rearrange the arrangement of features in a river but not change its form. This sort of adjustment is a regular occurrence in braided and semi-braided rivers, where

bars and channels are constantly being rearranged, while the overall the 'form' of the river remains stable.

24. Figure 2 illustrates a 'continuum' of river forms and how they can vary based on different catchment conditions, such as sediment supply and gradient.

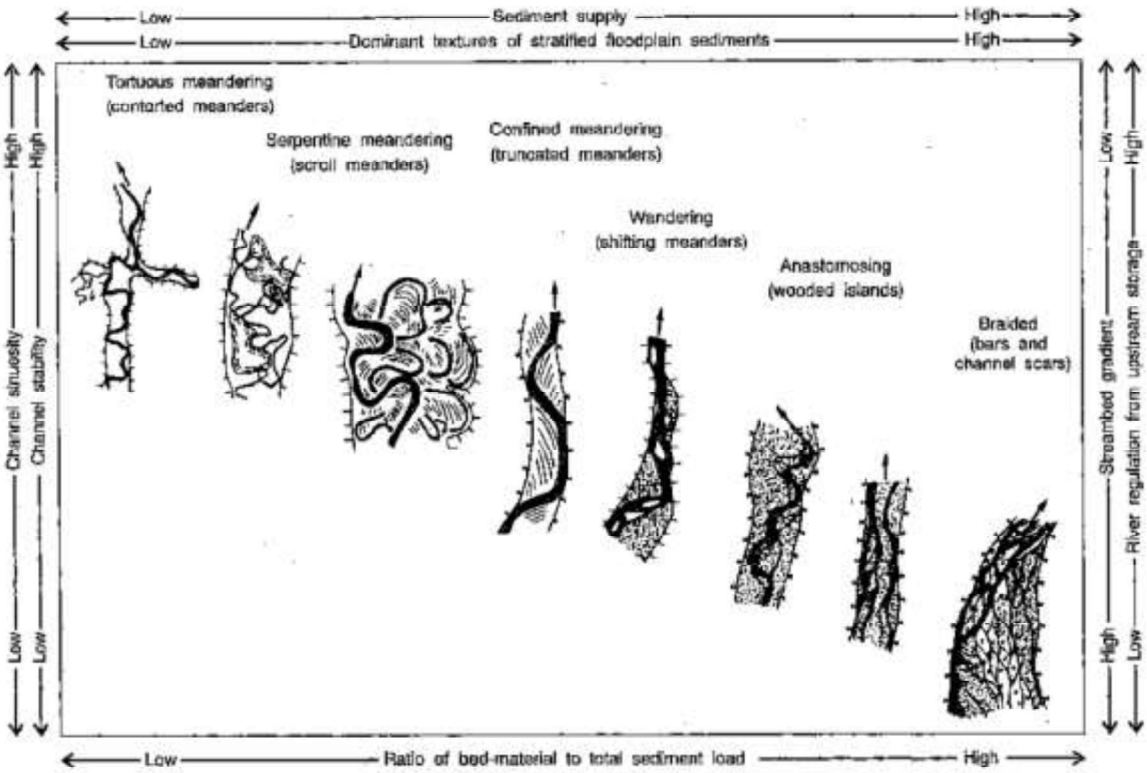

Figure 2: *The continuum of alluvial river channel types (Fig 16.1, from Mosley, 1992, cited in Fuller, Appendix 2 to this document).*

25. Where there is a wide range of these features and representation of these variables, habitat quality is generally likely to be high. Where these features are lacking, generally habitat quality is likely to be low. Figure 3 provides an example this.

26. The representation of form and features in a river or stream also determines which species the habitat is suitable for. For example, fast-flowing, smaller rivers with lots of riffles/rapids provide habitat for Whio (Blue duck), while large braided rivers provide habitat for Tarapuka (Black-billed gulls).

27. The overall form of a river, in combination with the 'mosaic' of features (the riffles, runs, pools, etc.) within the river, defines its 'natural character'.

28. The overall form of a river (or reach, since rivers often change form from the headwaters to the coast) and it's features provide valuable habitat for native riverine species, including invertebrates, fish, and birds. These features include not only riffles, runs, and pools, but also variables such as the amount of in-stream cover, substrate composition, sediment cover, riparian vegetation, and shading.

Table 1 illustrates which of these features are known to be important for different native fish species (noting the table is by no means exhaustive).

29. Effective methods to measure change in river form and features—i.e. natural character and physical habitat quality—are vital to ensure that regional councils are meeting the requirements of policy direction in regard to natural character and physical habitat, including their objectives for enhancement, improvement, or restoration. Without effective monitoring tools and strong direction towards maintenance (as a bare minimum) and improvement, further degradation of natural character and habitat quality is likely.

Figure 3: *Examples of rivers/streams with a high integrity of habitat quality (left) and low integrity of habitat quality (right) (adapted from Death & Fuller, 2018).*

Table 1: *Habitat variables known to be important for each of ten native species of fish (from Petrove et al., in Death et al. (n.d.c)).*

	Longfin eel	**Torrentfish**	**Giant kōkopu**	**Kōaro**	**Dwarf galaxias**	**Inanga**	**Shortjaw kōkopu**	**Lamprey**	**Bluegill bully**	**Redfin bully**
Substrate										
Percent Deposited fines (100 – %x)	x	x		x	x	x	x	x	x	x
Particle compaction	x			x	x		x		x	x
Inorganic substrate diversity	x	x	x	x	x	x	x	x	x	x
D_{50} (mm)	x	x	x	x	x	x	x	x	x	x
Instream cover										
Total area of Instream cover	x		x		x	x	x	x		x
Undercut banks	x		x				x			
Instream wood	x		x		x		x	x		x
Macrophytes	x				x	x				
Flow types										
Deep pools	x		x				x			
Backwaters	x		x			x	x			
Side braids				x		x	x			
Riffles	x	x	x	x	x				x	x
Runs		x	x	x	x	x		x		
Riverbank										
Riparian vegetation			x		x	x	x	x		x
Overhanging vegetation	x		x				x			
Stream bank height			x			x	x			
Inanga spawning habitat						x				
Floodplain width	x					x	x			
Sinuosity	x					x			x	

Adverse effects on natural character and physical habitat

30. Despite the importance of having a high integrity of river form and features to functioning river systems, and the importance of those systems to human health and the health of ecosystems, river form and habitat quality tend not to be given the consideration in resource management for maintenance, protection, and improvement other metrics, such as nutrient or pathogen concentrations, are given.

31. The Ministry for the Environment and Stats NZ's 'Our Freshwater 2020' report summarised some of the degradation to freshwater habitat thus:

> Many of the freshwater habitats that our native species rely on have been reduced or damaged – sometimes entire ecosystems have been degraded. This has made some species particularly vulnerable to extinction…
>
> Modifying waterways with dams, pipes, concrete or rock banks, and constraints to a natural shape (such as forcing a wide floodplain into a narrower channel), can destroy and damage habitat. Removing riverside (riparian) vegetation from the banks of a waterway also reduces habitat for native species like īnanga…
>
> (p. 18, Our Freshwater 2020, MfE and Stats NZ)

32. Pressure on rivers and streams continues to rise as a result of human activity (Maddock, 1999). This has occurred, and continues to occur, through in-channel activities such as gravel extraction or flood protection, river channelisation (e.g. with stop banks, planting, or riverbank 'reinforcement'), damming, land cover changes, and encroachment (e.g. of farmland), among other things.

33. With the frequency of extreme climatic events increasing there is a perception that further modification to river systems will be required, as communities attempt to alleviate the effects of climate change on agriculture, human health, or infrastructure (Death et al., 2015; Vaughan et al., 2009).

Current state and management of the natural character and physical habitat of TANK rivers/streams

34. The condition of the natural character and habitat of rivers and streams in the TANK catchments varies widely. While some reaches of some rivers are 'natural-state' (such as the upper Ngaruroro) others are degraded (lowland streams and rivers).

35. An example of the degradation from 'natural state' (in terms of natural character) can be seen in the lower reaches of the Ngaruroro River, from the Whanawhana cableway to the coast. An example reach is provided in Figures 3a and 3b, illustrating how floodplain and active channel widths in particular have been significantly reduced when compared to a historic baseline.

36. While the Ngaruroro River remains braided through this reach and is clearly still an impressive and ecologically significant river with significant habitat values (having been recognised as an outstanding habitat for native birds by a Special Tribunal hearing the case for a Water Conservation Order[1]) the *natural character* of the river in this reach has clearly been modified and degraded.

37. This is again illustrated in the Karamū/Clive River and the reaches of the Ngaruroro River closest to the coast, where the main stem of the Ngaruroro River was diverted as part of flood management some decades ago. Figures 4a and 4b illustrate how the Ngaruroro River main stem flowed in what is now referred to as the 'Clive River' channel.

38. While Figures 3-4 illustrate historical degradation of natural character through significant 'flood protection' works in the Ngaruroro River, degradation of natural character and loss of habitat continues to occur through ongoing smaller-scale works, the cumulative effects of which constitute significant degradation. For example, Figure 5 illustrates recent attempts by Hawke's Bay Regional Council to plant willow poles in the active channel of the Ngaruroro River. Further examples of this activity in the Ngaruroro are provided in evidence I presented for the Ngaruroro WCO case, attached to this submission as Appendix 3.

[1] https://www.epa.govt.nz/assets/FileAPI/proposal/NSP000041/Boards-decision/WCO_Ngaruroro_and_Clive_Rivers_Recommendation_Report_Final_erratum_2019.10.04.pdf

Figure 3a: *The Ngaruroro River at Maraekakaho in 2020.*

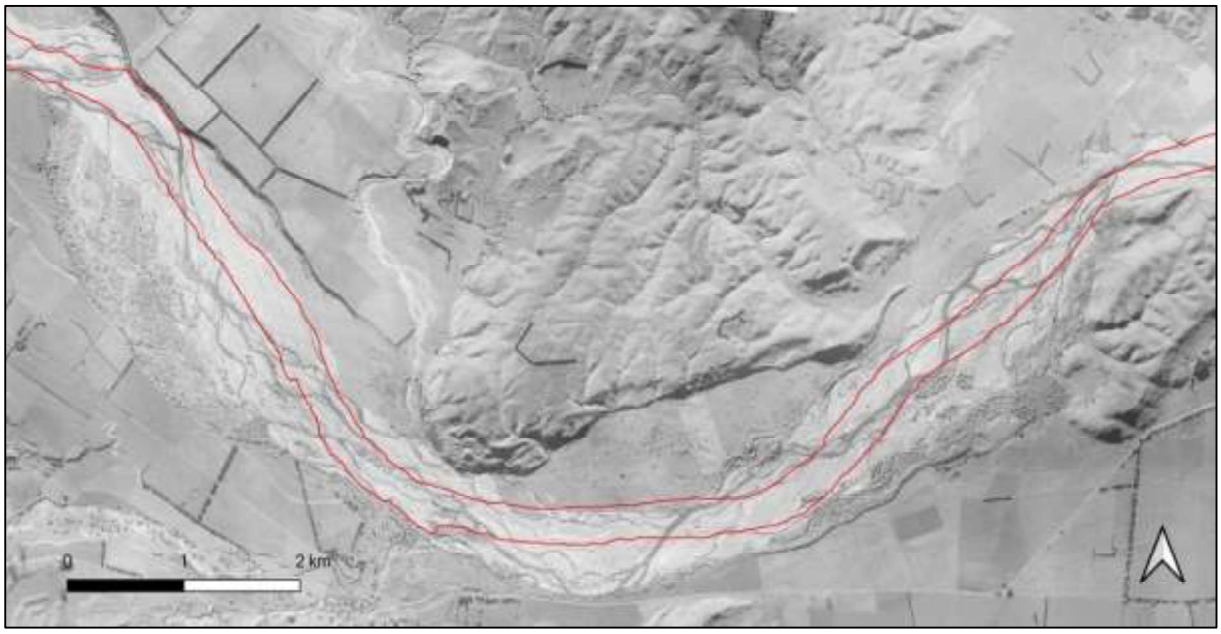

Figure 3b: *The Ngaruroro River at Maraekakaho in 1937 with the 2020 active channel outline laid over in red. Note the significant channel constriction, which, while it has not changed the river type (i.e. it is still a braided river), does illustrate a degradation of natural character and has reduced the area of physical habitat available.*

Figure 4a: *Ngaruroro and Karamū/Clive Rivers prior to diversion (1937).*

Figure 4b: *Ngaruroro and Karamū/Clive Rivers following diversion (2020). Note where the main stem of the Ngaruroro used to flow past Clive (Figure 4a) and how it no longer has the capacity to do this, instead flowing through an extremely straight 'flood' channel.*

Figure 5: *HBRC 'flood protection' 'edge' planting in the active channel of the Ngaruroro. This is a prime example of trying to further channelise a river—destroying braided river habitat in the process and adversely affecting natural character.*

39. This method of river management will not protect the ecological values of the river and is an obvious threat to natural character and habitat for native birds and fish. The cumulative impact of this activity could amount to a significant reduction in the width of the river corridor over time, reduce the area of unvegetated bar, and reduce the extent of braiding.

40. Channelisation and encroachment of rivers through the construction of stopbanks, river realignment/channelisation, and encroachment is widely accepted in academic literature as being a severe driver of ecological degradation and a reduction in natural character. It is this sort of activity that has narrowed the very lowest reaches of the Ngaruroro River (i.e. those nearest the coast) so significantly when compared to their 'natural' condition. Reaches of the Tutaekuri[2] and Ahuriri[3] have also been affected by similar works (and the Karamū has been impacted by realignments, including as above when the Ngaruroro main stem was shifted).

41. In order to maintain, protect, and restore natural character and physical habitat, river management approaches need to change, and better monitoring of natural character and physical habitat is required.

42. In terms of modern approaches to river management, I direct the panel to paragraph 69 of the evidence in reply of Professor Fuller in the case for a WCO on the Ngaruroro River (Appendix 2), which clearly states that modern approaches to river management emphasise a need to maintain and/or widen river corridors, rather than narrow them. This allows rivers to naturally adjust to fluctuations in their systems:

[2] https://www.hbrc.govt.nz/services/flood-control/major-schemes/
[3] Pages 6 and 24 of: https://www.napier.govt.nz/assets/Documents/Ahuriri-Masterplan/Ahuriri-Estuary-Masterplan-Final-10-August-2018.pdf
[3, 4] Also see images under 'NAPIER OPEN WATERWAYS WATER QUALITY' in http://hawkesbay.infocouncil.biz/Open/2021/05/EICC_12052021_AGN_AT.htm#PDF3_Attachment_14828_2

> Good practice in river management now recognises the need to provide room for the river to accommodate natural processes of adjustment (e.g. Piegay et al. 2005; Buffin-Belanger et al., 2015; Chone and Biron, 2016). That is, good practice now rarely allows for the further restriction or narrowing of river corridors. This practice is applied internationally and is beginning to be applied in New Zealand (Ramon Strong, Horizons Regional Council, pers. comm.)

43. Incorporating a robust methodology for measuring changes in natural character and habitat quality in PC9, as well as 'bottom line' limits on changes in natural character and habitat quality as sought by Forest & Bird will assist in ensuring a more informed and modern approach to river management is taken and drive a transition away from degradation to enhancement/improvement.

44. This can be achieved through the use of the Natural Character / Habitat Quality Index.

An explanation of the Natural Character Index (NCI) and Habitat Quality Index (HQI), and examples of where it has been used

45. Death et al. (n.d.a, n.d.b, n.d.c) developed the (essentially synonymous) 'Natural Character Index' (NCI) and 'Habitat Quality Index' (HQI) to assess change in the condition of a river's physical habitat in response to the lack of suitable available tools to assess the quality of physical habitat in rivers.

46. The NCI identifies and quantifies change in the natural character of a river over time. It involves assessing a river's 'current' form against its form at some point in the past. As Professor Ian Fuller states:

> … the NCI compares a parameter, or range of parameters, (relating to river geomorphology, such as channel width) observed in the present river form with that same parameter, or parameters, at the same site at a reference point in time. If no change in the overall assemblage of morphological units or river parameters measured has occurred (e.g. the width of a river channel is the same now as it was 10 years ago), the observed condition is the same as the reference condition and the ratio is 1.00. If there has been a reduction in the parameter (e.g. the channel has narrowed) the ratio will be less than 1.00 because the observed (current) condition is smaller than the reference (past) condition. In contrast, if there has been an increase in the parameter (e.g. the channel has widened) the NCI will exceed 1.00 because the observed condition is greater than the reference condition.
>
> (para. 30, Professor Ian Fuller, Appendix 1)

47. For example, Figure 6 shows how the width of the active channel at a number of points along a reach of the Rangitata River was measured in imagery from 1937 and 2016-2018 (Kay, 2020). The average width of this reach in 1937 was 569 m, while the average width in 2016-2018 was 382 m. The NCI for this parameter in this reach is therefore:

$$NCI_{active\ channel} = \frac{width\ in\ 2016/2018}{width\ in\ 1937} = \frac{382}{569} = 0.67$$

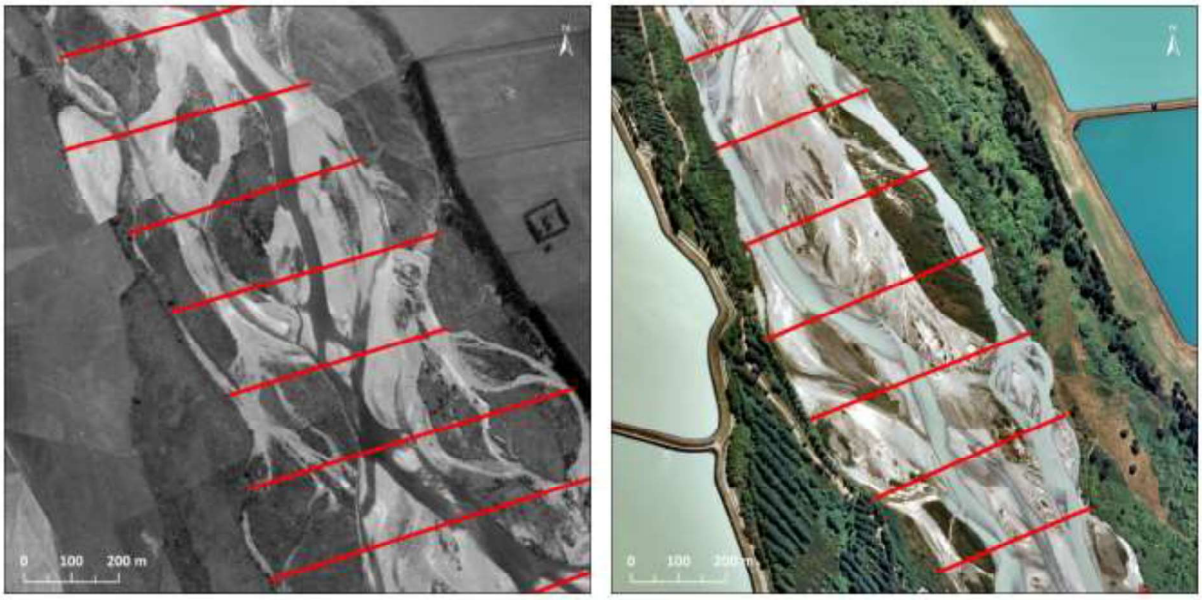

Figure 6: *An example of how a parameter of river geomorphology, in this case active channel width, can be measured at the same point at different times to assess change. This image shows the Rangitata River at Ealing in 1937 (left) and 2016-2018 (right). (Kay, 2020).*

48. Which, and how many, parameters are measured depends on the objective of the assessment, nature of the river, and availability of data (in the case above, imagery). Each parameter measured generates a separate NCI ratio and the median of these values can be used to provide an indication of the overall condition of the reach. This is illustrated in Table 1.

Table 1: *NCI scores for selected parameters in the Rangitata River, 1937 to 2016/2018. The $NCI_{overall}$ score reflects the median value of the active channel, floodplain width, and braiding index scores. Adapted from Kay, 2020.*

REACH	a	b	c	d	e	f	$NCI_{overall}$
Active channel	0.67	0.88	0.57	0.41	0.39	0.52	**0.55**
Floodplain	0.53	0.55	0.85	1.00	1.00	1.00	**0.92**
Braiding index	1.85	0.95	0.76	2.46	0.91	1.00	**0.98**
$NCI_{overall}$	**0.67**	**0.88**	**0.76**	**1.00**	**0.91**	**1.00**	

49. NCI assessment uses desktop analysis in GIS and is usually based on aerial imagery, from which key parameters can be measured. LiDAR data, historical maps, or other forms of geographical data can also be used. Assessments can be made of any period for which there is available data – usually years or decades.

50. Because of the scale at which the NCI is assessed, and because it is a desktop exercise, the NCI is most suitable for longer-term, larger-scale analyses of change in natural character or river habitat by measuring variables such as channel and floodplain widths, braiding indices, sinuosity, riparian vegetation, and the area of unvegetated bars. Other variables might also be appropriate.

51. While essentially synonymous with the NCI in that it uses the same before/after ratio method, I now tend to use the term 'Habitat Quality Index' (HQI) to refer to assessments of 'finer-scale' variables in a river (riffles, runs, pools, woody debris, substrate, etc.) across shorter time frames (days, weeks, months).

52. In this way, there can be a useful classification between:

    i. The **Natural Character Index**, which uses desktop analysis in GIS and is usually based on satellite/aerial imagery or maps, from which larger-scale variables relating to 'natural character' such as channel and floodplain widths, braiding indices, sinuosity, riparian vegetation, and the area of unvegetated bars can be measured. Assessments can be made of any period for which there is available data – usually years or decades, and;

    ii. The **Habitat Quality Index**, which uses aerial (including drone) imagery or on-the-ground measurements to assess smaller-scale variables relating to 'habitat quality', such as flow types (riffles, runs, pools), shading, substrate composition, sediment cover, riparian vegetation, and in-stream cover. Assessments can be made of any period for which there is available data – usually days, weeks, or months.

53. As stated by Fuller (Appendices 1 & 2), an NCI or HQI score is not a statement of a river's 'naturalness' or indication of how far it might be from being 'pristine'. Rather, it is an indication of change from a reference condition – which might be near natural or significantly degraded. Drivers of that change might be natural or human-induced.

54. In this way, the NCI and HQI can usefully be used in resource management frameworks and policy in that:

    iii. the **NCI** could be used to assess (and limit or set objectives for) changes to geomorphology and natural character; and guide policies, rules, and management plans on natural character, landscape values, river management, flood protection, and damming, among other things; and,

    iv. the **HQI** can be used as a finer-scale tool to assess the effects of a specific activity occurring under the regional plan (or set limits or objectives for the impacts of such work), such as in-stream works occurring under a resource consent or a river management plan, or restoration work. Where effects are

recorded (had they not been foreseen and addressed already), remediation work would need to be undertaken. Where restoration is intended, the HQI can help ascertain whether it is successful in achieving objectives.

55. Some examples of where the NCI and HQI (using my above definition to separate the two) have been used include:

NCI

- the Hutt, Waikanae, Otaki, Rangitikei, and Motueka Rivers, NZ; the Ebro, Spain; and the Sava, Croatia (Fuller et al., 2014, 2020)
- the Rangitata River (Kay, 2020)
- the Ngaruroro River (presented in evidence for the Ngaruroro WCO case, Appendices 1 & 2)
- the impacts of large flood events on the Waikanae River that occurred in 1998 and 2005, using available 'before' and 'after' aerial photographs (Fuller, work in progress).

HQI

- The Hutt River to assess the impact of in-stream flood management works on fish habitat (Death et al., n.d.a., n.d.c)
- The Waiohine River to assess the impact of in-stream flood management works on fish habitat (this was the case study for my thesis project)

Application of the NCI to PC9

56. As mentioned above, effective methods to measure change in river form and features—i.e. natural character and physical habitat quality—are vital to ensure that regional councils are meeting the requirements of policy direction in regard to natural character and physical habitat, including their objectives for enhancement, improvement, or restoration. Without effective monitoring tools and strong direction towards maintenance (as a bare minimum) and improvement, further degradation of natural character and habitat quality is likely.

57. I consider the Natural Character / Habitat Quality Index can be incorporated into PC9 to help achieve policy requirements by:

    i. Directing the use of the NCI/HQI as a monitoring tool[4] to ensure TANK/NPS/RMA objectives relating to habitat, natural character, and ecosystem health are being achieved,
    ii. Including minimum numeric thresholds against which NCI/HQI monitoring should be assessed (using a 'current state' [2020] baseline), whereby any score below these thresholds would be considered a degradation in natural character or habitat quality, and therefore a failure to meet objectives,

[4] e.g. as part of State of the Environment reporting

iii. Requiring significant activities with a potential impact on natural character or habitat quality to include NCI/HQI monitoring as part of their consent conditions,

iv. Including policies, objectives, and/or methods directing:

(a) the assessment of natural character and habitat quality against historical conditions to look at longer term change and identify opportunities for improvement

(b) the improvement/restoration of habitat quality and natural character where HQI/NCI scores show degradation

(c) the implementation of modern approaches to river management,

58. In regard to 62(ii), I have proposed a 'Schedule 26.X: Natural Character / Habitat Quality Limits' that incorporates NCI/HQI limits into PC9. This includes numeric and narrative limits on natural character and habitat quality for all TANK freshwater management units (Schedule 26.X: Table 1). These are minimum numeric thresholds against which NCI/HQI monitoring should be assessed (using a 'current state' [2020] baseline), whereby any score below these thresholds would be considered a degradation in natural character or habitat quality, and therefore a failure to meet objectives. These have been informed by:

- the nature of these management units (e.g. whether they are in headwaters/lowland areas),
- the NCI limits proposed by Professor Russell Death in his evidence on the Wellington Natural Resources Plan[5],
- reports and guidance on assessing impacts with the NCI/HQI,
- analysis of the Ngaruroro River undertaken for the Ngaruroro WCO case

59. Assessment of the above (whether it be part of ongoing monitoring or for a specific resource consent or activity) would be assessed with a standard NCI/HQI assessment using a median value as the 'overall' score. Notes on methodology are included in the schedule.

60. In addition to these limits, I have incorporated more specific limits on components of natural character in the lower Ngaruroro River. These were proposed by Professor Fuller for the lower Ngaruroro River as per his evidence for the Ngaruroro WCO case (Appendices 1 & 2).

61. I note that while Professor Fuller determined the NCI limits proposed for the WCO, as Forest & Bird's 'case manager' for the Ngaruroro WCO application, I assisted with the mapping of the Ngaruroro River to inform the analysis and determine these values and am therefore familiar with the process.

[5] https://pnrp.gw.govt.nz/assets/Uploads/HS3-Fish-and-Game-Dr-Death-Freshwater-objectives-Tabled-Evidence.pdf and https://pnrp.gw.govt.nz/assets/Uploads/HS3-S308-Russell-Death-Technical-Evidence.pdf

62. It is important to note that these specific limits would apply in addition to the median and minimum HQI/NCI limits, and that should any of these variables score below these individual component limits it would amount to degradation.

63. Proposed Schedule 26.X would need to be accompanied by an objective and/or policy (as per para. 57i and 57ii) stating (or with words to the effect that):

> The natural character and physical habitat of fresh water bodies is monitored and reported on, safeguarded such that ecosystem health is maintained or improved, and limits in Schedule 26.X are not exceeded.

64. In regard to 62(iii), PC9 should incorporate provisions that direct the use of the Natural Character and/or Habitat Quality Index as a requirement of any river management activities or resource consent applications with an 'in-stream' component or physical effect on the river geomorphology, and that any degradation in habitat quality and/or natural character as a result of works would need to be remediated. Schedule 26.X would provide the thresholds against which change would be assessed.

65. There should be direction that NCI/HQI analysis must be undertaken by a suitably qualified ecologist and/or geomorphologist (depending on what is being measured).

66. In regard to 62(i) and 62(iv), PC9 should also include methods stating:

> **Method X:** HBRC will report on natural character and habitat quality using the NCI/HQI as part of its State of its the Environment monitoring, including against Schedule 26.X limits.
>
> **Method Y:** HBRC will utilise the NCI/HQI to
>
> i. assess past and future change in the natural character and habitat quality of TANK water bodies,
> ii. investigate opportunities for restoration and improvement of habitat quality and natural character, including against historical condition
> iii. inform river management and flood protection planning and decisions (including the development of a modern approach to flood management), and
> iv. safeguard natural character and physical habitat in accordance with the limits in Schedule 26.X

SCHEDULE 26.X: NATURAL CHARACTER / HABITAT QUALITY LIMITS

TABLE 1: All Freshwater Quality Management Units					
Attribute	**Freshwater Quality Management Units**	**Reach**	**NCI / HQI Limit ***		**Narrative**
			Median	**Minimum**	
Natural Character[6] (NCI) / Habitat Quality[7] Index (HQI)	Upper Tūtaekurī	All	0.85	0.60	River form (including pool, run, riffle, and riparian margins) and function is suitable to support fish and macroinvertebrates through their life phases and protect ecosystem health.
	Tutaekuri tributaries	All	0.85	0.60	
	Lower Tutaekuri	All	0.85	0.60	
	Upper Ngaruroro	All	0.90	0.80	
	Ngaruroro Tributaries	All	0.85	0.60	
	Lower Ngaruroro**	All	0.85	0.60	
	Ahuriri	All	0.85	0.60	
	Lowland tributaries (including Ngaruroro)	All	0.85	0.60	

* Median and minimum refer to the component NCI/HQI scores – i.e. the lowest value in an assessment should not be < 0.6 and the median value not < the relevant median limit

** in addition to the NCI/HQI limits in table 1, the lower Ngaruroro River is subject to specific limits for the components of natural character listed in table 2.

TABLE 2: Additional Limits specific to Lower Ngaruroro Freshwater Quality Management Unit					
			NCI Limit		
Attribute	**Freshwater Quality Management Units**	**Reach**	Average channel width	Braiding Index	Area of unvegetated bar
Natural Character Index[7] (NCI)	Lower Ngaruroro	Whanawhana cableway (NZTM2000: 1891901E, 5615830N) to Matapiro Rd (NZTM2000: 1899143E, 5615058N)	0.93	0.78	0.88
		Matapiro Rd (NZTM2000: 1899143E, 5615058N) to top of HBRC Flood Management Scheme (NZTM2000: 1906679E, 5610950N)	0.98	0.85	0.90
		Top of HBRC Flood Management Scheme (NZTM2000: 1906679E, 5610950N) to Fernhill Bridge (NZTM2000: 1923019E, 5611264N)	0.99	0.86	0.86

[6] NCI assessments should be undertaken against a 2020 baseline using the methodology in: Fuller, I. C., Death, R. G., Garcia, J. H., Trenc, N., Pratt, R., Pitiot, C., Matoš, B., Ollero, A., Neverman, A., Death, A. (2020). An index to assess the extent and success of river and floodplain restoration: Recognising dynamic response trajectories and applying a process-based approach to managing river recovery. *River Research and Applications*, 1-13. https://doi.org/10.1002/rra.3672

[7] HQI assessments should be undertaken over the relevant time period using the methodology in: Kay, T. J. (2021), *A Methodology to Assess River Habitat Quality* [Master's thesis, Massey University]. URL to be confirmed.

Summary

67. Habitat and natural character are as important as water quantity and quality for ecosystem health in rivers and streams.

68. Degradation of natural character and physical habitat, and therefore ecosystem health, has occurred, and continues to occur, through in-channel works such as gravel extraction or flood protection, river channelisation (e.g. with stop banks, riverbank 'reinforcement', and planting), damming, land cover changes, and encroachment (e.g. of farmland), among other things.

69. Effective methods to measure change in river form and features—i.e. natural character and physical habitat quality—are vital to ensure that regional councils are meeting the requirements of policy direction in regard to natural character and physical habitat, including their objectives for enhancement, improvement, or restoration.

70. Use of the NCI and HQI, through policies/methods directing their use in monitoring, river management decisions, resource consenting processes, and through limits in PC9 will assist in achieving the objectives of the NPS Freshwater Management (2020), the RMA (1991), and PC9.

71. The Natural Character / Habitat Quality Index can be incorporated into PC9 to help achieve objectives by:

    i. Directing the use of the NCI/HQI as a monitoring tool[8] to ensure TANK/NPS/RMA objectives relating to habitat, natural character, and ecosystem health are being achieved,
    ii. Including minimum numeric thresholds against which NCI/HQI monitoring should be assessed (using a 'current state' [2020] baseline), whereby any score below these thresholds would be considered a degradation in natural character or habitat quality, and therefore a failure to meet objectives,
    iii. Requiring activities with a potential impact on natural character or habitat quality to include NCI/HQI monitoring as part of their consent conditions,
    iv. Including policies, objectives, and/or methods directing:

        (a) the assessment of natural character and habitat quality against historical conditions to look at longer term change and identify opportunities for improvement
        (b) the improvement/restoration of habitat quality and natural character where HQI/NCI scores show degradation
        (c) the implementation of modern approaches to river management,

[8] e.g. as part of State of the Environment reporting

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