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**ASSESSMENT AND MANAGEMENT  
OF INHERENT AND DYNAMIC SOIL PROPERTIES  
FOR INTENSIVE AGRICULTURE  
IN THE NORTH ISLAND, NEW ZEALAND AND  
TASMANIA, AUSTRALIA**

A collection of Published Papers and a Review

**Volume 1 – A Review and Part publications**

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## DECLARATION

The papers presented for the degree are the original works, either by the candidate alone, or written in conjunction with others. Where other authors are involved, the estimated percentage contribution of the candidate is shown in the list of publications submitted for the degree under 'Contributions to joint publications by the candidate' section of the thesis.

The thesis contains no material by the candidate that has been accepted for any higher degree or graduate diploma in any other Tertiary institution.

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## ABSTRACT

The primary aim of the research reviewed in this thesis has been to provide information required by land managers on inherent and dynamic soil properties for sustainable intensive agriculture.

A soil survey in the Te Puke district, New Zealand, found the soils to be young with the majority having a layer of tephra in their profiles which gives rise to low overall nutrient status and free draining properties. Soils in north west Tasmania were found to be predominantly Red Ferrosols formed on basalt. The Ferrosols are characteristically strongly structured, strongly acid and have high organic carbon contents. The Ferrosols surveyed were being managed at their optimum land capability or better, with little evidence of soil degradation.

The importance of taking a morphological approach to the studies of soil health is illustrated by comparing data from similar paddock histories across the soil orders studied. The differences in physical properties and soil carbon contents between soil orders were pronounced. The measured effects of cropping on soils varied depending on inherent differences between the soils studied. Soil carbon levels were found to be falling with increased years of cropping on all soils studied. Strong correlations were found between soil carbon and a range of soil physical, chemical and biological properties. Target levels of soil carbon are suggested for cropping systems, which can be used as an indicator of sustainability. The soil properties and paddock variables found to be significantly correlated with crop yield varied, depending on crop and soil type. Two easily applied measures of soil structure were correlated to crop production on heavier textured soils.

Research into the off-site effects of agriculture in north west Tasmania found that there were high levels of water turbidity caused by soil erosion from cropped paddocks and high levels of nutrients emanating from dairy pastures on drained lowland areas.

There has been a positive change in farmer perceptions and soil management practices over a ten-year period in north west Tasmania. Several information

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brochures have been published for farmers to assess and manage their soils for sustainable production.

The research undertaken and reviewed here has produced information on inherent and dynamic soil properties required by farmers for sustainable intensive agriculture. The work has played a major role in the understanding of how soil management has an impact both on and off site and in influencing soil management on farms in both Tasmania and the Bay of Plenty, New Zealand.

### **CONTRIBUTIONS TO JOINT PUBLICATIONS BY THE CANDIDATE**

Sixteen of the twenty three publications and the unpublished report used as the basis of this thesis involved joint authorship. Of these the candidate was the senior author of eleven publications and the unpublished report, and is the second author in the remaining four publications. The estimated percentage contribution by the candidate is shown in parentheses in the list of publications submitted for the degree under the 'References' section of the thesis.

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