BEFORE THE HEARING COMMISSIONERS
AT WHANGAREI

IN THE MATTER of the Resource Management Act 1991 ("**the Act**")

AND

IN THE MATTER of the hearing of submissions on Proposed Plan Changes 85 and 85A-D to the Whangarei District Plan

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STATEMENT OF EVIDENCE BY ROBERT WILLIAM CATHCART FOR HORTICULTURE NEW ZEALAND

29 June 2017

VERSATILE SOILS OF THE WHANGAREI DISTRICT

BACKGROUND AND EXPERIENCE

1. My name is Robert (Bob) William Cathcart, I am a Land and Environment Management Consultant at AgFirst Northland. I joined AgFirst Northland in January 2014 after 49 years in land and water resource management with regional government in Northland (44 years) and Canterbury (5 years).

2. My academic and professional achievements include:
   - Bachelor of Agricultural Science (Massey);
   - Postgraduate Diploma in Business Studies (Massey);
   - Certificate in Soil Conservation from Lincoln College and the Soil Conservation and Rivers Control Council;
   - Fellow of the NZ Institute of Primary Industry Management;
   - Honorary Member of the NZ Association of Resource Management;
   - Member NZ Society of Soil Science; and
   - Registered Primary Industry Management Consultant.

3. My fields of expertise include soil, land and water management, both at a whole catchment or resource planning level and at a farm, forest or orchard scale. I have wide practical experience in soil conservation-erosion control, sustainable soil management, land drainage, flood risk reduction, natural hazard management, and management of water quality and quantity, including water harvesting.

4. In my early years with the Northland Catchment Commission I was involved in the original mapping of land resource inventory and land use capability data across Northland. The maps we prepared became the First Edition of the New Zealand Land Resource Inventory(1), on which the Fundamental Soils Layer is based.

5. Because it is available in electronic form and there is nation-wide coverage, this data is increasingly being used by local and regional authorities to define land over which they wish to exercise land use controls to protect, for example, highly versatile soils, and to manage nutrient losses to water. I also developed and implemented a system of more detailed urban land use capability mapping, accurately recording at a detailed scale the suitability of or limitations to land for urban uses. Limitations include risk from flooding, erosion, instability and poor soakage for effluent disposal. I use the same mapping

technique for detailed farm, forest and orchard development and management plans.

6. Before leaving the Northland Regional Council ("**NRC**"), I assisted the Northland Horticultural Forum, a collaborative group with members from almost all branches of horticulture in Northland, by identifying land suited to horticulture and impediments to that land being developed.

7. Actual or potential horticultural land was broken into three categories:

   i. the most versatile land which has deep, free-draining soils, suited to crops such as avocado and tamarillo, e.g. younger/less weathered volcanics soils which can be cultivated or machinery worked all year round;
   ii. less free-draining or less fertile soils which, while suited field and vegetable crops and to shallow-rooted crops such as citrus, persimmon, kiwifruit and the like, has some soil limitations (stoniness, clay subsoil, etc.) which limit the range of crops or trees that can be successfully grown, e.g. older, more weathered volcanic soils; and
   iii. soils suited to field crops such as corn/maize, kumara, vegetables, etc., e.g. alluvial soils which are only able to be worked during summer and autumn.

8. The data[(2)] I gathered was used by NRC Economist Darryl Jones to produce documents for a regional horticultural development strategy.

SOILS IN WHANGAREI DISTRICT

9. Northland has a very complex geology with a wide range of sedimentary and volcanic rocks, and floodplains, terraces and dunes formed from material washed off the sedimentary and volcanic rocks. The fact that it has remained above sea level, not been subjected to glaciation nor blanketed by huge clouds of volcanic ash like the middle part of the North Island means that soils are older or more developed than elsewhere. Our warm, moist climate has weathered rocks to a much greater depth and leached nutrients and other material through and from the soil, leaving behind generally low nutrient, heavy clay soils.

10. Water draining through leaf litter under dense stands of kauri formed mild acids which have accelerated the leaching process

and created some very low fertility soils – gumlands and ironstone soils.

11. There are over 230 distinct soil types mapped in Northland with over half of these represented in Whangarei District. There are large variations within these soil 'types', variations which ca only be identified by detailed in-paddock mapping. With different rates of soil 'aging' depending on slope and vegetation type, as well as rock type, the distribution of soil types can at best be described as a 'mosaic'. There may be several distinct soil types and several variants of these basic 'types' within one paddock.

12. The soils of Whangarei County, along with the rest of Northland, were accurately mapped in the between 1937 and 1951 by Taylor, Sutherland and Wright(3) at a scale of 1:63,360 (the old '1 inch to 1 mile topo sheet scale). These maps were updated in the late 1970s and, while now accurate to a scale of 1:50,000, were republished in hard-copy map form by the NZ Soil Bureau(3) at 1:100,000.

13. The soil boundaries were determined by field inspection, including digging soil profiles and checking soil physics and chemistry. There are over 230 distinct soil types in Northland with about half of these represented in Whangarei District. Unpublished Soil Bureau reports, which should have formed part of Soil Bureau Bulletin 4, Soils of Whangarei County (never published), show that there several 'variants' mapped for each of the named soil types, all with different soil characteristics and production potential.

14. In short, the pattern of soil types in Northland is even more complex than published maps show. I will comment on 'scale of mapping' later.

BASE DATA FOR IDENTIFYING HIGHLY VERSATILE SOILS

15. In preparing the Land Use Capability Maps, now available online as NZLRI maps, land with similar management requirements for farming forestry and horticulture, and with similar vegetation cover or land use was defined on aerial photos as polygons. The land use capability – the capability of that land for long-term, sustainable production – was assessed under the 8-Class Land Use Capability system (LUC). The polygons so defined are management units and can contain several related soil types, or soil types requiring similar management.

16. Because this data is available online, while the old NZ Soil Bureau maps are not, users of Geographic Information Systems (GIS) began using the NZLRI data for a wide range of purposes. The Fundamental Soils Layer (FSL) was published showing the dominant soil type within each one of the LUC Unit polygons. While this data is useful tool at a regional or large catchment

modelling scale, and is indicative of what soils might will be found at a location at a scale of 1:50,000, it is not a true 'soil map' and should not be used at a more detailed scale.

17. The Northland Regional Council used an interpreted version of the FSL to generate maps to accompany its Regional Plan policies on protecting versatile soils but expected the District Councils to produce more detailed or scale-accurate mapping when defining land subject to District Plan policies and rules – it indicated general areas where the District Councils would need to develop more site-specific plans and rules.

VERSATILE SOILS

18. The most versatile soils are those that have the potential for high and sustainable production for the widest possible range of pastoral, arable, horticultural and forestry uses. The very best would be flat land with fertile soils and evenly distributed rainfall. You would be able to grow anything suited to that climate and be able to cultivate the land and harvest the produce all year round.

19. The best we have in Northland are small areas around Maunu, like the Austin Road area, Maungakaramea and near Ohaeawai. Even this land has limitations, the free-draining soils drying out in summer and may have some stone which interferes with cultivation, so it is mapped as Class 1c1 (it has a climatic/dryness limitation, particularly for pastoral farming). There was a total area of 435 hectares of this Class 1c1 land in Northland in the mid-1980s but, as a consequence of urban and life-style subdivision, very little is now available for primary production.

20. Almost as good are areas of Class 2e1 and 2s1, mainly Kiripaka and Whatitiri soils in the Glenbervie-Kiripaka, Three Mile Bush, Maunu-Maungatapere-Whatitiri and Maungakaramea districts. Class 2e1 is sloping, with a risk of sheet and rill erosion if under continuous cropping, while Class 2s1 has slight stoniness and dryness limitations. The dryness limitations in each of these units can be overcome with irrigation if the value of the crop warrants that expenditure. The lower slopes of Whatitiri Mountain have been assessed as Class 2e1, while the easy land above Poroti School and in Pukeatua Road is mapped as 2s1, all very valuable land for horticulture and within the Maungatapere Irrigation Scheme supply area.

21. Maunu and Kiripaka soils are silt loams, but most of the other volcanic soils are friable clays or clay loams. Whatitiri clay loam, is a finer-textured soil and requires care not to compact its surface when moist and measures to prevent avocado trees getting 'wet feet'. The area has the advantage of being on gentle slopes so that cold air drains down-slope and out of orchards.

22. Land Use Capability or versatility are not the only measures of a soil's productive potential. Trees like avocado and tamarillo thrive on deep, free-draining soils so can be successfully grown on more drought-prone and stony volcanic soils, land not suited to cultivation and of limited value for pasture, and on the deep and extensive former sand dunes on the Aupouri Peninsula, assessed as Class 6e and 7e, providing water is available for irrigation. Similarly, aspect is important for some crops while some tree crops like citrus are shallow-rooted do better where there is a heavy subsoil which restricts root run.

23. For these reasons, a high proportion of the Class 3e1 and 3s1, and even some Class 4s1, land around Kiripaka-Glenbervie, Kauri, Three Mile Bush, Maunu-Maungatapere and Maungakaramea may well be suited to tree crop or vine horticulture but has limitations, such as stoniness, for pastoral or arable farming, and for market gardening. The available 1:50,000 maps, whether hard-copy or digital, are of a scale too coarse to separate out the land that is from the land which is not suited to tree or vine crops, and to determine the practicality of establishing and managing trees or vines.

EXTENT OF HIGH CLASS SOILS FOR HORTICULTURE

24. As noted above, identifying land suitable for horticulture goes several steps further than just Land Use Capability. In 'Soils Suited to Horticulture in Northland', a table-top survey and report prepared in 2012, Cathcart[(2)] estimated, as part of a Northland-wide survey, the following potential for the expansion of horticulture in the Whangarei area:

Land suited to Avocado

	Gross area (hectares)	Planted (ha)	Remainder (ha)	Assumed maximum uptake (ha)
Maungatapere**	3,737	1,172	2,565	1,600
Maungakaramea	513	75	438	300
Kiripaka	656	141	515	200
Kauri – Matarau	516	52	464	218
	5422	1440	3982	2318

** Maungatapere Irrigation Scheme areas

Land Not suited to Avocado

Poroti	198	13	185	100
Maungatapere	77	8	69	40
Kauri, Apotu	322	51	271	100
Ngararatunua	218	11	207	50
Matarau	209	-	209	100
Ruatangata	454	25	429	250
Puhipuhi (Pt of lower plateau)	268	-	268	50
	1,746	108	1,638	690

Explanation

- '*Gross area'* is the total mapped area of soil types suited to that form of development;
- '*Planted area'* – the total area already planted in horticulture (orchards);
- '*Remainder*' is 'Total area' less 'Planted area';
- '*Assumed maximum uptake'* is the proportion of the land potentially available for orcharding that is likely to be planted (deducting stony land, bush areas, units too small to be attractive as economic units, and knowing the landholders' general interest in horticulture/willingness to change.

WHY HORTICULTURAL SOILS SHOULD BE RETAINED

25. A study currently underway into the potential for irrigation development in Northland suggests that there is an industry move to greatly increase the areas of kiwifruit and avocado in Northland. Avocado development has been at the rate of about 330 new hectares each year for the last five years. These crops complement rather than compete for labour, that is, there is an opportunity to provide full-time orchard employment rather than

seasonal labour, and to develop new employment. Alternative crops, such as covered raspberry, are being developed in the Whangarei area to fill in any gaps in year-round employment.

26. Taking a conservative estimate as to the proportion of the suitable land that may be developed, there is an opportunity to increase the area of land in avocado-type crops in the Whangarei area by 160% and other orchard or vine crops by over 600%. Based on the same study, planting the 'assumed uptake' area of 1600 hectares within the Maungatapere Irrigation Scheme area in avocado could generate work for another 190 people within the orchards and 350 full time-equivalent positions within the orchards and support industries – packing, transport and other services. The same arguments as to job and wealth creation apply to other similar land around Whangarei.

27. Once versatile soils are subdivided into small holdings it is almost impossible to restore them to primary production. Topsoil will have been removed and sold during development and takes hundreds, even thousands of years to develop a topsoil on even a 'clean' subsoil. Removing houses and roads from urban and small lifestyle bocks and restoring it to primary production is not a practical or economic option.

28. Lifestyle block development is just as effective in taking versatile soils out of production as full urban development. Even if houses, buildings and services are sited on the less productive pockets of soil, it is extremely difficult to establish commercially viable orchards or market gardens on the pockets of 'good' soil unless the householders are prepared to accept that activities such as spraying, cultivation and other machine activities, management of shelterbelts, construction of plastic house, etc., take precedence. It may work for a while but eventually reverse sensitivity issues will arise.

29. Also, most lifestyle block owners will not undertake the necessary management regimes to optimise production from orchards or gardens they have on their land. Some landholders would and examples of niche, local supply ventures can be found around Whangarei. Instead, the land would need to be attractive enough, in scale, to entice commercial operators to lease or share crop it. Again, reverse sensitivity issues would arise and a case would be made to urbanise the land - the process is not reversible!

30. During the late 19th, early 20th Century, Whangarei supplied a very high proportion of the fruit and vegetables consumed by an expanding Auckland. With prime market gardening land at Pukekohe being swallowed up by urban sprawl, there is an opportunity for Whangarei District to again be the fruit (and vegetable) bowl for Auckland. Improvements to the northern highway network (and increasing congestion to the south of the

city) means that fresh produce can be in the markets in Auckland just as quickly as South Auckland produce. But we need to retain the land on which these crops can be grown.

MAPPING

31. As noted, the Fundamental Soil Layer is an indicative soil map derived from the NZLRI Land Use Capability Units rather than a 'pure' soil map.

Its main advantages are:

- There is national coverage; and
- It is in electronic form and can be used in GIS and modelling systems.

Its disadvantages are:

- Only one soil type is shown when, sometimes, several should be listed.
- Polygons on the Fundamental Soil Layer tend to be larger (more generic) because they are drawn around multifactorial rather than single factor units.

32. The 3rd Edition, Land Use Capability Handbook(4), which sets out methods and standards for land resource inventory and land use capability mapping in New Zealand, has a section in which 'scale' is discussed:

> "Scale is also important when using LRI and LUC map information in Geographic Information Systems (GIS). Such systems can readily rescale the information beyond its original scale of collection. Significantly enlarging the scale can produce unreliable and misleading results, or result in information that is at best nonsense (Hewitt and Lilburn 2003; Manderson & Palmer 2006)."

33. This section of the Handbook goes on to state "As a general rule, LRI and LUC information should not be significantly enlarged beyond the scale at which it was originally collected."

34. The NZLRI maps were field mapped at a scale of 1:50,000. In Northland, where we have soil maps compiled by Soil Bureau, DSIR, published[(3)] at 1:100,000 but field mapped at 1:50,000, these soil maps are the most accurate maps of soil type at that scale (1:50,000).

35. The Handbook advises basing mapping scale on the smallest area of interest. "For farm mapping this is usually the smallest area of land that can be managed or treated differently, say:

- 10 square metres/1:500 within an orchard, market garden of riparian area,
- 0.1ha/ 1:5,000 under horticulture, viticulture, arable or intensive pastoral,

- 0.4 ha/1:10,000 arable and pastoral farming,
- ha or 1;15,000 under pastoral or catchment studies,
- 5 ha or 1:35,000 under extensive pastoral, catchment studies and forestry surveys
- 10 ha or 1:50,000 district and regional studies"

36. Use of Fundamental Soil Layer data at a regional level to identify where further work should be done is OK. Use of it within larger catchment areas or the whole of Whangarei District to do some rough calculations is marginal, but use of it for any detailed planning is not acceptable. Accurate definition of land suited or not suited to horticulture within the various areas of 'regionally versatile soils' requires soil mapping at 1:5,000 and at 1 :500 for a development plan within an individual orchard.

DESCRIPTION OF SOILS IN IDENTIFIED RURAL LIVING AREAS:

MAUNGATAPERE – KARA RD STH

37. This area is within the Maungatapere Irrigation Scheme area.

38. All the soils in the area between Maungatapere and Maunu mountain area are either Red Loams formed on scoria and ash or Brown Loams formed on basalt lava flows. The cone of Maunu has Papakauri clay loam, a weakly to moderately leached Red Loam soil, formed under broadleaf bush on scoria and ash. As is evidenced by the pine plantations and native bush on the hillside, it supports tree growth but only the easier lower slopes are suited to a orcharding or grazing. The soils are free-draining and dry out quickly in summer so irrigation is required to support horticulture.

39. The plateau-like shoulder immediately south of Kara Road is a basalt lava flow with weakly to moderately leached Brown Loam soils, Kiripaka bouldery silt loam on the flat top and easier sides and Kiripaka bouldery silt loam, large boulders phase, on the edges of the lava flow. These are free-draining soil, well suited to horticulture but tend to be a mosaic of soil variants ranging from deep soil completely free of boulders to large outcrops or almost entirely large boulders around the edges. Like the same soil types at Three Mile Bush, Kiripaka-Glenbervie and Maungakaramea, there are easy basins on the plateau top which have infilled with soil washed of adjoining slopes, small mounds and outcrops of basalt boulders and swampy basins, all scattered within the Kiripaka silt loam soils. Each of these areas has a different value for horticulture.

40. As noted, the steeper sides to the west (SH14), south (towards Kokopu Block Road) and west down Kara Road have Kiripaka bouldery silt loam, large boulders phase, but even within this area

there are patches of less bouldery soils suitable for primary production.

41. Maunu has had more than one crater. It is a feature of these more recent (320,000 years before present) basalt cones that the cone-building part of the eruption only lasted a few days, the whole eruption over a week or so. As the wind would have been blowing from one direction during this cone building stage, the ash and scoria fall is more to one side of the crater resulting in a thin crater wall to windward. At a later stage the crater has filled with water, the thin crater wall has collapsed and ash and scoria from the collapsed crater wall has spread in a fan across surrounding land. The soil that has developed on this outwash fan has some of the features of the scoria cone soils, has a higher clay content but has no boulders. This soil type, Whakapai clay loam is found on the easy slopes between SH14 and Cemetery Road, around Newton Road and the almost flat land between Kokopu Block Road and Maungatapere. The same soil type occurs around the Fonterra Dairy factory at Kauri, and north of Maungakaramea cone.

42. While less free draining than Kiripaka and Maunu soils, Whakapai clay loam is well suited to intensive horticulture, including market gardening, open field tree nurseries and the like because it has no boulders.

43. The land from Maungatapere to Pukeatua Road, extending east down Otaika Valley Road and west along Mangakahia Road has Kiripaka silt loam soils, overlying an older lava flow with moderately to strongly leached Waiotu friable clay soils at the head of the Otaika Valley. The soils are highly variable from Maungatapere School to Tatton Road with sheet basalt rock within 300mm of the surface in some areas, swampy basins and more free-draining ridges and mounds. The soils in the vicinity of Pukeatua Road and around the foot of Maungatapere mountain are a complex of Maunu silt loam and Kiripaka silt loam, again, well suited to horticulture.

GLENBERVIE – KIRIPAKA

44. This area has been formed by two lava flows, one from Pukepoto (Glenbervie) and then by Kiripaka, flowing down the fault-valley once occupied by the Ngunguru River. The cones of the volcanoes have Papakauri silt loam soils like those on Maunu while the lava flows have Kiripaka bouldery silt loam soils. The more detailed Soil Bureau Soil Maps record shallower Kiripaka bouldery silt loam with compact subsoil in a basin immediately east of Maruata Road, basins with Kamo clay loam, a gleyed soil formed on basalt alluvium, and strips of the large boulder phase of Kiripaka silt loam around the edges of the flows.

45. This mix of soil types is due to the hummocky nature of the lava flow, small patches of scoria and ash some distance from the main cones, alluvial material and peat accumulating in basins and the lava flows damming of streams which once flowed through this area. A more detailed soil survey of this area would more clearly define this mosaic of soil types and identify, at a reliable scale, land more or less suited to horticulture.

KAURI-APOTU ROAD

46. The soil types along Apotu Road from Kauri to the intersection with Jordan Valley Road include those formed on dacite, a rhyolitic volcanic material, erupted from Parakiore, old basalt lava flows from Vinegar Hill, lava flows and remnant cones from Kauri, underlying mudstone and shale, alluvial deposits, and the eroded cone of Apotu, a basalt scoria, ash and lava eruption some 4.2M years bp.

47. The eroded cone of Apotu has Apotu friable clay, a red Loam soil formed on a mix of basaltic scoria, ash and lava. This is an older, moderately to strongly leached, soil with a friable topsoil over a dense red clay subsoil. While not suited to deep rooted trees, the northern face of this hill is sheltered from cool winds to create a micro-climate well suited to persimmon and similar shallow rooted tree crops.

DESCRIPTION OF SOILS IN ADDITIONAL AREAS SOUGHT FOR RURAL LIVING

MAUNGAKARAMEA

48. Maungakaramea is a basaltic scoria cone of similar age to Maunu, Maungatapere and Hurupaki. The cone itself has Papakauri silt loam soils like those on the other recent basalt cones. Slope is the only limitation to horticulture on this soil type. Maunu silt loam has formed on ash and lava erupted north-westward and south-eastwards from the cone. This soil type has less and generally softer rock than the lava flows and is well suited to all forms of primary production. It has been assessed as Class 1c1, the highest ranked, most versatile Land Use Capability unit/soil type in Northland, and a worthy of protection.

49. Kiripaka soils have formed on lava flows surrounding the Maunu soils, with varying amounts of surface rock. Again, more detailed mapping is required to differentiate between land with little or no rock, basins with shallow volcanic soil over sheet rock, basins which have infilled with alluvial material or peat, and areas which are almost solid rock.

50. The northern edge of the cone is flanked by an outwash fan, as described for Maunu, with Whakapai clay loam soils, another versatile soil type suited to orchards and market gardens.

Bob Cathcart

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