BEFORE COMMISSIONERS APPOINTED
BY THE WAIKATO REGIONAL COUNCIL

IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of the First Schedule to the Act
AND	
IN THE MATTER	of Waikato Regional Plan Change 1- Waikato and Waipā River Catchments and Variation 1 to Plan Change 1
AND	
IN THE MATTER	of submissions under clause 6 First Schedule
BY	**BEEF + LAMB NEW ZEALAND LIMITED** **Submitter**

BRIEF OF EVDIENCE OF SIMON JOHN STOKES
3 May 2019

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BACKGROUND

1. My name is Simon John Stokes.

2. I am employed by Beef + Lamb New Zealand (B+LNZ) as the Environment Strategy Manager. I have a Bachelor of Science majoring in environmental science and physical geography from Massey University (1994), Palmerston North and a Diploma in Business Management from Eastern Institute of Technology (2003), Napier. I am a Certified Practising Resource Manager as accredited by the New Zealand Association of Resource Management. I also hold a certificate in Sustainable Nutrient Management in New Zealand Agriculture from Massey University (2006).

3. I have over 22 years' experience in natural resource management, primarily in land, water, biodiversity and catchment operations and management. I worked in regional councils for nearly all those 22 years. My particular areas of expertise are with farm planning and the use of the Land Use Capability Survey technique and application, soils, biodiversity operations and catchment planning and management. I also have expertise in corporate management, governance and the business of regional government.

4. Prior to joining B+LNZ I was the Eastern Catchments Manager for the Bay of Plenty Regional Council. I had previously worked for Manawatu Wanganui Regional Council as a soil conservator, based in Taumarunui, and the Hawke's Bay Regional Council, as a land management officer, based in Napier. I am also a past President of the New Zealand Association of Resource Management and was on the executive for 10 years. I led the New Zealand Deer Farmers Association Environmental Awards programme for 4 years in the mid 2000's where the emphasis of those awards was a triple bottom line assessment and whole of farm systems approach akin to farm planning. I recently resigned as a Trustee of the New Zealand Poplar and Willow Research Trust and the New Zealand Farm Environment Trust which runs the Ballance Farm Environment Awards programme.

5. I am also on the governance group for the Land Use Capability Classification System, managed by Landcare Research, established in 2012. I have also co-authored a guidebook on farm forestry for the Hawke's Bay, which used the land use capability system data of the region as a basis

for anchoring the guides information about the landscape and tree planting options.

6. My most recent work was for the Bay of Plenty Regional Council as the Eastern Catchments Manager tasked with implementing the Annual Plan and ten-year plan programmes. I specifically managed the integrated catchment management programmes for the Rangitāiki River, Ōhiwa Harbour, Waiōtahe, and Eastern river catchments. The management of these programmes were about implementing co-governance strategy's (Ōhiwa Harbour and Rangitaiki catchments); implementing sustainable land use and biodiversity plans on properties as projects with funding; providing an advisory service on a range of natural resource management issues, and building relationships, especially with iwi.

7. I have read the Code of Conduct for Expert Witnesses in the Environment Court's 2014 Practice Note and agree to comply with it. I confirm that the opinions I have expressed represent my true and complete professional opinions. The matters addressed by my evidence are within my field of professional expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

8. I can confirm that I am qualified to provide evidence on the use of the Land Use Capability system, including the Land Use Capability Survey Handbook, the mapping of the land resource inventory system in the field, the use of the Land Resource Inventory Worksheets, Regional classification bulletins and farm planning. This involves the ability to complete a preliminary investigation, mapping (field survey), synthesis and implementation required to undertake an extensive Land Resource Inventory assessment and a Land Use Capability assessment of land, using the methodology set out in the Land Use Capability Survey Handbook (3rd Edition) – A New Zealand handbook for the classification of land. I undertook field work from 1995-2007 using the technique to generate soil conservation plans and latterly comprehensive farm plans.

9. I was involved in the 'Green Project, a Sustainable Business Council funded project, which developed a quality assurance programme for farmers in a form of farm planning approach, incorporating the geo-physical spatial assessment of a farm along with a suite of actions to manage the

environmental issues on farm. The output from that project was then used in the development of the Land and Environment Plan document and programme, still being implemented by B+LNZ currently. Since entering management in 2007, I have used the technique as a basis for catchment scale planning in the Bay of Plenty in the Manawahe coastal area, Waiōtahe, Ōhiwa/Nukuhou, and Rangitāiki catchments. The Land Use Capability system was also used as part of the assessment criteria for riparian management plans in the Bay of Plenty region, supporting a plans approval process.

10. I also ensured that the training requirement for new land management officers at the Bay of Plenty Regional Council required attendance at a Land Use Capability training course so that all staff could use and understand the system. I developed and ran the training courses for Land Use Capability system in the mid 2000's for land management officers from throughout New Zealand. That structured course programme over three days is still in use today.

11. There is no current formally recognised qualification for using the Land Use Capability Survey Handbook and associated skills. The aforementioned training course is delivered by two experienced NZLRI/LUC practitioners when demand requires a course. There is a qualification at Massey University titled Advanced Soil Conservation Module 1, which includes tutoring on the technique. Historically soil conservators were assessed on their on-going capability in its use through their soil conservation certification programme. In development in New Zealand is a farm planning accreditation and certification scheme, similar to the sustainable nutrient advisor scheme. Competencies are being developed to validate a provider's ability to produce and audit farm environment plans. The extent to which the Land Use Capability Survey technique will be incorporated requires investigating. There is a good farming principle/practice which relates to LUC Class 7 and 8 and there will need to be some training and competency emphasis on using the Land Use Capability system.

12. For the purposes of this evidence I will be using and referencing the Land Use Capability Survey Handbook 3rd Edition (2009).

PURPOSE AND SCOPE OF EVIDENCE

13. My evidence explains the New Zealand Land Resource Inventory and Land Use Capability Classification system and it proposes its inclusion within the farm environment plan process for farmers in the Waikato and Upper Waipa river catchments.

14. My evidence will explain the New Zealand Land Resource Inventory and Land Use Capability Classification system through the following topics:

    (a) The New Zealand Land Resource Inventory and Land Use Capability history (in brief);

    (b) The New Zealand Land Resource Inventory and Land Use Capability system; and

    (c) Inclusion of Land Use Capability into PC1.

15. I also provide evidence on the cultivation and grazing rules proposed in PC1 and in relation to the section 42a Officers recommendations.

THE NEW ZEALAND LAND RESOURCE INVENTORY AND LAND USE CAPABILITY HISTORY (IN BRIEF)

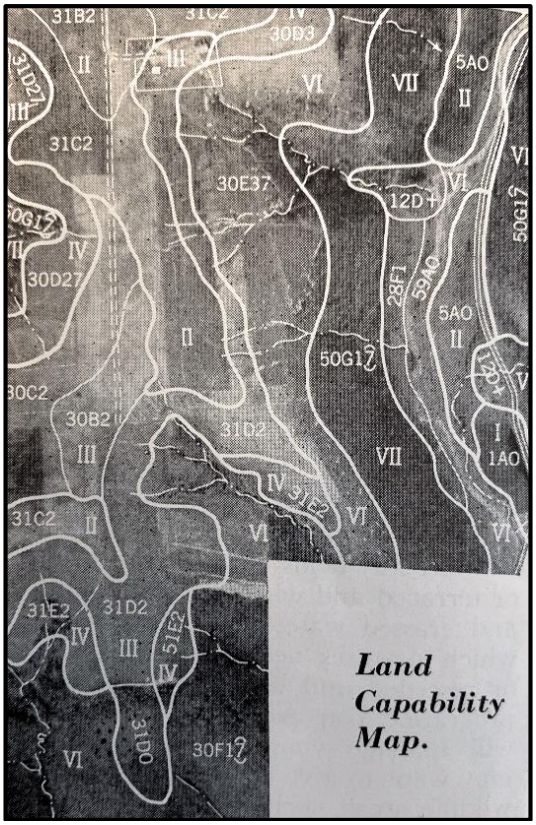
16. There is a long history to the development and use of the land use capability system which requires some explaining to understand why the system was used, how it was used and why it is still in use today.

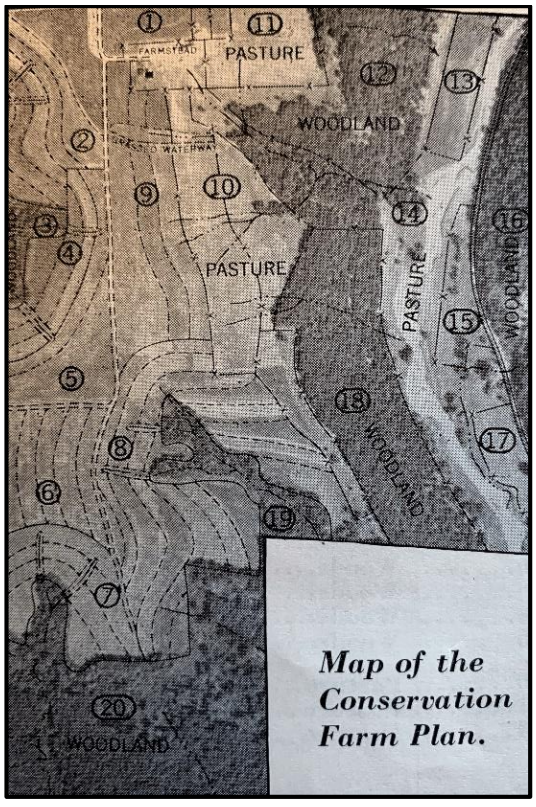
17. New Zealand started to experience widespread and severe erosion in the early 1900's and cyclone Thelma in 1938, which devastated the east coast of the North Island, was the catalyst for farmers and politicians to seek some form of legislation to manage landscapes and rivers. In 1941 the Soil Conservation and Rivers Control Act (SCRCA) was passed into legislation, which still exists to this day and is the responsibility of regional councils. Its primary purpose was to manage the erosion problem, including river erosion. To support catchment and river authorities in the implementation of the SCRCA, a land use capability mapping technique was investigated in the United States where it was being used by the United States Department of Agriculture in drafting soil conservation plans. The land resource

inventory field mapping and land use capability analysis which were both included in a conservation plan was accepted as an approach for use in New Zealand. The Land Use Capability system is more than just about erosion management, it is a holistic and appropriate tool for investing the long-term sustainable capability of the land, and in understanding its linkages to freshwater. It can be used to inform management decision around the sustainable use of land including pastoral land uses, farm systems, stock holding capacity, land management decision, biodiversity values, retirement, planting, and relationships between land and water resources.

18. An example is “What is a Conservation Farm Plan?”, Leaflet No 249, 1948, U.S Department of Agriculture – Van Buren County, Spencer, Tennessee. This document outlines the description of a conservation farm plan based on land use capability mapping.

Figure 1 is an example of a Land Use Capability map and Conservation Farm Plan, page 4 and 5, “What is a Conservation Farm Plan?”, Leaflet No 249, 1948, U.S Department of Agriculture – Van Buren County, Spencer, Tennessee.





19. This early example of land planning was seen as useful for New Zealand catchment authorities to use as a tool for individual farm and run plans.

20. In the late 1940's and throughout the 1950's, the development of a land resource survey mapping technique suitable for New Zealand was undertaken, based on the introduced United States system. It was a combination of the Pohangina Conservation Survey and the South Canterbury Catchment Board surveys that led to the National Water and Soil Conservation Council adopting the eight-class system in 1952. The application of this system was based on land resource inventory surveying (or examining of the nature of land) enabling an assessment of the land use capability, of an area (polygon), to support the planning of land use at farm scale and latterly regional or catchment scale.

21. The National Water and Soil Conservation Council officially adopted farm planning as part of its national soil conservation programme in 1955-1956. They used pilot and demonstration farms across the country and allegedly the first farm conservation plan was prepared in 1951 near Pohangina, on the Tew property. The plan at the time included a future land use map based on land use capability classifications and proposed land use changes. The purpose of the plan was strongly orientated towards reconciling socio-economic considerations with soil conservation necessities. The intent was to solve erosion problems by changes in land use that did not involve any monetary loss or ensured permanence and maximum productivity. Source Manderson A K, 2003, Farming from the Ground Up, Vol 2, Thesis, Massey University, Palmerston North.

22. From the late 1950's through the 1960's until 1967 the land resource inventory surveys and land use capability analyses were a mixture of soil conservation plans and regional and catchment surveys. National surveys were carried out and approx 9.3 million hectares was surveyed (page 323, Manderson A K, 2003). During this time, a range of farm plans were developed all using the land use capability survey system. Types of plans varied depending on the need; examples were soil conservation plans (general nationwide sheep and beef farms), run conservation plans (South Island high country farms), shelter plans due to wind erosion (Hawke's Bay

and Canterbury), orchard conservation plans (Moutere gravel erosion), and a dairy farm plan.

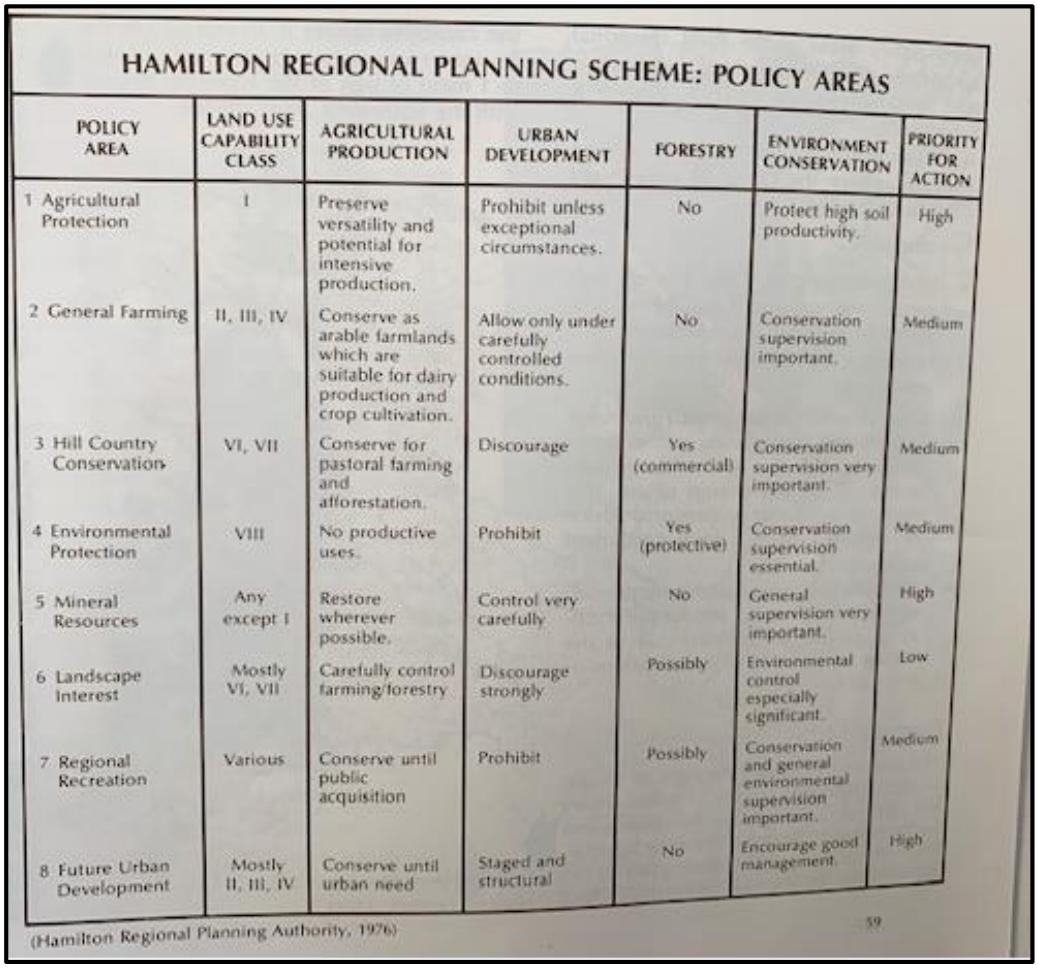
23. The use of this system grew beyond individual farm analyses to examine problems at catchment scale. The passing of the 1967 Water and Soil Conservation Act (1967) increased the need for the study of land use, land use capability, water management at complete catchments and river systems scale. It was now that it was decided that the entire country be mapped to assist the National Water and Soil Conservation Council with its responsibilities for the development of catchments and promotion of wise land use. The national survey was also to be more widely used to support the Town and Country Planning Act 1977 with comprehensive information about the land they were responsible for.

24. In 1970 progress was again made on the standards for land use inventory mapping and land use capability classification. The first edition of the Land Use Capability Survey Handbook was published (1969) and the emergence of the system as a nationally recognised approach to mapping New Zealand was re-enforced which resulted in the first New Zealand Land Resource Inventory dataset. The Handbook in particular was to be strictly adhered to based on the standards defined when completing a survey. It should be noted here that soil conservators were the only qualified professionals at the time with the ability and capacity to do land resource inventory surveys.

25. To quote A.L Poole, Chairman, Soil Conservation and Rivers Control Council (1971-1978), when describing the benefit of the land use capability technique for the lake Taupo catchment, "*nowhere in this country is the interrelationship between land use and water management better illustrated or of greater significance*". He went on to state "the importance of detailed land resource mapping in providing the basis for district planning has been realised as shown by the recent Hamilton Regional Planning Scheme. A set of eight rural resource policy areas has been defined each sharing some basic characteristics or problem and needing particular management or protection".[1]

[1] Source pages 9 & 10, Our Land Resources, 1979; Bulletin, Water and Soil Division, Ministry of Works and Development, Wellington.

Figure 2 is the Hamilton Regional Planning Authority use of Land Use Capability Class, page 59, Our Land Resources, 1979; Bulletin, Water and Soil Division, Ministry of Works and Development, Wellington.



HAMILTON REGIONAL PLANNING SCHEME: POLICY AREAS

POLICY AREA	LAND USE CAPABILITY CLASS	AGRICULTURAL PRODUCTION	URBAN DEVELOPMENT	FORESTRY	ENVIRONMENT CONSERVATION	PRIORITY FOR ACTION
1 Agricultural Protection	I	Preserve versatility and potential for intensive production.	Prohibit unless exceptional circumstances.	No	Protect high soil productivity.	High
2 General Farming	II, III, IV	Conserve as arable farmlands which are suitable for dairy production and crop cultivation.	Allow only under carefully controlled conditions.	No	Conservation supervision important.	Medium
3 Hill Country Conservation	VI, VII	Conserve for pastoral farming and afforestation.	Discourage	Yes (commercial)	Conservation supervision very important.	Medium
4 Environmental Protection	VIII	No productive uses.	Prohibit	Yes (protective)	Conservation supervision essential.	Medium
5 Mineral Resources	Any except I	Restore wherever possible.	Control very carefully	No	General supervision very important.	High
6 Landscape Interest	Mostly VI, VII	Carefully control farming/forestry	Discourage strongly	Possibly	Environmental control especially significant.	Low
7 Regional Recreation	Various	Conserve until public acquisition	Prohibit	Possibly	Conservation and general environmental supervision important.	Medium
8 Future Urban Development	Mostly II, III, IV	Conserve until urban need	Staged and structural	No	Encourage good management.	High

(Hamilton Regional Planning Authority, 1976)

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26. Between 1975 and 1988 the foundations of what we use today were developed and set in place. The land resource inventory technique was refined and standardised as being based on the physical factors of rock type, soil type, slope, erosion and vegetation. The Land Resource Inventory Worksheets were completed for New Zealand (330 maps) at 1:50,000 scale, which for the first time gave a complete national picture and the public a view of the countryside as never understood before. There was also the development of the regional classicisation bulletins to represent the information in a way which was useful to land use planning, which contained the first use of regional (geological/landform) suites and sub-suites of land use capability units. For example, in the Bay of Plenty-Volcanic Plateau region you will find a Taupo pumice suite which has 9 sub-suites due to its geological complexity at a more granular level. Only 8 of the 12 Land Use

Capability regions of New Zealand were provided with bulletins. What was very important development during this period was the national standardisation of mapping vegetation, erosion and rock type necessary to provide the nationally consistent application of data for surveying and analysis.

27. Essentially each region has its own unique set of land use capability units that can be correlated to other regional sets of units allowing for a language of landscape interpretation to occur for the use in farm, regional and catchment planning.

28. The current version of the land use capability system is still used today in New Zealand since its original inception in 1952. It has been refined since 1952 with little change occurring since 1988. Primarily in my belief because it is still the only national and regional scale data set with multi-factor information that allows an interpretation of the landscape to be used for a range of purposes. It underpins advanced farm environment planning and as such is a cornerstone to B+LNZ Land Environment Plans, and Horizons Sustainable Land Use Initiative, which is supported and part funded by the Ministry of Primary Industries.

29. It is important to understand that its use is still seen as relevant and important even with the growing list of environmental issues and growing need to see farm management practices applied more robustly. The topographical variation and complexity of farm systems requires an objectively gathered set of geo-bio-physical factors as a starting point, or base set of data, to allow a property/farm to become more precise in achieving potential minimum standards of practice and achieving business goals for economic, environmental, social and cultural reasons. The land use capability system in New Zealand was developed primarily for soil conservation purposes, focusing on erosion, conservation principles and wider environmental issues have never been left out of the conversation or reflected in the decision making of practitioners. It is planning tool by its simplest definition for which additional information or decision-making layers can be built upon.

30. Some practitioners within regional councils will also be using it for catchment scale analyses or using it within catchment models to provide land resource

information. The national Land Use Capability classification data set is used for understanding the risks of plantation forestry and harvest on soil conservation and associated risks on freshwater ecosystem health, within the National Environment Standards for Plantation forestry (2018). The land has been classified into yellow, orange and red categories based on its susceptibility to erosion which when applied then allows the interpretation of the standards required to be implemented, for example, a consent for planting and harvesting is required on 'red' land, whereas 'green' land is permitted activity for both activities. The Land Use Capability system is also underpinning the emerging landscape and landscape planning tools and models such as the National Sciences Challenge Land Use Suitability Program, which utilises the national LUC inventory as one of its base land inventory layers.

31. Regional and Unitary Authorities use the land use capability data set in regional and district planning. The Mitigator model developed by Ballance Agri-Nutrients uses the national Land Use Capability classification data set within the model to help determine the critical source areas on a farm. Bay of Plenty Regional Council uses it to protect land with versatile land use on Land Use Capability Classes 1, 2, and 3. Gisborne District Council District Plan contains rules for certain land use activity relating to the type of land use capability class. It is also used to outline a good management practice in the Land section for ground cover good management practice. It states: *retire all Land Use Capability Class 8 and either retire, or actively manage, all Class 7e to ensure intensive soil conservation measures and practices are in place.* Source Industry-agreed Good Management Practices relation to water quality, Version 2, September 2015. This practice definition has been carried over into the national list of good farming principles released by the government in 2018.

THE NEW ZEALAND LAND RESOURCE INVENTORY AND LAND USE CAPABILITY SYSTEM

32. The Land Use Capability system has two key components. A land resource inventory (LRI) compiled as an assessment of the physical factors present

in the field and an interpretation of that information into the standardised land use capability (LUC) classification.

33. The basis of the Land Use Capability classification is defined as a systematic arrangement of different kinds of land according to those properties that determine its capacity for long term sustained production. Capability is used in the sense of suitability for productive use or uses after taking into account the physical limitations of the land. Source: page 8, Lynn IH et al 2009, Land Use Capability Survey Handbook – A New Zealand handbook for the classification of land, 3rd Ed, Hamilton - AgResearch, Lincoln - Landcare Research, Lower Hutt – GNS Science.

34. This definition has remained unchanged since the first edition of the handbook. Interpretation of the definition often ends up debating what is meant by the words 'sustained production' and 'productive use or uses'. Their use in the interpretation infers that all land must be used and sustained for productive purposes because it has the capacity to do so, but this is too simplistic an understanding. My own interpretation would infer that the use or uses can include a vegetative state and land use activity, or perceived non-activity, which has no direct link to agricultural production or plantation forestry systems for example. In simple terms a bush clad hill country location is productive within itself and this can be a sustained long-term option. This connects the classification system with the concept of natural capital.

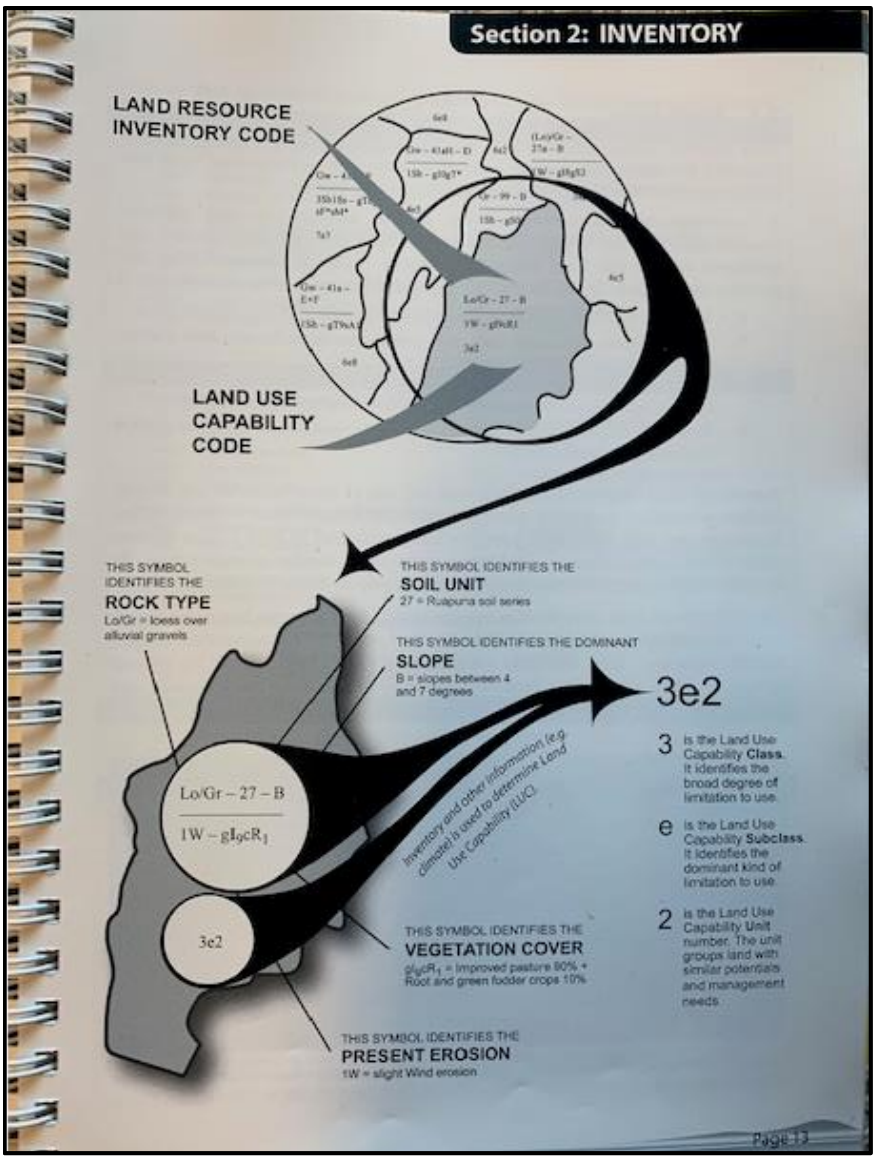
35. The benefit of modern supplementary information ecology and biodiversity, climate, archaeology, tectonic data-fault lines, and the greater understanding of the standard limitations (erosion, soils including vulnerability to leaching, wetness and climate) and environmental considerations, are taken into account. This example in figure 3 shows a landscape map in accordance with the standards of the handbooks use – a polygon of land with a wetness limitation and vegetative cover of wetland and estuarine species bordering an estuary. The physical factors mapped are the land resource inventory facts and would correlate to a known Land Use Class, sub class and land use capability unit. The land use option for the polygon in a farm plan could then be subjectively assessed and framed as an area unsuitable for any other use than retirement or a critical source

area. It doesn't have to have an industrial use. That is still a sustained long-term use considering our greater understanding of the benefits of this type of land use from an economic, environmental, cultural and possibly social perspective in this example. The point being that no matter what the land resource inventory and or the associated land use capability unit, not all land has to be thought of for industrial use. If there are rules relating to the land polygon which need to be complied with then the process of mapping the land resources and understanding that lands potential is a solid basis for more precise decision making for the plan owner.

36. The land resource inventory is used by the land use capability system as a basis for interpreting long term sustainable land use and water management, Source; page 12, Lynn IH et al 2009, Land Use Capability Survey Handbook – A New Zealand handbook for the classification of land, 3rd Ed, Hamilton - AgResearch, Lincoln - Landcare Research, Lower Hutt – GNS Science. There are five factors mapped; rock type, soil type, slope angle, erosion type and severity and vegetation cover. These physical factors are the focus due to their relative importance, either individually or in combination, in relation to how the land behaves under various uses. Add in climate, knowledge about current and past land use and other supplementary information and the capability of the land can be assessed for permanent sustained production.

37. The key difference between a land resource inventory approach and other land assessments is the multi-factor field technique versus single factor analysis. In my opinion a single factor field analysis cannot determine alone the land planning required. The natural resources present and land use activities (present or future) consist of a complex series of interrelationships crossing for example geo-physical, bio-physical, and ecological boundaries for instance. Understanding this concept places single factor analysis as useful and important, but not 'complete' enough to plan farm systems or land use management. Yet I would fully agree that a single factor such as rock type or soil type could have predominance in the subjective determination of a land use which is why the land resource inventory has an impact on the land use capability class, sub class and unit decision.

Figure 3 is an example of Coded Land Resource Inventory recorded as a formula', and the accompanying Land Use Capability code (adapted from NWASCO 1979). Page 13, Lynn IH et al 2009, Land Use Capability Survey Handbook – A New Zealand handbook for the classification of land, 3rd Ed, Hamilton - AgResearch, Lincoln - Landcare Research, Lower Hutt – GNS Science.



38. Rock type is recorded because it gives information on the geology and lithology present. This information can be used for giving background information to understand and plan for land stabilisation-erosion control and the nature and rate of run off. Rock type is underestimated in the process of land planning. It has major influence on slope angle, soil stability and the natural fertility of our landscape. New Zealand's geological and

geomorphological landscape is complicated further with various aerial and alluvial deposits occurring from loess and volcanic activity and river plain deposition. Another aspect of rock type mapping often mis-understood and mis-mapped are faultlines. Tectonics plays a large part in shaping New Zealand's landscape and the faultlines in our landscape are often associated with increased erosion levels where the resulting tectonic activity has crushed the bedrock causing massive scale slump or earthflow structures. This erosion activity can then be the source of huge volumes of sediment which can reshape and redefine catchment waterways and receiving environment.

39. Soil type is recorded for a multitude of reasons but primarily to understand what type of soil (soil order) exists where, and therefore, how can that soil be best managed and protected for example from degradation, for production or informing irrigation requirements. The mapping of the soils on a farm at farm scale provide for a higher level of precision in identifying the vulnerabilities of soil such as leaching, pugging, compaction, or erosion, and informing management decisions which can reduce the impact of land uses on these vulnerabilities. The current soil knowledge provided by S map and other publications also enables the plan holder to understand soil drainage and soil water holding capacity and therefore provides key characteristics that impact on the soils leaching potential. This knowledge is critical for the future management of soils and land in relation to the environmental issues that prevail.

40. Slope angle is recorded as a factor to support the understanding of the land's suitability and capability for use and the risk of surface erosion and mass movement erosion. In the context of PC1 LUC predominant slope could be used to determine management interventions at the land parcel scale such as stock exclusion provisions, which would reduce subjectivity and uncertainty for farmers and land management officers in determining when standards should apply.

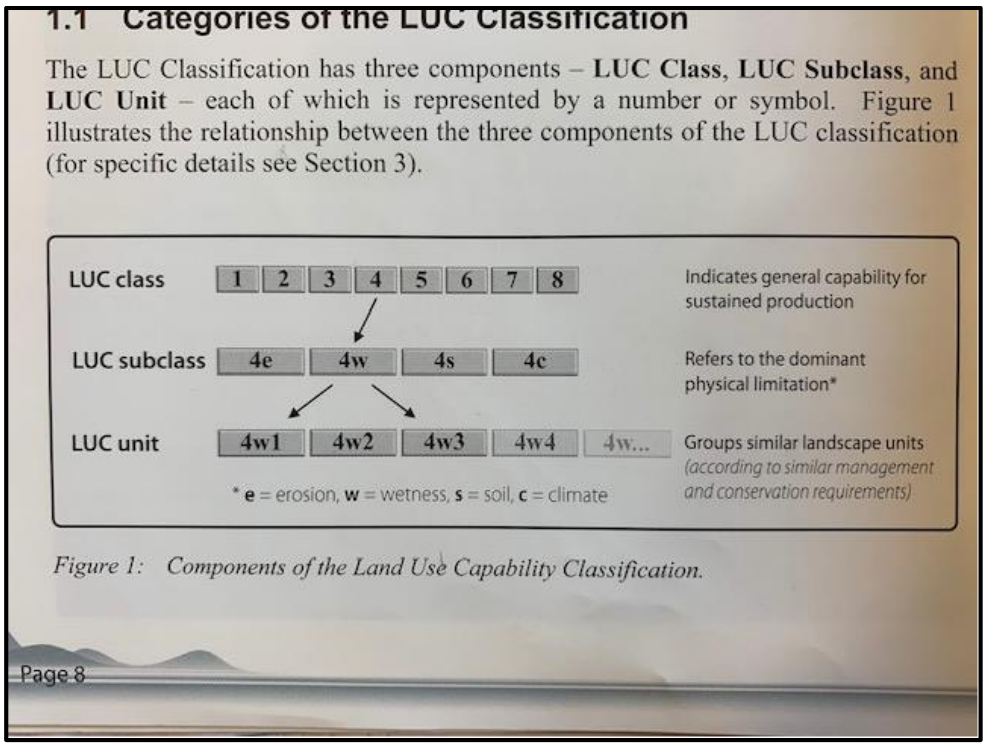
41. Erosion type is recorded because of our landscapes propensity to erode and that effect on our economy and environment. It is the fundamental reason legislation was required in New Zealand to conserve our landscape and environment and why the land use capability system was introduced. It is

the key limitation associated with the land use capability sub classes. It is mapped as present and potential erosion and by erosion severity. Decisions about land use and land management should always consider or be influenced by this factor, particularly in hill country. There are thirteen erosion types and one deposition category as defined in the 3rd Ed Handbook in New Zealand. The classification and definition of erosion types has been refined over 50 years of the use of the land resource inventory technique with the current definitions based on The New Zealand Land Resource Inventory Erosion Classicisation publication No85, Eyles G O, 1985, National Water and Soil Conservation Authority, Palmerston North. Each erosion type has its own guideline for mapping its severity which is then described within the land use capability code. This is an important assessment as it gives the assessor and farmer an understanding of the impact of the land use and the land management on the state of the natural resource which can then be managed more precisely.

42. Simply the land resource inventory mapped and recorded in the field is described in a code form – the land use capability code. This information is then interpreted into a land use capability classification. This assessment of the information outlined in lines on a map creating polygons or areas, is going to define its capacity for sustained productive use, taking into account the physical limitations, management requirements and land resource management needs. As mentioned previously this is where supplementary information is very important and useful.

43. The Land use capability classification has three components – land use capability class, sub-class and unit. Each is represented by a number or symbol.

Figure 4 is an example of the three components from page 8, Lynn IH et al 2009, Land Use Capability Survey Handbook – A New Zealand handbook for the classification of land, 3rd Ed, Hamilton - AgResearch, Lincoln - Landcare Research, Lower Hutt – GNS Science



1.1 Categories of the LUC Classification

The LUC Classification has three components – **LUC Class**, **LUC Subclass**, and **LUC Unit** – each of which is represented by a number or symbol. Figure 1 illustrates the relationship between the three components of the LUC classification (for specific details see Section 3).

Figure 1: Components of the Land Use Capability Classification.

Page 8

44. The land use capability class is the broadest grouping of the capability classification. It gives an indication of the lands versatility for sustained production taking into account the mapped inventory and therefore the general degree of limitation to use. There are eight classes ranging from class 1-8. This eight-level system was modified from the original brought from the United States. The scale ranges from Class 1 which is the most versatile land with the least limitation, to use, to Class 8 which has the least versatility and highest level of limitation, to use.

Figure 5 is an example of the often-shown table showing – Increasing limitations to use and decreasing versatility of use from LUC class 1 to LUC class 8 (modified from SCRCC 1974). *t* Includes vegetable cropping. Page 9 Lynn IH et al 2009, Land Use Capability Survey Handbook – A New Zealand handbook for the classification of land, 3rd Ed, Hamilton - AgResearch, Lincoln - Landcare Research, Lower Hutt – GNS Science.

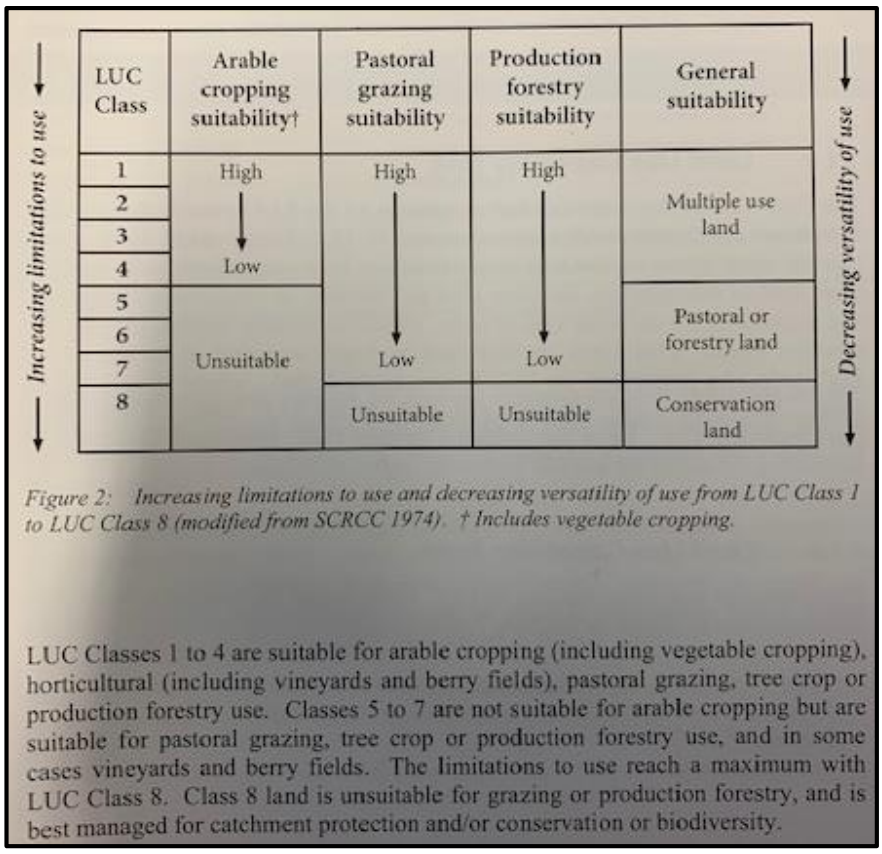


Figure 2: Increasing limitations to use and decreasing versatility of use from LUC Class 1 to LUC Class 8 (modified from SCRCC 1974). † Includes vegetable cropping.

LUC Classes 1 to 4 are suitable for arable cropping (including vegetable cropping), horticultural (including vineyards and berry fields), pastoral grazing, tree crop or production forestry use. Classes 5 to 7 are not suitable for arable cropping but are suitable for pastoral grazing, tree crop or production forestry use, and in some cases vineyards and berry fields. The limitations to use reach a maximum with LUC Class 8. Class 8 land is unsuitable for grazing or production forestry, and is best managed for catchment protection and/or conservation or biodiversity.

45. The land use capability sub-class is added to the code because it divides the land by its major kind of physical limitation or hazard to use is identified. Four physical limitations are prescribed in the 3rd Ed Handbook – erodibility where susceptibility to erosion is dominant; wetness where a high-water table, slow internal drainage, and or flooding constitute the dominant limitation; soil where dominant limitation is in the rooting zone. This can occur from shallow soil profiles, subsurface pans, stoniness, rockiness, low soil water holding capacity, low fertility and salinity and toxicity; climate where the climate is the dominant limitation. This can occur from consistent drought, excessive rainfall, frost and snow and exposure to strong or salt spray. Only one dominant limitation can be used in a map polygon or area. When one or more of the limitations are mapped which can occur on non-

arable land, a sub class hierarchy exists in the Handbook, whereby erosion has precedence over wetness and soil as the dominant limitation who both in turn have precedence over climate. The primary principle when prescribing a sub class is the permanency of the physical limitation, so even with management to improve or reduce the impact of the limitation, such as a land practice to improve fertility, remove stones, install permanent irrigation or erosion control, the limitation remains.

46. The land use capability unit is the most detailed part of the land use capability classification and provides a management prescription for its long-term sustained use. The development of this part of the classification system was primarily to enable a more precise application of the system at farm scale for the farm-soil conservation planning programme. While a land use capability class and sub-class can be mapped, similarities and differences within the land area or polygon needed codifying to enable more precise application of the land use capability analysis. Such as similarities or differences in soil conservation management, suitability for cultivation, pasture dry matter growth, crop types or forestry species.

47. This provides a more specific level of detail about the land use capability unit, which is provided in the extended legends in the national land resource inventory worksheets. For example, two land use capability units, 6e1 and 6e6 in pumice hill country. Based on their inventory both have been classified as land use capability class 6, both have a dominant erosion limitation, but due to a subtle change in slope angle, soil type, vegetative productivity variance, and possibly other factors, they are not the same in relation to their capability for long term sustained productive use. But neither are they significantly different by land use capability class or sub class – therefore the allocation of a unit descriptor defines their difference which can then be managed accordingly. This is why the land use capability unit is called the ‘management level’ within the land use capability system. Source: page 87, Lynn IH et al 2009, Land Use Capability Survey Handbook – A New Zealand handbook for the classification of land, 3rd Ed, Hamilton - AgResearch, Lincoln - Landcare Research, Lower Hutt – GNS Science.

48. Within the national data set there are several land use capability units, listed numerically, based on their assessment of degree of versatility and degree

of limitation to use. At a farm plan scale the land use capability unit is necessary to fully maximise the land resource inventory assessment. The application of this within farm plans is supported by the development and use of the land use capability suites mentioned previously, which tie land use capability units into a landscape picture based on a geomorphological, geological or regionally distinguishable feature e.g. Banded Mudstone suite or Taupo flow tephra and water sorted tephra suite.

49. The following is an example of what a land and environment planning (Level 3) exercise would look like. The two maps highlight the detailed and tailored benefit of a land use capability survey providing a land use capability (unit) map and the ability to provide a possible recommended land use management plan to be actioned by the farmer.

Figure 6 is an example of a land use capability assessment map. Source: Hawke's Bay Regional Council Plan No 3778.

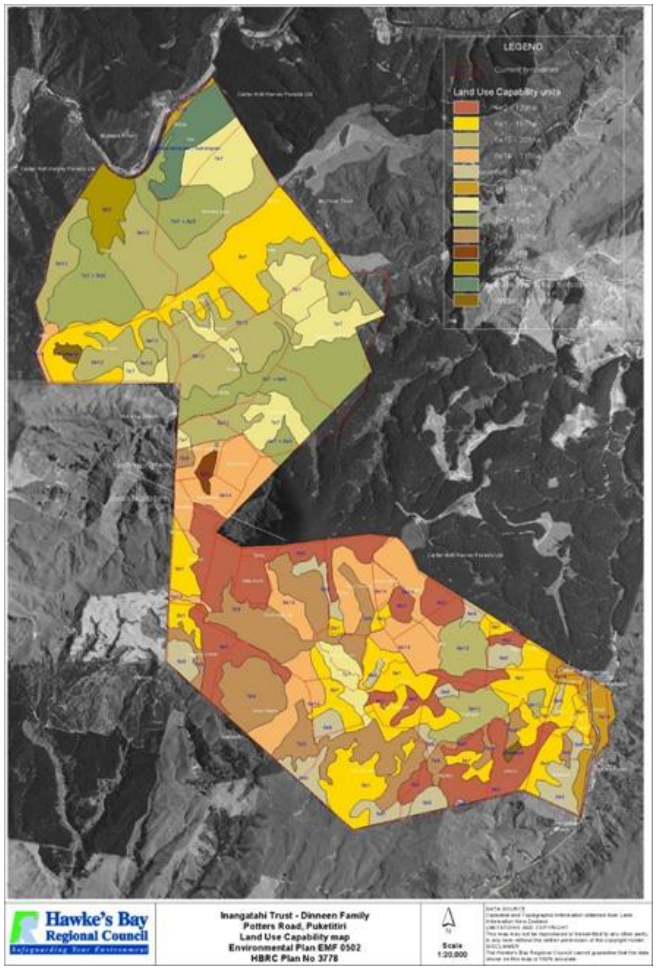
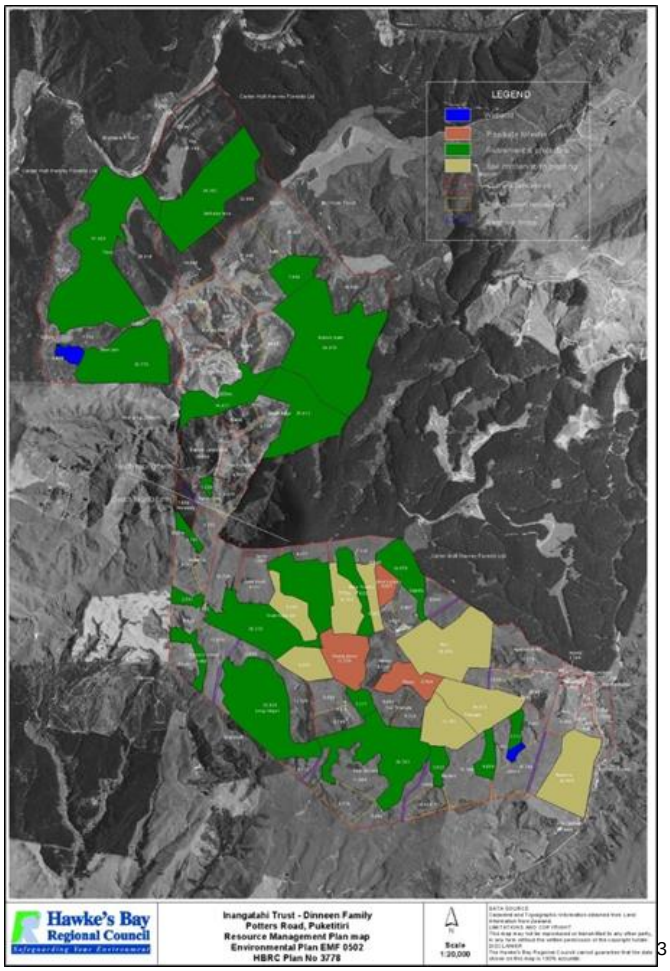


Figure 7 is an example of a recommended land use map derived from a land use capability assessment[2].



[3]

These types of visual drivers for a farmer translate into the two supporting photos. Both photos display the mosaic land cover of farms that have been managing through the application and then deliver of farm based LUC mapping which has shaped land use and management choices resulting in a diverse and resilient productive landscape[4].

[2] Source: Hawke's Bay Regional Council Plan No 3778.

[3] Photo source: Hawke's Bay Regional Council

Figure 8 Photos of farms that have been managing through the application and then delivery of farm based LUC mapping.

 [5]

 [6]

[5] Photo source: Hawke's Bay Regional Council

[6] Photo source: Hawke's Bay Regional Council

50. While both photos and the farm plan map examples are not from the Waikato, the principles of farm planning, its implementation, and result would not be dissimilar.

51. There is much scientific research and papers published nationally and internationally outlining the robustness and place of LUC within sustainable natural resource kete. Regional councils, primarily, find a common language and scientifically robust process of analysis, to manage and protect land and water in farm planning. The fact that the breadth of environmental issues and risks associated with a piece of landscape, whether in agricultural or horticultural or conservation management use, has grown to match the needs of the community and landowners, does not affect the validity of using the system nor undermine its role in providing a clearly understood platform of analysis to manage issues and risks into the future.

52. In the last decade new tools for interpreting our natural resources and mitigating effects on the natural resources have been developed like lidar, geo-magnetic surveying, catchment modelling – e source, land models – MyLand, Mitigator, LUCI, GIS, S-map, riparian planner, and the many varied farm environmental plan options, to name a few. These tools are all beneficial participants to achieving the overarching outcome of managing natural resources sustainably, however much of their utility comes from enhancing the use of LUC or its application, and many tools such as MitAGATOR continue to rely on LUC as a fundamental building block within its model. The complexity of the natural ecosystem and economic system cannot be measured in single factor steps even when trying to focus on a issue such as water quality, but must be built on integrated platforms that assess the complexities of the natural environment.

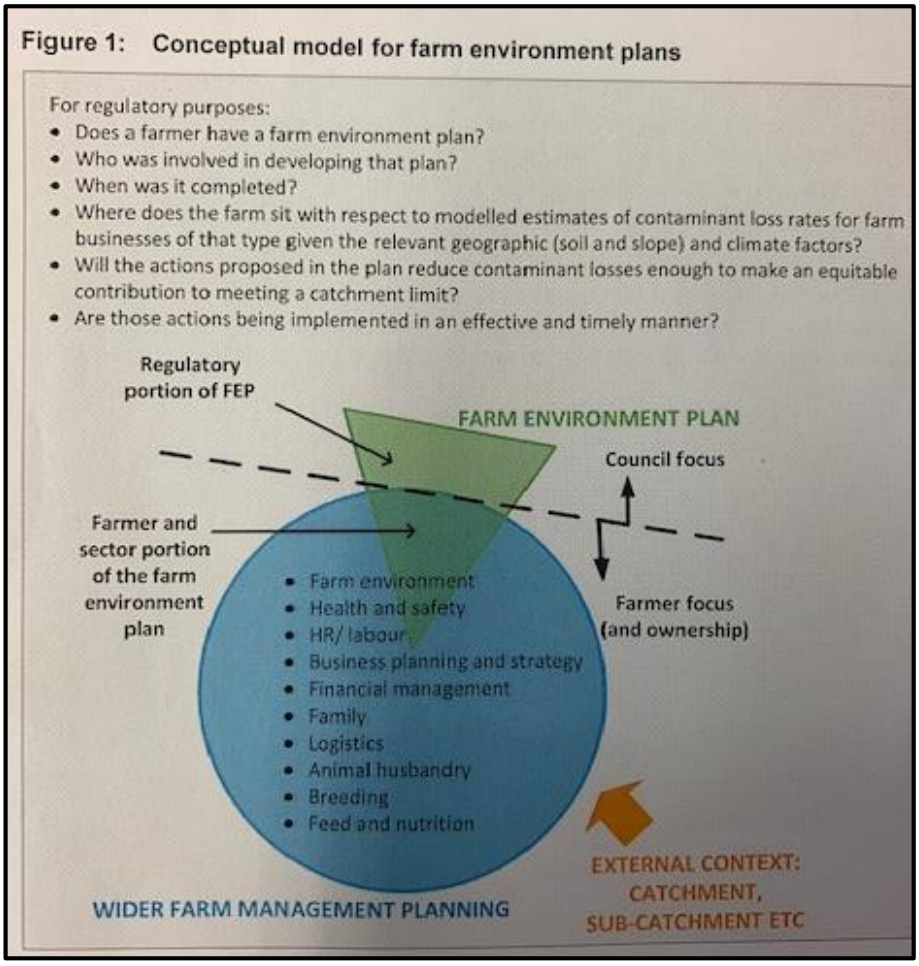
INCLUSION OF LAND USE CAPABILITY INTO PC1

53. B+LNZ has been implementing its Land and Environment Plan programme for over a decade. Farm planning, as defined by its many versions over the last 70 years and in the last decade more often termed farm environment plan, has been an ongoing consistent approach to managing natural resource issues. Even though different regions and different agencies have faced different pressures and drivers with different planning backdrops, everyone turns towards some form of planning document or process tailored

to achieve the required end result. The Farm Environment Plans National Collaborative Working Group's final report in 2015 commented that "Farm environment plans are a long-standing risk management and capacity building tool. They are used by "farmers to understand the impact that they have on the environment and to shift practice to mitigate this impact, and by some sectors as part of a strategy for extracting additional market value" Source, page 1, Farm Environment Plans National Collaborative Working Group - Final Report, 23 June 2015, Martin Jenkins, Wellington.

54. The Working Group also commented that "Resilience and resilient farming systems present a great opportunity for long term focus. However, while farmers have long term business strategy, the immediate regulatory need to manage within limits while increasing profitability requires hard business calls to be made to ensure the viability of their farming enterprise. The best possible short-term result through this process is the co-production of decision support tools that accounts for all of our natural capitals – environment (ecological, biodiversity), economic, social, cultural – to enable farmers and growers to make the best decisions for their farm." Source, page 2, Addendum to the Martin Jenkins Final Report: Farm Environment Plans National Collaborative Working Group, 23 June 2015, Martin Jenkins, Wellington. Figure 6 highlights the Working Group's conceptual model they saw, which in their minds provides access to actions on-farm and a recording mechanism, to give the user and regulator/auditor confidence and credibility in relation to the benefit of a farm environment plan.

Figure 9 is the conceptual model for farm environment plans, from page 15, Martin Jenkins Final Report: Farm Environment Plans National Collaborative Working Group, 23 June 2015, Martin Jenkins, Wellington.



55. A Ministry for the Environment report in its summary statements also recommend the ongoing use of farm environment plans as an effective approach to meet future challenges in resource management. The report, Review of New Zealand Environmental Farm Plans, May 2003, Blaschke P & Ngapo N, published report by the Ministry for the Environment, provides two clear statements from its executive summary that helps to underpin why B+LNZ support farm planning in a mixed regulatory-non-regulatory approach. Executive summary No 6 states “that many regional councils recognise that environmental farm plans are an effective method of achieving good environmental outcomes in a non-regulatory way”, and No7 elaborates on their potential use by stating “there is also the potential to integrate environmental farm planning with other on-farm objectives, as well

as wider catchment goals. They can be an ideal mechanism for implementing catchment schemes".

56. In my opinion, the use of a tailored farm environment planning approach in PC1, underpinned by a robust stock take of the farms natural resource and the identification and management of critical source areas will deliver sustainable and enduring outcomes in the integrated management of land and water resources. These Farm Environment Plan requirements, however, should require a land resource inventory assessment interpreted into a land use capability unit at farm scale, essentially using the Land Use Capability system, which provides a multi-factor assessment to understand the natural capital (resources), their opportunities and their limitations. Farm environment planning based on prescriptive practice standards controlled by the Waikato Regional Council will not result in the farm system change required to significantly reduce emissions for current farming systems and practice.

57. A fundamental principle for B+LNZ is to support farming excellence and to support a sense of purpose that has a tangible impact for their farmers. I support this principal. An enduring benefit that a tailored farm environment plan provides is not just the plan itself, but in the process of plan development, the knowledge connections that the farmer makes in relation to their natural resources and their long-term sustainable management. It is process of reviewing and where required changing farming systems and practices to realise the opportunities provided by these resources while avoiding and remedying their limitations, that deliver on the ground change and shape diverse and resilient landscapes. At its most fundamental level, a farm environment plan is critical to this sense of purpose because it can be a capability and culture building tool on farm and maintain a level of credibility in the eyes of a farmer in being effective in supporting them to meet future challenges, be they environmental or about productivity.

58. Figure 9 shows the current table in the Land Use Capability Survey Handbook, 3rd Edition. This is a clearly outlined standard for mapping that can and should be used by a practising land use capability mapper. The scale of mapping should correlate with the management purposes. For tailored farm or land environment planning, and in particular in diverse

landscapes the appropriate scale to support the land resource inventory field assessment and mapped land use capability units is 1:10,000 (1cm-100m). This is because it is necessary to map a farm at the level of the land use capability unit. J Wallace Ramsay's paper on Conservation Farm Planning in the Soil Conservation and the Planning of Land Use proceedings of the 10th New Zealand Science Congress, August 1962, on page 18 he states that "In conservation farm and run planning greater use is made of sub classes designated by the chief limitation factor; and units, designated by a land management factor". The current national worksheets containing the land resource inventory and land use capability units is at 1:50,000 (1cm-500m), which is appropriate for regional or catchment planning and the identification of vulnerability or opportunity at a broader scale, and to use the national worksheets to provide background information to the mapping and land resource inventory analysis.

Figure 10: Table 18: Guidelines to selection of appropriate scales for extensive LRI/LUC surveys (modified from McRae & Burnham 1981 and Jessen 1987), Source: page 100, Lynn IH et al 2009, Land Use Capability Survey Handbook – A New Zealand handbook for the classification of land, 3rd Ed, Hamilton - AgResearch, Lincoln - Landcare Research, Lower Hutt – GNS Science.

Table 18: Guidelines to the selection of appropriate scales for extensive LRI/LUC surveys (modified from McRae & Burnham 1981 and Jessen 1987).

Scale level[1]	National	Regional	District and catchment	Farm
Scale[2]	1:250,000 to 1:100,000	1:100,000 to 1:50,000	1:50,000 to 1:15,000	1:<15,000
Scale size[3]	Small ◄			► Large
Map detail[3]	General ◄			► Detailed
Smallest area[4]	40–250 ha	10–40 ha	1–10 ha	≤ 1 ha
LUC level	Dominant capability class or subclass	LUC unit (regional)	LUC unit (regional)	LUC unit (regional and farm[5])
Common application examples	Strategic overview, broad planning, prioritising or targeting projects for detailed investigations.	Land use planning, targeting of regional priorities and projects, reference for more detailed survey.	Catchment projects, small district/community projects, farm planning for large properties.	Farm planning (detailed), nutrient budgeting, farm development projects, precision agriculture.

[1] Scale levels are subjective. Meaning is often dependent on context (e.g. a 'detailed' scale in a farming context is different from a 'detailed' scale in a regional context).

[2] Recommendations are based on common NZ scales used in soil, geology and LRI/LUC surveys.

[3] Large and small scale terminology is confusing. A 'large' scale (e.g. 1:5,000) is actually more detailed than a 'small' scale (e.g. 1:500,000). Scales are essentially fractions, and fractions with large denominators are smaller numbers (e.g. 1:5,000 is the same as 1/5000 or 0.0002, which is a larger number than 1:500,000 = 0.000002).

[4] The smallest area of interest represents the minimum legible area (MLA) that can be displayed on a paper map at a given scale. Any smaller and labelling becomes illegible, and line boundaries become disproportionate. Modern digital printing can accommodate a minimum legible area as small as 0.4 cm^2 (after Forbes *et al.* 1982).

[5] Occasionally regional LUC Units may require adaptation at the farm scale (see Section 4.4).

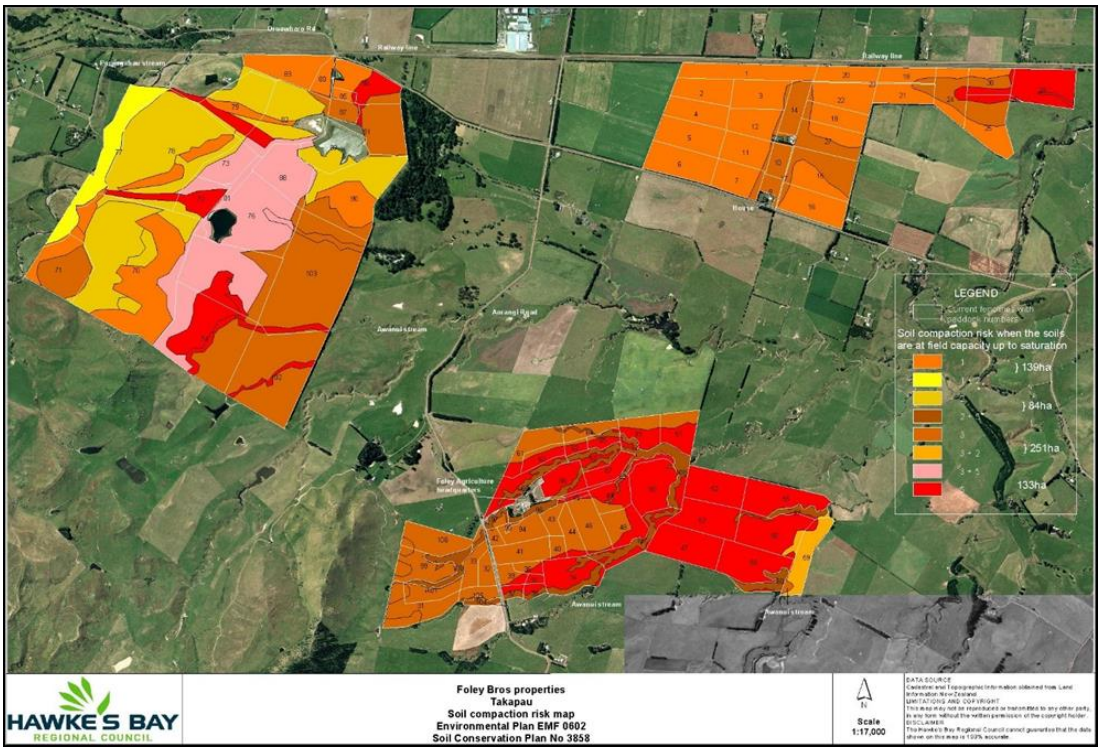
59. A sheep and beef farmer, or any landowner, with a professional land resource inventory field assessment can use that information within a land and environment plan, farm environment plan, or other version of farm plan, to more precisely manage their business. This is necessary due to the increasing precision being requested of landowners in relation to stock exclusion, stocking rates, cultivation management, erosion and sediment control in a landscape which is not flat and contiguous, but complex. When asked to comply or implement rules relating to the activities on the farm or other land uses, having farm scale or higher mapped inventory and land use capability units provides a consistent approach to ensuring those rules or minimum standards or good management practices are applied more robustly and precisely.

60. Having a consistent approach to farm environment planning will help data collection, reporting, auditing and compliance. Having a visual guide such as a map is very useful for all involved in any land activities as it connects everyone visually to the landscape. This is important because connection with the land is a characteristic of sheep and beef landowners in a way which is more than just ownership. The mapped property can also be spatially interrogated on computer and easily managed for update or recording. This means that sheep and beef farmers and agencies and rural professionals can use the same language to communicate. As modern technology transforms how we see and map the land using drones, it will be important to standardise how we approach 'reading' the landscape and then managing and protecting it.

61. An example of the multiple and flexible use of a land use capability assessment can be to develop risk maps for various environmental or production-based requirements. In a paper to the titled "Working with Farmers to Implement Sustainable Farm systems", Stokes S et al showed the use of the land use capability system and land use capability units to support additional land use management in implementing sustainable farm systems. A soil compaction risk map was developed for the Foley Bros properties in Hawke's Bay which was used for managing the effect of their grazing system for the winter. Soils were derived from the land resource inventory filed assessment and then used as the GIS field to highlight their risk. Soil drainage classes were used for each soil which provided the basis

for each soils risk. This process of highlighting a single factor from within a suite of land resource factors is an underutilised usage of the land use capability unit. This approach does not mean the other land resource inventory factors have been isolated from the specific analysis, if anything they re-enforce the risk decision making process comes from a more complete ecosystem footprint analysis.

Figure 11 is a Foley Bros property soil compaction risk map. Source: Working with Farmers to Implement Sustainable Farm systems, Stokes S, Eyles G O, Clouston T G & R G,8-9 February 2007, Designing Sustainable Farms – Critical aspects of soil and water management, Proceedings of Fertiliser and Lime Centre Conference, Massey University, Palmerston North



62. A farm environment plan with a land use capability system in place can also be used to support the allocation of nutrients. Land Use Capability provides a well-known and scientifically robust approach for planning land use and providing detail on land management required to conserve the natural capital of the landscape which will be linked to nutrients, pathogens, and erosion loss risk. Both phosphorous and nitrogen are not isolated from general farm use or activity in how they impact on the environment. Their

impact on waterways and other receiving environments is dependent on many factors in relation to the landscape and farm system. In my opinion the development of the natural capital allocation approach and the use of Land Use Capability as a proxy for appropriate approach to the allocation of nutrients within a farm business or combination of businesses within a catchment or sub-catchment is robust. This approach enables allocation to be decoupled from current land uses and linked, instead, directly to the underlying natural biophysical resources in the catchment.

63. A farm environment plan with a land use capability system can be used in models such as Overseer or Farmax, for example, ensuring greater precision in the input and output data. Overseer and Farmax both can create 'blocks' within their models which should be correlated to a property's land use capability units. Once a land use capability unit has been mapped, even in several locations on a farm, it is the same land and can be treated as a 'block'. A farm could then manage its allocation standard more accurately via a combination of more precise land resource inventory data, nutrient management input and output and pasture/crop type and dry matter production and harvest. This would give the farmer a greater level of ability to mitigate the problems associated with nutrients.

64. Tied inexplicably to meeting the challenge of nutrient allocation is also the running of the farm system, especially the intensity of stocking on a farm as an overall average or as a practice in grazing management. As set out in the evidence in chief of Dr Chrystal and Dr Dewes stocking rate and stock type are primary divers in nitrogen leaching risk. In combination with my previous comments in para 46, an additional advantage of the farm scale map with land use capability units is understanding more precisely stock carrying capacity, and the appropriateness of stock type and weight in relation to the natural characteristics of the land. A farmer can learn and derive the present average carrying capacity (this they will know from their own records), the carrying capacity of a top farmer and the attainable physical potential carrying capacity from the region's overall assessment from the LUC extended legend. The inclusion of this type of data in the land resource inventory worksheets started in 1978 as a cooperative exercise involving the Ministry of Agriculture and Fisheries – specifically the Economic Division and Regional Advisory Officers, New Zealand Forest

Service (for site indexing of *Pinus radiata*) and the Ministry of Works and Development's land resource inventory scientists. The farmer will have much more up-to-date information along with the data collected for the worksheets, where both can contribute towards the subjective analysis of the land use capability units. This data would not change the land resource inventory mapped except possibly where there is a variation to vegetation type that has occurred. Further detail as to the development and application of the stock carrying capacity data within the national land resource inventory data set is available.

65. In drafting farm plans over the years, I have referenced the stock carrying capacity by land use capability unit to give the farmer a sense of the potential stock carrying capacity, or site indexing for forestry potential. From that experience and anecdotally, many farmers were not surprised at the carrying capacity potential provided by the worksheet data, but more importantly, in combination with a greater understanding of the land use capability mapped and presented in a planned context, they were able to better grasp improving their farm system by paddock sub-division or realignment, implementation of erosion control of their soil, or provision of other values such as biodiversity. It is a pathway towards continual improvement and behavioural change.

66. A paper titled "Deriving pasture growth patterns for Land Use Capability Classes in different regions of New Zealand", Cichota R, Vogeler I, Li F.Y, and Beautrias J, 2014, AgResearch Grasslands, to Grasslands Association conference provides researched validation that the assessed productivity levels of pasture within the land use capability data associated with stock carrying capacity as agreeing well with researched pasture growth patterns and yields. The papers abstract states, "Farm system models are increasingly being used to assess the implications of land use and practice changes on profitability and environmental impacts. Exploring implications beyond individual farms requires the linkage of such models to land resource information, which for pastoral systems includes forage supply. The New Zealand Land Resource Inventory (LRI) and associated Land Use Capability (LUC) database includes estimates of potential stock carrying capacity across the country, which can be used to derive annual, but not seasonal, patterns of pasture growth. The Agricultural Production Systems

Simulator (APSIM) was used, with generic soil profiles based on descriptions of LUC Classes to generate pasture growth curves (PGC's) in three regions of the country. The simulated pasture yields were similar to the estimates in the LRI spatial database and varied with LUC Class within and across regions. The simulated PGC's also agreed well with measured data. The approach can be used to obtain spatially discrete estimates of seasonal pasture growth patterns across New Zealand, enabling investigation of land use and management changes at regional scales". Source: page 203, Grasslands Conference Proceedings, 2014. This researched example gives confidence to using the land use capability units as a basis for correlating a level of stock carrying capacity to potential nutrient inputs and outputs, understanding that for that land use capability to be sustained in long term use in must be managed accordingly to that unit's management prescriptions. There is nothing in the 3rd Edition Handbook to suggest that new management requirements could not be added to existing land use capability units' management practices.

67. In summary, allocation of nutrients within a farm system or aligned to the land is not easy. However, the close alignment between the concept of natural capital and the land use capability system allows for a more appropriate and tailored application of potential minimum standards for land use practices, which may affect land use change. Modernisation of mapping techniques or data collection process for the land use capability classification system will not change the basic process of collecting land resource inventory or how that is interpreted into a land use capability unit. If anything, this will help refine the data and its accuracy in mapping which makes it more precise to be measured against a minimum standard or target.

68. Issues with nitrogen leaching and losses of phosphorus arise through the vulnerability of the soil to leaching, and erosion, shaped by the underlying geology, and vegetation cover, and stocking rate and intensity. As such management approaches/ frameworks should appropriately focus on holistic and integrated approaches to managing land and water resources including the use of tools which appropriately reflect this diversity including the combination of natural capital and land management activities. The use of land use capability systems within regulatory frameworks is applicable

and provides a framework which is able to be implemented practically, and creates the framework which shapes land use and management practices to deliver resilient, integrated, and healthy functioning ecosystems within productive landscape.

69. Dr MacKay further discusses the role of LUC as a proxy for natural capital and its function in regulatory frameworks. I support his conclusions in this regard.

RULES FOR CULTIVATION AND GRAZING

70. I would like to comment on Rule 3.11.5.2(4)(c) in the Section 42A Report, Proposed Waikato Regional Plan Change 1 – Block 2, Parts C1-C6: Policies, Rules and Schedules (most). Specifically, officer's advice from para 724-741 on the provision of an upper slope limit of 15 degrees on cultivation and grazing. Both the upper slope limit of 15 degrees along with restrictions on grazing of land above 15 degrees should be deleted.

71. While I support the notion that a proportion of the Waikato region is vulnerable to erosion as estimated from analysis of the National Land Resource Inventory survey, it is not appropriate nor scientifically justified to extrapolate this to regulatory restrictions on the use of land as proposed by the officers. Within the survey any reference to hectares “affected to some degree by erosion” will be based on the mapped inventory erosion types established within the standards of the Land Use Capability Survey Handbook 3rd Ed. This suite of erosion types does not include grazing or cultivation specifically. It does include sheet erosion, a form of areal or surface erosion type which can occur from cultivation and tracks or areas of heavy stock concentration. This highlights the need for further analysis of the Waikato land use capability units where surface/sheet erosion has been mapped to provide a more substantive understanding of the area involved.

72. For the remaining para’s 727-741 I would like to comment in general on the officer's comments. I have reviewed Environment Waikato Regional Councils Technical reports for changes in soil stability (Sources; Changes in soil stability in the Waikato region from 2002 to 2007 Environment Waikato Technical Report 2009/30 – referenced in the S42 report and; and Soil stability in the Waikato region - 2012. Waikato Regional Council

Technical Report 2016/20). In summary, both reports highlight the relevance of natural erosion occurrence as being significant. Focusing on the most recent report from 2012 as opposed to the 2009 version used in the officer's comments, out of 2661 sample points across the region analysed for soil stability, 48.7% were erosion prone but inactive, fresh erosion or had extensively disturbed soil. Therefore approximately half of all sample points have been assessed as having eroding characteristics and highlights not only the relationship between an eroding landscape and its potential to be unstable and contribute sediment but the scale of the problem in the Waikato. Where that erosion is a large earthflow or slump structure or is related to riverbank or streambank erosion there is a large long-term flux of sediment deposited directly into a receiving environment. The erosivity of the region needs further analysis to be more precise in understanding the types of erosion occurring and the management required by sub-catchment or catchment – this analysis would be supported by a farm scale planning approach to the issue and risk of sediment movement, which is what I am proposing. This is as opposed to a rule on grazing which is not linked to effect, is arbitrary, and would have limited environmental benefit.

73. When each site was assessed for soil disturbance across the entire sample 23.2% had soil disturbed by land use related activities with 6.8% of that disturbed area related to drystock, (sheep and beef and deer sector). The erosivity of the landscape is again highlighted with 9.1% related to natural processes such as mass movement, and only 4.8% is indicated to come from drystock.

74. While bare ground is a known contributor of eroded material as the officers allude to. Tracking only contributes 0.89% of the 1.93% of the regions area, assessed as soil, sediment or rock exposed by all forms of disturbance. In addition, cultivation, harvest (related to forestry), earthworks, rural roads and drain excavation are also contributors making up the remaining percentage with grazing assessed at 0.05% of the regions area. The 2012 report also notes that 0.38% of the 1.93% of the regions area is causing bare ground by natural processes of erosion. Of this 0.2% is linked to surface erosion processes which include sheetwash, sandblow, geothermal activity and rockfalls. These erosion types arise for numerous reasons and are not attributed to grazing pressure. Sheetwash erosion for example is

due to the cultivation practices which have been consistently carried out over the last decade with pasture renewal and green feed cropping.

75. The report goes on to outline that the rural land uses were observed at approx. 64% of the sample points. About half of these bare soil sites were located on dairy pasture (0.32%) with only 0.22% on drystock. The report states that across the three rural land use sectors (dairy, forestry and drystock), the bare soil caused by soil disturbance was mostly due to formed tracks, 2012 report.

76. While I agree with the statements in para's 724-741 with regards to the impact of cultivation, I do not agree that land over 15 degrees should be singled out in relation to targeted restrictions. Land considered at <15 degrees is vulnerable or accelerated by natural or anthropogenic erosion activity, as highlighted below. Management frameworks which simply rely on slope as is proposed here are not effects based. While it is difficult to determine the area cultivated in the Waikato, I would estimate that the majority cultivated was on landscape at <15 degrees. Therefore, its contribution towards soil disturbance and the presence of bare ground would be a significant contributor to sediment loss into waterways. The Council's 2012 report on soil stability supports this comment. Cultivation should be managed using best management practices irrespective of slope.

Figure 12 is an example of land <15 degrees with extreme gully erosion on a river terrace with the regolith composed of material known as water sorted Taupo flow tephra, present at depth. This erosion occurred because of the intensive farming of cattle over several years compacting the shallow topsoil causing ponding on the paddock surface, which was then subsequently drained away by the landowner, resulting in extreme gully erosion. Source S Stokes.

Figure 13 is an example of gully erosion that occurred on land at <15 degrees, where the regolith was composed of layering's of volcanic eruptive material. The land was in pasture with no apparent reason for the erosion to occur – other than the impact of the intense rainfall at the time.

77. Both photos highlight that the angle of slope is not a methodology on its own, to fully understand and appreciate the erosivity of a landscape by natural occurrences or anthropogenically derived. To truly understand erosion types and their management, including surface/sheet erosion you

need to understand the multi-factor complexity of the landscape and ecosystem – in essence, the natural capital.

78. I do not agree that grazing requires a rule to manage erosion or reduce soil disturbance at any relevant slope angle. There is no clear researched relationship between grazing and soil instability in the hill country or on land >15 degrees, presented by the officers' comments. There is a reference in para 739 to Appendix 1, page 137 of the Land Use Capability Survey Handbook 3rd Ed, “that the formation of cross slope stock tracks tends to occur above 25 degrees, indicating a visible level of soil instability”. What the Handbook on page 137 actually states is, “Above 25 degrees some soil movement and the formation of stock tracks across the slope are common”. What I think the officer is noting is that soil creep, which is a known process, is topographically highlighted by the cross-slope movement of stock which is a visible reference point for many observers of hill country of soil creep, but it does not unrefutably mean that the landscape has soil instability. What soil creep highlights is a function of the regolith and its mass holding it to a slope angle which can be affected by rainfall and water infiltration, creating a physical change in the dynamics of the soil mass relative to being held at that slope angle. This is particularly noticeable in mudstone and sandstone hill country and indicates a potential for mass movement erosion such as a soil or earth slip and earthflow.

79. Soil stability in the councils own 2012 report is defined and identified at sample points that are on stable or unstable surfaces. Unstable surfaces include; erosion prone, recently eroded or freshly eroded surfaces. Surface and rill erosion associated with cultivated sites, as stated in my evidence, could potentially occur mostly on land at <15 degrees. Soil disturbance is defined in the 2012 report as identifying bare soil which has the potential to move. The report again uses land use related activities such as cultivation and harvest, not grazing, or natural process such as landslides.

80. I agree with the officer's comments in para 739 where they doubt that there is sufficient evidence to support restrictions on grazing hill country slopes. Natural erosion occurrences, tracking, and cultivation all creating soil instability, soil disturbance and bare ground are more responsible for sediment moving into receiving environments than grazing. Rules are

already provided for in the Regional Plan for such activities. Active and potential erosion can be managed very effectively through a land use capability assessment at farm scale.

SUMMARY

81. Farm planning from the 1950's until 1987 were a requirement of government policy and any national monitoring of farm plans and their achievements ceased. Since that time farm planning has been variable in its application by regional councils and unitary authorities, depending on their history in the use of farm plans and or their interest in it as a method for implementing policy under the RMA 1991. While there has been a renewed interest in farm planning since the late 1990's, it is still of variable use, even in the shape of a farm environment plan. Because it has not been monitored nationally or regionally where used in a way which shows its effectiveness, there is much debate about the certainty a farm planning approach provides. This may be true in relation to a lack of certainty, but that uncertainty is due to its variable application and mixed policy approach. It is not a measure to suggest a decline in the effectiveness of the tool itself. Quite the opposite is occurring with the growth in farm environment planning nationwide. I applaud the growth in farm environment planning and general farm planning, but as my evidence alludes to, its effectiveness must be based on including a land use capability system assessment.

82. Land capability farm plans identify the fundamental base upon which a sustainable farm is defined. They identify, assess, and match the ability of the land to sustain a socioeconomically sustainable system of land use

I believe farm planning provides the following benefits;

- It creates direct liaison with farmers on a one-to-one basis which helps to establish a long-term relationship with the farm planner, regional council or other authority.

- It provides an evaluation of farm specific land capability, sustainable land management issues and risks and requirements and the farmers capabilities

- They address constraints to use and management through assistance towards integrated and long-term sustainable management of land. For example, they encourage and re-enforce the need for farmers to consider long term dimension to their farming operation well beyond the yearly focus on production management.

- They provide a high degree of effectiveness towards addressing on-farm sustainable land management concerns – primarily by using the knowledge contained within the assessment to integrate environmental management into everyday farm management.

- Lastly a farm plan provides a system for assessing a farms sustainable land management progress and if a consistent approach to the lands assessment is used e.g. LUC units, then a farmer or farmers in a catchment have comparable background, analyses, and results to discuss and report on. A farm plan also provides for a legitimate approach to applying a funding intervention which is shown using farm plans in the Horizons region and their SLUI plans which obtain grant funding.

83. There are also disadvantages which are well known such as the cost of the activity, the commitment required by all involved for long periods of time, and the difficulty of farmers realising the relative advantage a farm plan and its information gives them. However, at this time in New Zealand, the necessity of a farm plan is greater than ever, whether through a regulatory or non-regulatory approach. Farm environment planning as a regulatory tool is effective when strengthened with spatially defined land resource inventory assessments and land use capability unit classification to support its implementation.

84. In my opinion, the farm environment plan proposal within PC1 will be ineffective if it does not have a land use capability system as a baseline dataset, presented spatially and used at land use capability unit management level, to manage and protect the environment and add the additional benefits to a landowners economic, social and cultural dimensions. LUC provides a framework and system to enable and assist

farmers to meet policy requirements in complex landscapes with complex ecosystems.

S J Stokes

3 May 2019