APPENDIX C – AGRICULTURAL AND FARMLAND MAPPING ASSESSMENTS

Gem Planning Projects:

- Soil Landscapes Decision making Criteria for Regionally Significant Farmland, Mid North Coast Farmland Mapping Project 2008

- Assessment of Potential Conflicting Land Use from the Living & Working in Rural Areas Handbook 2009, Department of Primary Industries, Northern Rivers CMA & Southern Cross University, and

- Interim Variation Criteria under North Coast Regional Environmental Plan 2036 Department of Planning & Environment.

Ludwing Mueller & Associates:

- General site comments (8 Oct 2013)
- Agricultural Viability Assessment (8 October 2013)

KeyCrober – Dale paterson

- Soil Program Recommendation including Laboratory soil tests.

Using soil landscape data to identify regionally significant farmland

The farmland mapping was built using soil landscapes which were selected on the basis of their agricultural potential. Regionally significant' farmland became defined as follows:

> *'Land capable of sustained use for agricultural production with a reasonable level of inputs and which has the potential to contribute substantially to the ongoing productivity and prosperity of a region.'*

BACKGROUND

The land qualities listed in the criteria are as described in soil landscape reports published by the former Department of Land and Water Conservation, mapped at a scale of 1:25,000. Soil landscapes were not mapped at property level. A soil landscape may include small areas which have different characteristics to those described for the whole soil landscape.

The farmland map is based on those soil landscapes which were selected based on the criteria above and utilizing the decision-making chart below. Selected soil landscapes generally occur on rolling low hills and undulating rises in the region's plateau areas and some other areas with suitable soils, on river floodplains, levees and terraces, and on the major deltaic floodplains.

The agricultural viability assessment by Ludwig Mueller & Associates investigated the character of the soils, the vegetation present and requirements to improve pasture. The assessment clearly identifies that the level of inputs required to achieve any meaningful agricultural production is unreasonable and not sustainable. In particular, Mr Ludwig's letter of 8 October 2013 states:

> "I am astounded that this hill is like an island of rather poor fertility compared with the surrounding of flat country used in a rural housing subdivision to the south and also to the north, where alluvial flood plains have shaped fertile soils over the history of the landscape.
>
> The elevated paddock in question with good view to the valley and mountains has been formed by another geological background history, I assume volcanic deposits with broken rock evidence, similar like found in Telegraph Point's poorer country …
>
> The provided soil audit with recommendation shows the high expensive inputs needed to fix up soil of Bradbury Mountain is in my opinion not suitable for high return horticultural investments, cultivation of this soil due to the higher rock content in some areas makes cultivation difficult and being on a hillside high risk with erosion.
>
> The provided soil audit with recommendation shows the high expensive inputs needed to fix up deficiencies to improve just pasture production and or soil in general."*(source Ludwig Mueller & Associates, Biological Farming Consultant – 8 October 2013)*

Definition criteria to determine which soil landscapes represented regionally significant farmland was developed and the following qualities used in the broad soil landscape mapping:

Slope, Rockiness, Landform, Water holding capacity, Drainage, Intrinsic Soil Structure, Soil Depth, Soil Fertility, Stoniness, Soil Surface Qualities as summarised in Figure A below.

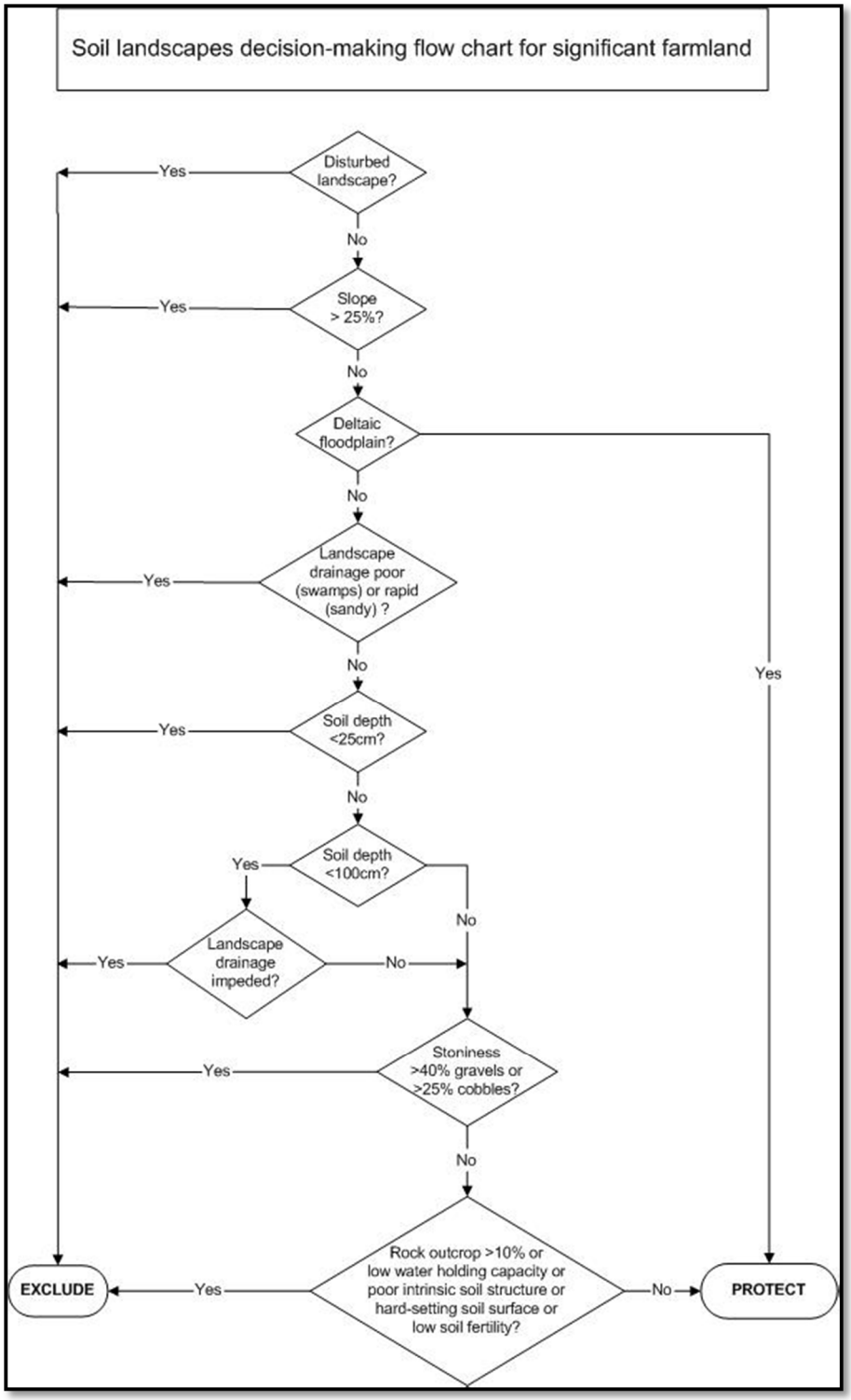

Figure A: Extract from Soil Landscapes Decision making Criteria for Regionally Significant Farmland: Mid North Coast Farmland Mapping Project 2008

BACKGROUND contd.

Assumptions

In addition, a number of assumptions were relied upon.

• Current land use can be an indicator of agricultural quality, but cannot be used as a criterion for judging long-term agricultural capability.

• The project's focus is on protecting the land resource rather than individual industries; therefore the current value of agricultural industries is not a deciding factor. However, the soil landscapes used by key agricultural industries were taken into account.

• Water availability (irrigation licenses etc) is a variable which can change over time with policy or technology. It is not a land attribute in the same way that soil or slope is a land attribute, so is not a deciding factor.

• Fragmented allotment patterns do not affect the quality of the land but can affect management. As above, lot size can change as a result of policy. It is not a biophysical land attribute, so is not used as a deciding factor.

• Microclimate is an important factor in agriculture. However, data is not available on a regional scale to make microclimate a useful criterion for selecting suitable soil landscapes.

• Extent of clearing is not a criterion. Much cleared country has not proved to be valuable farmland. Conversely, the existence of vegetation on significant farmland should not be taken to mean the land has to be farmed, or that the vegetation values are secondary to the agricultural values.

• Acid sulfate soils have the potential to be farmed sustainably, provided they are not exposed to the air by excavation or drainage. The presence of acid sulfate soils is considered to be a management issue, rather than an eliminating factor.

• Areas which support intensive agriculture but are located on inferior soils and highly dependent on irrigation or fertilisers are not considered to be regionally significant farmland. The versatility and the long-term potential economic and environmental sustainability of such land are likely to be lower than that of land which could be farmed with a more reasonable level of inputs.

• Flooding is not seen as either a limitation or a necessary inclusion for regionally significant farmland. Many of the region's valuable farming areas are fertile because they are flood-prone. Some flood-prone areas have poor drainage and infertile soils.

• Erosion risk is not included as a criterion. Erosion risk is built into other criteria such as slope class and soil structure. Soil erodibility is also not a criterion. Most soils are erodible. Erodibility refers to a fixed, inherent quality of the soil. Erosion hazard is a variable condition which refers to a combination of factors including landform, soils (including erodibility) and land management.

The following summarises the characteristics of Lot 101 in relation to the soil landscape criterion and site specific information determined by the Ludwig Mueller & Associates.

Pasture: Blady Grass, Broad Leaf Paspalum (paspalum mandioncanum), Giant Parramatta Grass (Sporobolus fertlis), Kikuyu (Pennisetum Clandestinum), Setaria (Setari sphacelata)

Slope: Varies 5% to >25%, E-W ridge line with rolling to steep sides gullies.

Soils: Brown Loam, Shallow topsoil, Subsoil rock, Fragile soil structure

Characteristics of this soil type in this location as determined by the Agricultural & Turf – Soil Evaluation Service KeyCrobe are:

- Light soil type range
- Light clay and light nutrient holding capacity.
- Low Calcium and high Magnesium.
- Limited Phosphorous.
- Less than desirable biological activity , high Organic Matter & low plant available nutrient conversion.
- Low pH
- Low conductivity
- Moderate dispersability
- Moderate permeability
- Low nutrient holding capacity
- Low to moderate water holding capacity
- Low pH, indicating low cation retention
- Low trace elements and limited availability due to low soil biology

Pasture Improvement: To adequately support growth of pasture species, significant inputs of lime and organic matter as well as other ameliorants is required as suggested below:

Suggested Applications in Order of Priority

	A
TraceLime	1000 kg/ha
Gypsum	400 kg/ha
FCMP	200 kg/ha
Formula 1	25 kg/ha

Suggested Foliar Applications in Order of Priority

	A
Mineral Plus P/S No 6	7 ltrs/ha

Suggested Long Term Program

	A
TraceLime	1000 kg/ha
FCMP	200 kg/ha

(source Agricultural & Turf – Soil Evaluation, Soil Test K5944 4 Oct 13)

Infrastructure: The property currently has no irrigation license, contains a weatherboard cottage, farm sheds in a state of disrepair and fronting Marys Bay Road, a disused dairy.

Conclusion: The soil in its current state will not support primary production and the area identified under the Regionally Significant Farmland mapping is approximately 2.5ha in area.,

The characteristics of the land does not fit the definition of :

> *'Land capable of sustained use for agricultural production with a reasonable level of inputs and which has the potential to contribute substantially to the ongoing productivity and prosperity of a region.'*

It is not capable of sustained use for agriculture and requires a high level of inputs. It does not have the potential to contribute substantially to the ongoing productivity and prosperity of the region.

Land Use Conflict Risk Assessment & Matrix

Consideration of potential impacts on adjacent agricultural land is discussed below and includes a Land Use Conflict Risk Assessment (LUCRA)

The neighboring property to the north is predominantly in 1 in 100 year flood zone, so intensive agriculture, such as horticulture (vegetables, citrus, stone fruit etc) and intensive livestock production (feed lotting, broiler or egg production, piggeries etc) are not economically viable due to flood risk for infrastructure, stock and vegetation.

The alluvial (flat) section of the land could potentially be used for more intensive grazing purposes than current land-use, based on improved pasture or seasonal cropping regimes.

Land to the east and south is under uses as rural lifestyle lots/large lot residential.

Given the most productive agricultural pursuit for the adjacent land adjoin, downhill to the north, would be grazing for beef production the following points detail the potential impacts to maintaining meaningful agricultural production, in the form of pasture and/or cropping improvements for livestock grazing, on the neighboring property.

Land Use Conflict Risk Assessment

Consideration	Response
The nature of the land use change and development proposed.	Large Lot Residential uphill to the east from existing grazing land is protected by a 50m buffer zone free of building envelopes and access roads. Some on site waste water disposal areas lots would potentially have potential for disposal areas. They are considered a useful buffer element – non habitable and excluded from outdoor living activities.
The nature of the precinct where the land use change and development is proposed.	Adjacent land uses east and south of the site and adjacent agricultural holding, include rural lifestyle/large lot residential developments, well established with quality housing. Further north grazing land and some lifestyle housing. Refer Image below of the nature of the uses in the precinct.
The topography, climate and natural features of the site and broader locality which could contribute either to minimising or to exacerbating land use conflict.	The sub-tropical environment of Kempsey supports year round production through the growth of warm climate species in summer, and temperate plant species in the cooler months. The benefit of such a climate is sub-tropical perennial grass species tend to dominate improved soils, and are only dormant during winter. A negative of this environment is winters are too cold to support year round growth of tropical species, as cold nights often kill tropical species. Due to these outcomes, and a slightly summer-dominant (although essentially year-round) rainfall pattern, pasture production for grazing livestock (beef and to a lesser extent dairy) tends to be the most reliable and best-suited industry. In terms of potential conflicting land uses Grazing livestock industries raise potential for conflict in terms of noise from cattle yards such as calves separated from their mothers, pumps and engines starting early, fence line weed spraying and the like.

The typical industries and land uses in the area where the development is proposed. This provides for a broad test of compatibility with the dominant existing land uses in the locality.	The typical land uses in the area proposed for rezoning is large lot residential consistent and flood prone grazing land beyond those areas.
The land uses and potential land uses in the vicinity of the proposed development or new land use. Identifying and describing what's happening within a minimum 1km radius of the subject land and development site helps to establish the specific land uses in the locality that are most likely to have some effect on and be affected.	Refer to figure below identifying land uses within 1 km radius.
Describe and record the main activities of the proposed land use and development as well as how regular these activities are likely to be. Note infrequent activities can create conflict.	Proposed land use is large lot residential. A 50m wide buffer between proposed building envelopes and the grazing land to the north can be achieved.
Describe and record the main activities of the adjoining and surrounding land uses as well as how regular these activities are, including periodic and seasonal activities that have the potential to be a source of complaint or conflict.	Adjoining agricultural land use activities to the north appears to be low intensity cattle grazing. To the east and south is large lot residential housing.
Compare and contrast the proposed and adjoining/surround land uses for incompatibility and conflict issues.	Potential impacts on adjacent agricultural uses include: a) **Potential backyard plant species to encroach on the neighbouring farmland** either through natural reproductive processes or even as simply as growing over the fence boundary. Only a very small percentage of backyard plant species are toxic to ruminant animals, and in most cases the toxic species need to make-up a large part of the animals daily diet to cause clinical symptoms. The proposal includes physical separation ot the boundary of 50m and more creating a physical buffer which is a combination of steeper and low lying lands not conducive to usage or gardening

	by lifestyle residents. The likely building envelopes and associated gardens are located at the front of the lots uphill near the proposed internal road. This 50m separation provides a buffer and the character of the landscape within that buffer is considered sufficient to negate those potential impacts. b) Contamination of the dams areas of the neighboring property, presumably currently used for stock drinking water, needs to be considered should stormwater run-off containing chemical or biological toxins enter these areas. The on site waste water report demonstrates a number of treatment and disposal options for the lots. in addition the concept layout demonstrates the possible location of disposal (and reserve) areas, typically 20 – 30m away from the common boundary, dams to the north and located outside the 40m buffers to gullies and drainage lines. c) Domestic Pets and Animals potential for domestic pets and animals to adversely affect the potential for primary production on the neighboring property is real, however given the extend of the rural lifestyle housing north along Marys Bay Road and to the east, existing domestic pets and animals are already potentially present in the landscape. Domestic animal's chasing, and in rare cases attacking livestock, particularly calves, is always a possibility but is no more enhanced by the proposed extension to the R5 zone.. Subclinical livestock production losses, due to stress events, can be caused by excessive noise, or startling noise such as dogs barking. In this case, the 50m separation distance reduces the potential impact domestic animals could have on livestock grazing the north.

	Existing fencing between the properties is proposed to remain in place. d) **Animal disease** as a potential risk. Poorly maintain residential areas can potentially harbor diseases that could cause sub-clinical production loss, and in extreme cases death of livestock. For example, rodent borne diseases, such as Botulism, have been known to kill livestock on the mid-north coast. In light of the high quality of housing established in the neighbourhood and the lovely views and vista possible from the proposed subdivision, this scenario is unlikely. Further, such issues are just as likely on any farmland from disease vector sources such as silage, hay, imported feed and dead plant and/or animal material.

Important Farmland Interim Variation Criteria	
Criteria	Comment
Agricultural capability: The land is isolated from other important farmland and is not capable of supporting sustainable agricultural production;	Complies: Agricultural viability assessment by Ludwig Mueller & Associates demonstrates that the farmland mapped land is not capable of supporting sustainable agricultural production and would end up an isolated and fragmented piece of rural land between rural lifestyle lots.
Land use conflict: the land use does not increase the likelihood of conflict and does not impact on current or future agricultural activities in the locality;* ** an evaluation may be required in accordance with the NSW Department of Primary Industry land Use Conflict Risk Assessment guide (2011).*	Land Use Conflict Risk Assessment. Completed above.
Infrastructure: the provision of infrastructure (utilities, transport, open space, communications and stormwater) required to service the land is physically and economically feasible at no cost to State and local Government. adverse impacts on adjoining farmland must be avoided;	Satisfied: The site has frontage to Marys Bay Road and immediate proximity to existing Large Lot residential neighbourhoods and has access to the services and existing infrastructure. The site capacity reports addressing on site waste water management and bushfire safety demonstrate the land is physically capable of the proposed use.
Environment And Heritage: the proposed land uses do not have an adverse impact on areas of high environmental value, and aboriginal or historic heritage significance; and	An AHIMS search of the locality indicates recorded sites some distance to the north and consultation with the local aboriginal community has been identified as required. There are no European heritage items identified.
Avoiding Risk: risks associated with physically constrained land are avoided and identified, including: flood prone; bushfire prone; highly erodible; severe slope; and acid sulfate soils.	The intended outcome plan at Appendix A demonstrates future building envelopes and waste water disposal areas above the identified flood planning level and the Bushfire Hazard assessment demonstrates requirements are met under Planning for Bushfire Guidelines.

LUDWIG MUELLER & ASSOCIATES

Biological Farming Consultant

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8 October 2013
To: Alex Irving and to whom it may concern
Re: Bradburys Mountain Soil Audit

Dear Alex,
On 19 of September I had the opportunity to inspect the site and we did together soil sampling, processing with paper trial and sending a mixed sample of at least 40 cores taken to a depth of pasture roots 150 mm away to the Independent Environmental Analysis Laboratory, part of the University of Lismore.

KeyCrobe has received the result figures from EAL and I received the independent report by E-mail from KeyCrobe. I have highlighted a copy of the original document and also produced a hard copy with comments to understand the process how to deal with such poor fertility if an improvement is considered.

I am astounded that this hill is like an island of rather poor fertility compared with the surrounding of flat country used in a rural housing subdivision to the south and also to the north, where alluvial flood plains have shaped fertile soils over the history of the landscape.

The elevated paddock in question with good view to the valley and mountains has been formed by another geological background history, I assume volcanic deposits with broken rock evidence, simular like found in Telegraph Point's poorer country where I live in a rural subdivision. We are located in partly forested hill country next to the larger elevation of Red Hill, part of it with fertile deep volcanic soils used for horticulture like growing Avocadoes and Vegetables and others. What a contrast, like at Bradburys Mountain, where Horticulture next to it in the north can be practised on the more drained elevated country side formed originally by floods over thousand of years.

The soil of Bradbury Mountain is in my opinion not suitable for high return horticultural Investments, cultivation of this soil due to the higher rock content in some areas makes cultivation difficult and being on a hillside high risk with erosion.

9196222

The provided soil audit with recommendation shows the high expensive inputs needed to fix up deficiencies to improve just pasture production and or soil in general.

If this site is utilised for a subdivision with housing, gardens and lawns, the soil audit and improvement suggestions provided, will bring this soil in good shape for such use as well. I would recommend to do before sub-dividing and not leaving it to the individual judgement of each land holder. Some of the surface rocks in some areas can be easy removed with machinery like a backhoe.

The appearing potential for this site as a Rural Sub - Division, would make this site the pick of any Sub - division I know off.

Some area like on top of the hill amongst trees, could be used for community parkland and a lookout with seating and Barbeque and the hill sides could become prestige house site locations. I leave it with these suggestions and inspirations for such a good opportunity in my eyes, in mind that the infrastructure with water and others is already existing on the Mary Bays road.

Yours Faithfully

Ludwig Mueller

LUDWIG MUELLER & ASSOCIATES

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8 of October 2013
To: Alex Irving and To Whom It May Concern
Re: Bradburys Mountain" 262 Mary Bay Road EUROCA

I have received instructions to comment on the agricultural viability of the property at 262 Marys Bay Road EUROKA VIA KEMPSEY ("The Subject Property"). I inspected the Subject Property on the 19th September 2013, took soil samples and reviewed the terrain.
The soil samples (approximately 40) were taken to a depth of 150 mm and provided to the Independent Environmental analysis Laboratory at the Southern Cross University Lismore.
This request has arisen in respect of the publication of the following studies by the Kempsey Shire Council:

a) The Background Report of Residential Land Use Strategy; and
b) Shire of Kempsey Rural Residential Land Release Strategy.

("The Land Release Documents")

The Land Release Documents identify the potential for the Subject Property to be re-zoned as suitable for rural residential development.
I have been provided with the Land Release Documents, together with plans and photographic material. That material is set out in annexure to this report.
I have inspected the property.

THE SUBJECT PROPERTY

The Subject Property is located at 262 Marys Bay Road EUROKA via KEMPSEY. The land is Folio Identifier 10/778496. A copy of the Plan is attached as Schedule 1.
Plan identifies the property as having an area of 30.15 hectares.
I am informed that the property was previously utilised as part of a dairy farm operated by Robert Welch, and included the neighbouring Folio 100/778496.

PHYSICAL CHARACTERISTICS OF THE SUBJECT PROPERTY

The land is gently undulating with some steeper country abutting the Macleay River.
No irrigation licence benefits the property.
Located on the land is a weatherboard dwelling, and a dairy building fronting Marys Bay Road. Some farm sheds in a state of disrepair are located on the land.
The property is lightly timbered.

AGRICULTURAL PRODUCTIVITY OF THE SUBJECT PROPERTY

I have attached hereto a Soil Analysis and Program from Keycrobe / Southern Cross University.

The soil profile is of a poor soil not suited to agricultural productivity. I refer to "Soil Sense – Soil Management for NSW North Coast Farmers", a publication of NSW Agriculture:

"The geology of the catchment is very mixed.....Middle catchment soils are formed mainly on sandstones and mudstones of the Kempsey Beds. Soil types are usually yellow or brown podzolic soils (kurosols) and soloths (sodosols). These beds have strongly acidic subsoils with hardsetting topsoils, tend to be sodic, and are dispersible when wet and prone to sheet and gully erosion: they are suitable only for grazing and timber".

Towards the higher country of this site, soil has less clay and therefore less nutrient holding capacity at the surface which is also mixed with rocks.

The soil on the Subject Property would require uneconomic application of fertilizer to bring the land up to a productive state for grazing. The soil has a significant amount of rock making cultivation difficult. Further, the property has some steeper slopes and erosion would be an issue where cultivated.

Other limitations of the property are:

a) Lack of an irrigation licence;
b) Significant amount of exposed and sub-surface rock limiting capacity to sod seed.
c) Area. Farming on the Mid North Coast presents opportunities in dairying, beef cattle and to a limited extent cropping. Turning to those undertakings:
    - Dairying. Simply, the property is not large enough to support a dairy enterprise. The dairy industry de-regulation has required dairies to enlarge their operations to remain competitive and viable. Schedule 2 is an extract from Dairy Australia regarding farm sizes for dairying. Average herd size in Australia now is 240 milkers.
      This property could carry, subject to seasonal conditions, about twenty cows year round.
    - Beef cattle. Stocking rates would not vary significantly for beef cattle. The property could run approximately twenty breeding cows year round – subject to seasonal conditions. Assuming a price per calf of $500 that provides a total gross income of $10,000 per annum.
    - Cropping/Market Garden. The property is significantly limited in not possessing an irrigation licence. It is dubious as to whether irrigation could be effected from the Macleay River due to brackish water. In addition the soil tests conducted indicate significant rock presence which impedes cultivation and in some cases harvesting.
    - Totpography – Schedule 3 indicates that the property is located on a significant ridge'hill which certainly nearer the Macleay River would present an impediment to both working the soil and harvesting.

PRODUCTIVITY OF THE LAND

Current pastures on the Subject Property include:

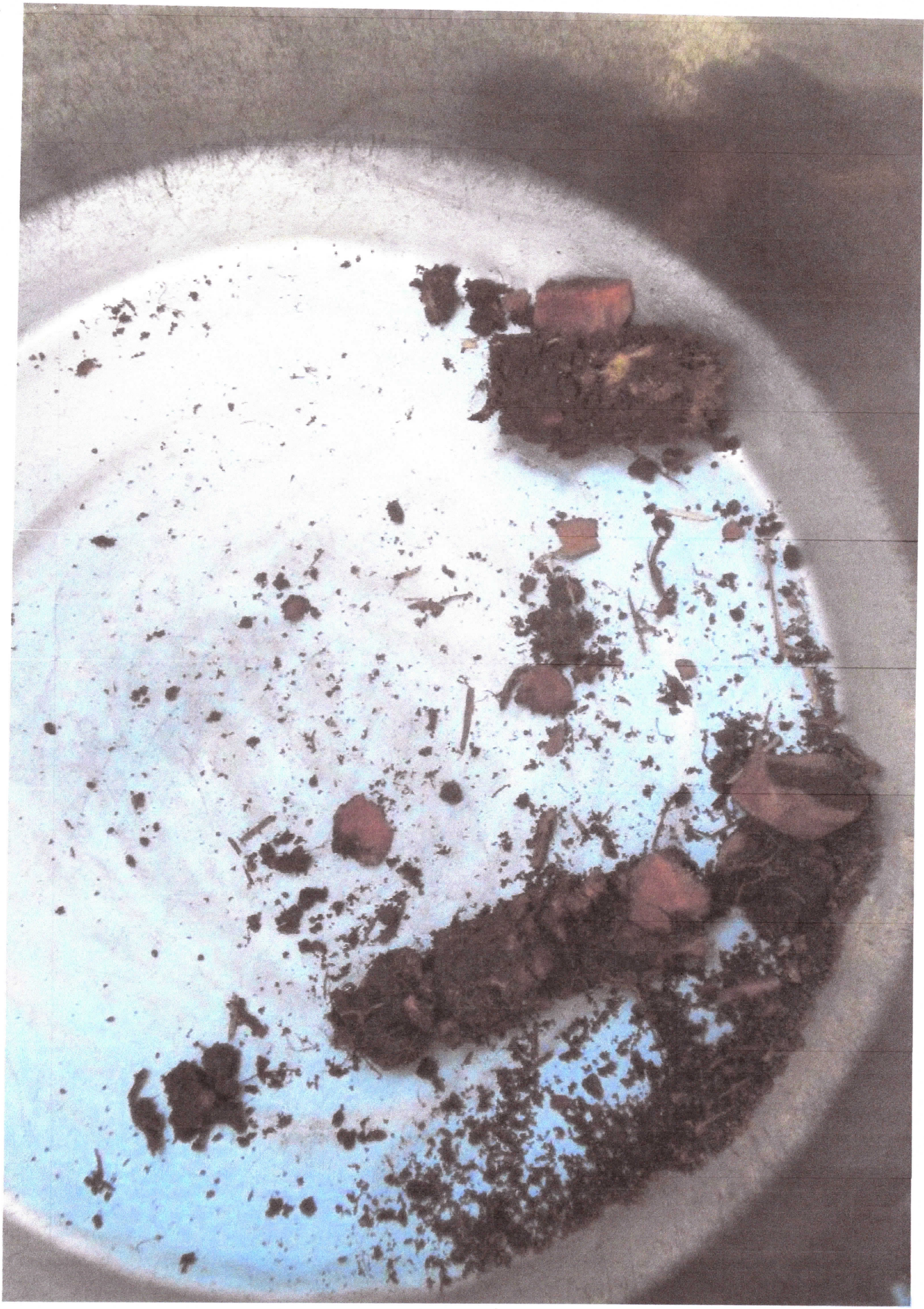
1) Broad Leaf Paspalum (paspalum mandioncanum) – a broad perennial grass classified as a weed by the Northern Rivers Catchment Management Authority;
2) Giant Parramatta Grass (Sporobolus fertlis) – a tussocky weed;
3) Kikuyu – (Pennisetum Clandestinum) – a common perennial on the Mid North Coast. a aggressive grass which spreads from runners. Hardy pasture but not a high quality feed;
4) Setaria – (Setaria sphacelata) – an introduced perennial tufted grass –
5) Blady Grass – Imperata Cylindrica – a native grass of poor digestibility.

Blady Grass is indicative on the Mid North Coast of NSW of poorer quality soils.

I leave it with this observations and investigations supported with pictures and the independent soil audit attached.

Yours Sincerely

Ludwig Mueller



Soil Program Recommendation

Grower: Alex Irving
Cowal Creek Rd
Bellangry
NSW 2446

Consultant: AgriVision
Ludwig Mueller
Ph: 02 6585 0381

Soil Test No: K5944

These comments and suggestions are based on our interpretation of soil analysis figures from your Environmental Analysis Laboratory soil test report. Our aim is to achieve a nutritionally well balanced, biologically active healthy soil, having optimum potential to grow any plants well. Crop specific nutrient applications are of most value when applied to well balanced healthy soils.

Environmental Analysis Laboratory soil test is based on the Albrecht soil model in conjunction with a Reams test.

The Albrecht soil model is a well proven format of mineral balance using base level requirements of nutrients designed to build soils for the long term as well as feed plants in the short term. Adequate Calcium levels are the basis on which this format is built. A good soil pH is not considered as a means of achieving optimum fertility levels but more as a result of achieving optimum levels of Calcium, Magnesium, Potassium and Sodium, which will produce maximum levels of fertility for a given soil.

The Reams component of our soil test includes the Soluble Tests, Conductivity (Ergs) and Nitrate N test.

Soluble tests are determined by use of the Morgan Extract, sometimes referred to as the La Motte Extract because La Motte make and sell the extract. This test was developed by Carey Reams to simulate as close as possible, the availability for uptake by plants of the soil nutrients Calcium, Magnesium, Potassium, Phosphorus and Nitrate Nitrogen.

Conductivity (Ergs) is a measure of soil energy release equal to grams/sec, indicating whether or not there is enough energy reaction going on in the soil to grow good plants.

Ammonium Nitrate test, which is recommended by Carey Reams, is only run if specifically asked for, as there is no way of determining how much Ammonia is from fertilisers versus biological life, causing false and confusing test results, where Ammonium fertilisers have been used.

General Comments

Your soil CEC (Cation exchange Capacity) is in the light soil type range. The exchange capacity of 9.3 indicates a reduced amount of clay and a light nutrient holding capacity which requires small quantities of added nutrients to change their relative levels in the soil. The "Base Saturation" of a given soil, is the specific percentage of nutrients that grows crops best, i.e. "Desirable Levels" of "Percentage Base Saturation" in your soil report. True soil balance is achieved by adding the required amount of each nutrient to achieve the desired level indicated for that soil type, an excess of a given nutrient will complex and cause a deficiency of another nutrient needed for proper plant nutrition. Fertility is the balance between elements in a biologically active soil.

Low Calcium together with high Magnesium is causing an imbalance and limiting your soil fertility. A good pH level is the product of balancing the CEC "Base Saturation Percentages" of Calcium, Potassium, Magnesium, Hydrogen and Sodium as per their desirable levels for a given soil CEC. As the Calcium concentration is increased, so is efficiency in getting other nutrients into the plant roots.

As Calcium levels are raised with introduction of lime to the soil, high Magnesium levels can be pushed down. A desirable Ca/Mg ratio is the key to good soil structure, enabling air and water movement through the soil profile and is vital for microbial proliferation and activity.

Phosphorus is a limiting factor in your soil and will need building to achieve good yields and quality. Plant growth and health is reliant on Phosphorus for its function in respiration, cell division and growth, sugar and starch formation, uptake and movement of nutrient in the plant. Good Phosphorus levels in the plant help to maintain high sugar and protein content which can ward off insect attack.

Sulphur in the form of Sulphate and Calcium are as important as Phosphate to plant nutrition. Adequate Sulphur improves the palatability of all crops and grasses, increases protein content and is necessary for chlorophyll formation, a deficiency of Sulphur will impair both yield and quality.

A less than desirable biological activity is evident, signified by high Organic Matter and low plant available nutrient conversion from reserve nutrient levels, i.e. "Ammonium Acetate and Bray 2 Test" figures compared with "Soluble Test" (Reams) figures in your soil report.

Low pH and the associated soil acidity will be limiting biological presence and activity in your soil.

Low conductivity (ERGS Energy Release per Gram of Soil. Established by Carey Reams) in your soil can be an indicator for lack of soil energy due to the depletion of conductive plant food ions to feed the plant at the rate it wishes to be fed, in other words diminished nutrient availability. If you have seen a weed pull much of the energy from the soil and stunt the crop next to it you have seen the ERGS concept at work. Low energy in the soil translates to low plant energy and can result in reduced productivity and disease susceptibility. As fertility improves, soil energy improves.

There is no established benefit from any quantity of Aluminium for plant growth and at toxic levels it is very detrimental. In acid soils, Aluminium is more available and can tie up valuable Phosphorus. Toxic levels of Aluminium vary with different plant species, soil types and pH levels. The main Al toxicity symptoms observed in plants are; inhibited root growth, particularly root tips, lateral roots thicken then turn brown, lack of fine hair roots and stunted top growth, seed germination may be inhibited. Maintaining good Calcium levels is the most effective remedy for excess Aluminium.

Trace elements are generally low and availability will be reduced because of low soil biology. Though soil application of traces is required, it would be better to supply traces in an available form as a foliar/soil treatment until soil biology is improved. Often trace deficiencies are rectified naturally by improved soil life releasing these traces to the plant. Monitoring of trace levels should be maintained.

Fulvic and Humic acids can play a significant part in improving this soil. Fulvic for its ability to penetrate and increase soil aeration, promote root growth and enhance soil structure. Humic acid or Humates for their ability to increase soil humus content, to buffer or protect plant roots from nutrient excesses and to promote the conversion of Phosphorus and other elements into plant available form by enhancing soil biology.

Audit of fertilizer requirements to raise deficient nutrients to desirable levels in this sample.

	A
Calcium	1436 kg/ha
Sulphate S	29 kg/ha
Phosphorus P	64 kg/ha
Zinc	6.6 kg/ha
Manganese	23 kg/ha
Copper	2.4 kg/ha
Boron	2 kg/ha

Recommendations:

Calcium is the first consideration when planning a soil improvement program. TNN TraceLime is an evenly ground, highly concentrated Calcium source, incorporating a full range of micronutrients, more suited for long term calcium remediation. The fineness of particle size together with the infused nutrients, makes the availability of this lime much faster and more complete than normal Aglime.

The addition of Gypsum (Calcium Sulphate) as a Calcium source would also supply the necessary Sulphur to increase the content to a desirable level. Liquid Sulphur 10-0-0-30 is an excellent liquid alternative Sulphur source.

Formula 1 microbial soil rebuild is a concentrated microbial compound including an initial food source, based on bacillus bacterium, designed to increase and enhance microbial presence and activity in the soil. This will boost organic matter decomposition, thereby increasing the all important soil humus content and in turn, nutrient availability for plants.

KeyCrobe – Dale Paterson 291 Eastwood Rd. Bairnsdale. Vic 3875
Phone: 03 5152 5221 Email: dwpat@bigpond.com

FCMP (Fused Calcium/Magnesium Phosphate), Rock Phosphate or MAP is recommended as a starter and long term source of phosphorus. Your base Phosphorous levels will need to be built over time.

The Mineral Plus pasture spray range was developed to remedy the much overlooked deficiencies of trace elements in our soils. This range is made up of a combination of the lignin chelated trace elements; Cobalt, Selenium, Manganese, Copper, Zinc, Molybdenum and Boron, using various rates to cater for common deficiencies and can be custom mixed for specific prescriptions formulated from soil and plant tissue tests.

We recommend regular soil testing to monitor nutrient levels and establish a fertility improvement trend.

Suggested Applications in Order of Priority

	A
TraceLime	1000 kg/ha
Gypsum	400 kg/ha
FCMP	200 kg/ha
Formula 1	25 kg/ha

Suggested Foliar Applications in Order of Priority

	A
Mineral Plus P/S No 6	7 ltrs/ha

Suggested Long Term Program

	A
TraceLime	1000 kg/ha
FCMP	200 kg/ha

Rates can be varied to suit budget, consult your TNN representative

Further Comments:

The above recommendations are based on your soil fertility and have not been developed for specific crops. "Good soil" will grow any crop well. Your crop fertility program should be reviewed in conjunction with the above recommendations.

Please remember that the aim is to build the soil over time, to spread out the cost and add in foliars to overcome what is lacking while the soil fertility is being built.

Disclaimer:

"The above program is not intended to be exhaustive and will be effected by soil variations, testing error and seasonal factors. Any recommendations should be viewed and acted upon as part of an ongoing fertility program. No responsibility can be accepted by the company in respect of consequences of any of the above matters or other matters beyond our control."

KeyCrobe – Dale Paterson 291 Eastwood Rd. Bairnsdale. Vic 3875
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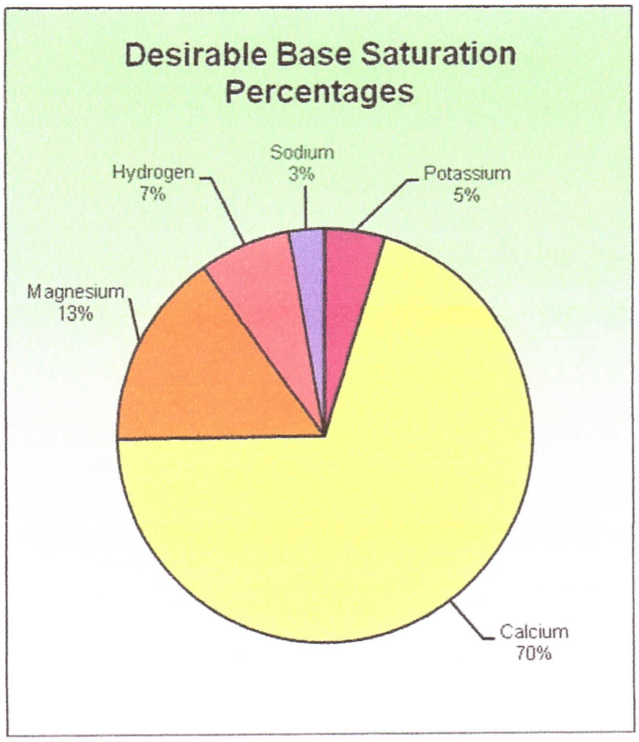
Sample No: 5944
Ref: C9099/8
Sampled At: Bradburys Mountain
Date Sampled: 19/09/13
Crop: Pasture
Soil Type: Brown Loam **Hectares:** 30

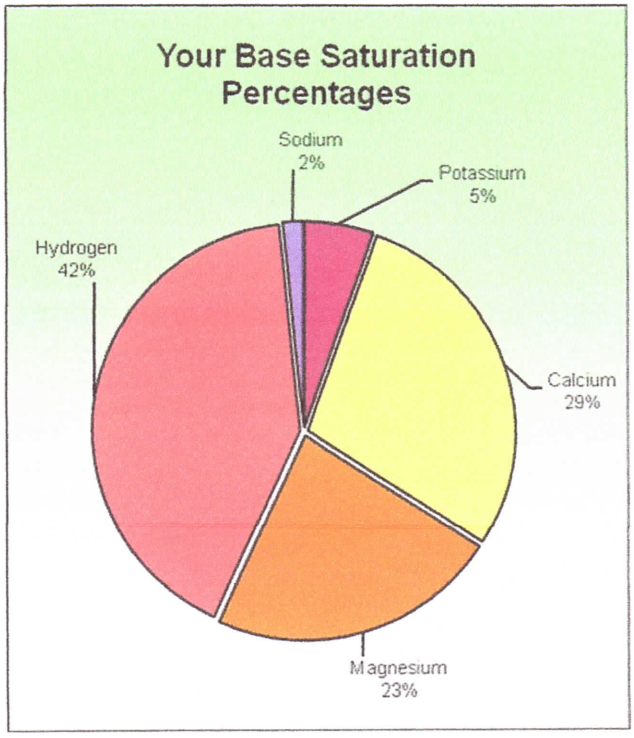
Soil Analysis by

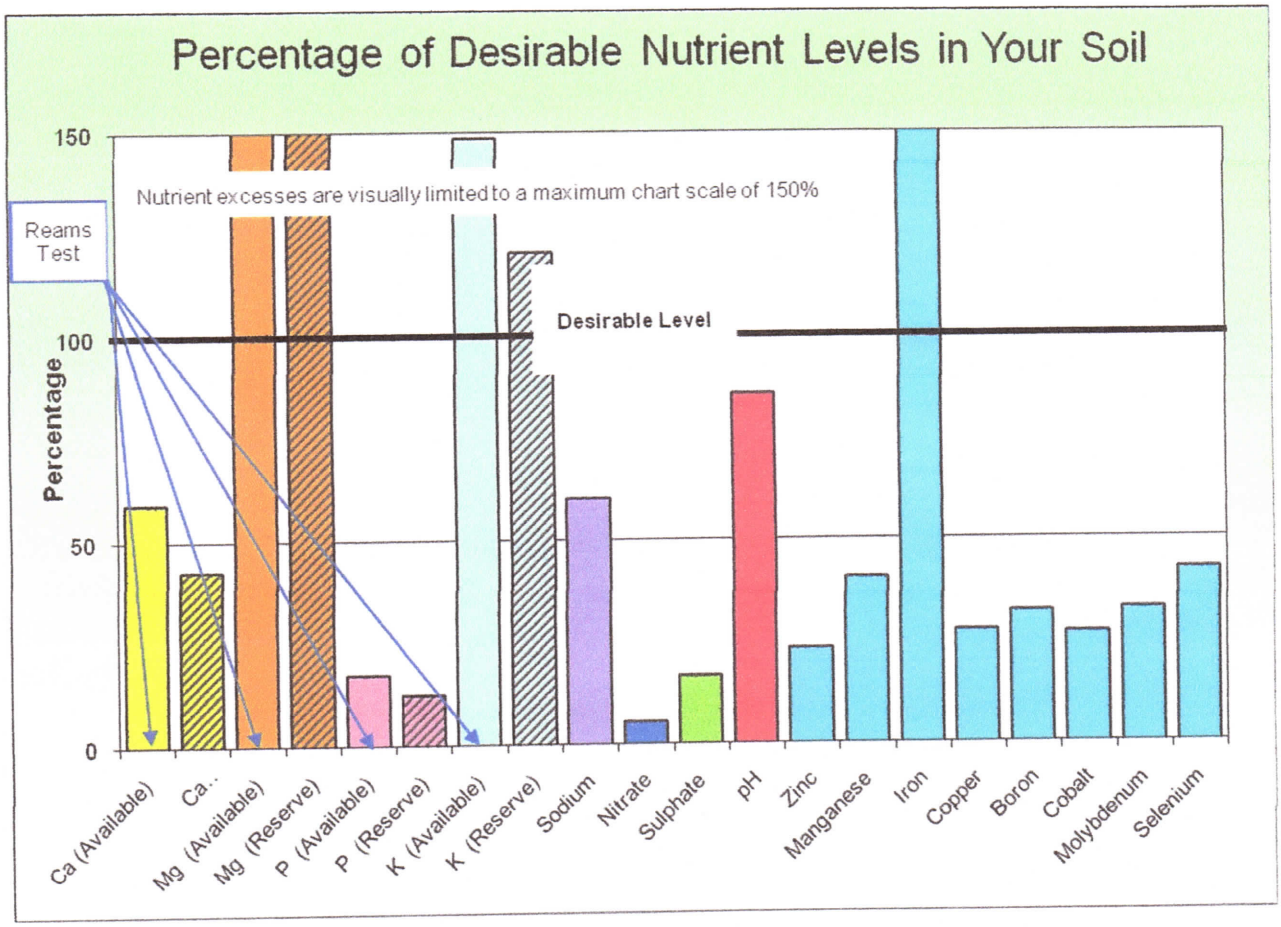
Environmental Analysis Laboratory
Military Rd. East Lismore. NSW 2480
P.O. Box 157
Ph: 02 6620 3678

	Nutrient		Laboratory Analysis Data		Evaluation		
					Units	Results	Desirable
Soluble Tests Reams Bray P_1	Calcium	Ca	ppm	317.23	Kg/Ha	634	1070
	Magnesium	Mg	ppm	193.35	Kg/Ha	387	140
	Phosphorus	P	ppm	3.17	Kg/Ha	6	36
	Potassium	K	ppm	121.63	Kg/Ha	243	164
Calcium/Magnesium Ratio					Ratio	1.6:1	7:1
Ammonium Acetate & Bray P_2	Calcium	Ca	$cmol^+/kg$	2.68	Kg/Ha	1070	2506
	Magnesium	Mg	$cmol^+/kg$	2.11	Kg/Ha	506	328
	Phosphorus	P	ppm	4.56	Kg/Ha	9	73
	Potassium	K	$cmol^+/kg$	0.50	Kg/Ha	393	327
	Sodium	Na	$cmol^+/kg$	0.15	ppm	34	57
Water Soluble Tests	Nitrate	N	ppm	0.62	Kg/Ha	1	22
	Sulphate	S	ppm	2.89	Kg/Ha	6	34
	pH (Water)		units	5.40	units	5.4	6.3
	Conductivity	Ergs	∝S/cm	35.00	∝S	35	130
	Organic Matter		%	7.70	%	8	4
	Aluminium	Al	ppm	71.60	ppm	71.6	<41
CEC	Cation Exchange Capacity		$cmol^+/kg$	9.31		9.3	
Percent Base Saturation	Potassium	K	%	5.42	%	5.4	4.5
	Calcium	Ca	%	28.76	%	28.8	67.3
	Magnesium	Mg	%	22.67	%	22.7	14.7
	Hydrogen	H	%	41.55	%	41.5	6.8
	Sodium	Na	%	1.61	%	1.6	2.7
Micronutrients	Zinc	Zn	ppm	1.01	ppm	1.0	4.3
	Manganese	Mn	ppm	7.84	ppm	7.8	19.3
	Iron	Fe	ppm	189.17	ppm	189.2	73.3
	Copper	Cu	ppm	0.48	ppm	0.5	1.7
	Boron	B	ppm	0.48	ppm	0.5	1.5
	Cobalt	Co	ppm	1.01	ppm	1.01	3.75
	Molybdenum	Mo	ppm	0.52	ppm	0.52	1.60
	Selenium	Se	ppm	0.64	ppm	0.64	1.50

Sample No: **K5944**







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