Soils in the Spotlight

GLENRAC's Smart Farms Soils in the Spotlight project

ACKNOWLEDGEMENTS

Glen Innes Natural Resources Advisory Committee (GLENRAC) is a community driven not-for-profit incorporated association that has more than 30 years' experience in sustainable agriculture, natural resource management and community capacity building projects within the Glen Innes region and wider community. GLENRAC's vision is to provide solutions for a sustainable and productive landscape. For more information about GLENRAC visit www.glenrac.org.au.

The GLENRAC Soils in the Spotlight project provides a snapshot of soil health and soil fertility from agricultural and pastoral enterprises across the Glen Innes district and its three broad soil types to help landholders make land management decisions.

For more detailed information, consult the references at the back of this document, or email glenrac@glenrac.org.au.

This project is supported by the Department of Agriculture and Water Resources, through funding from the Australian Government's National Landcare Program.

GLENRAC
Glen Innes Natural Resources Advisory Committee

Australian Government | National Landcare Programme

SOIL LAND FOOD
ECOLOGICAL AGRICULTURE

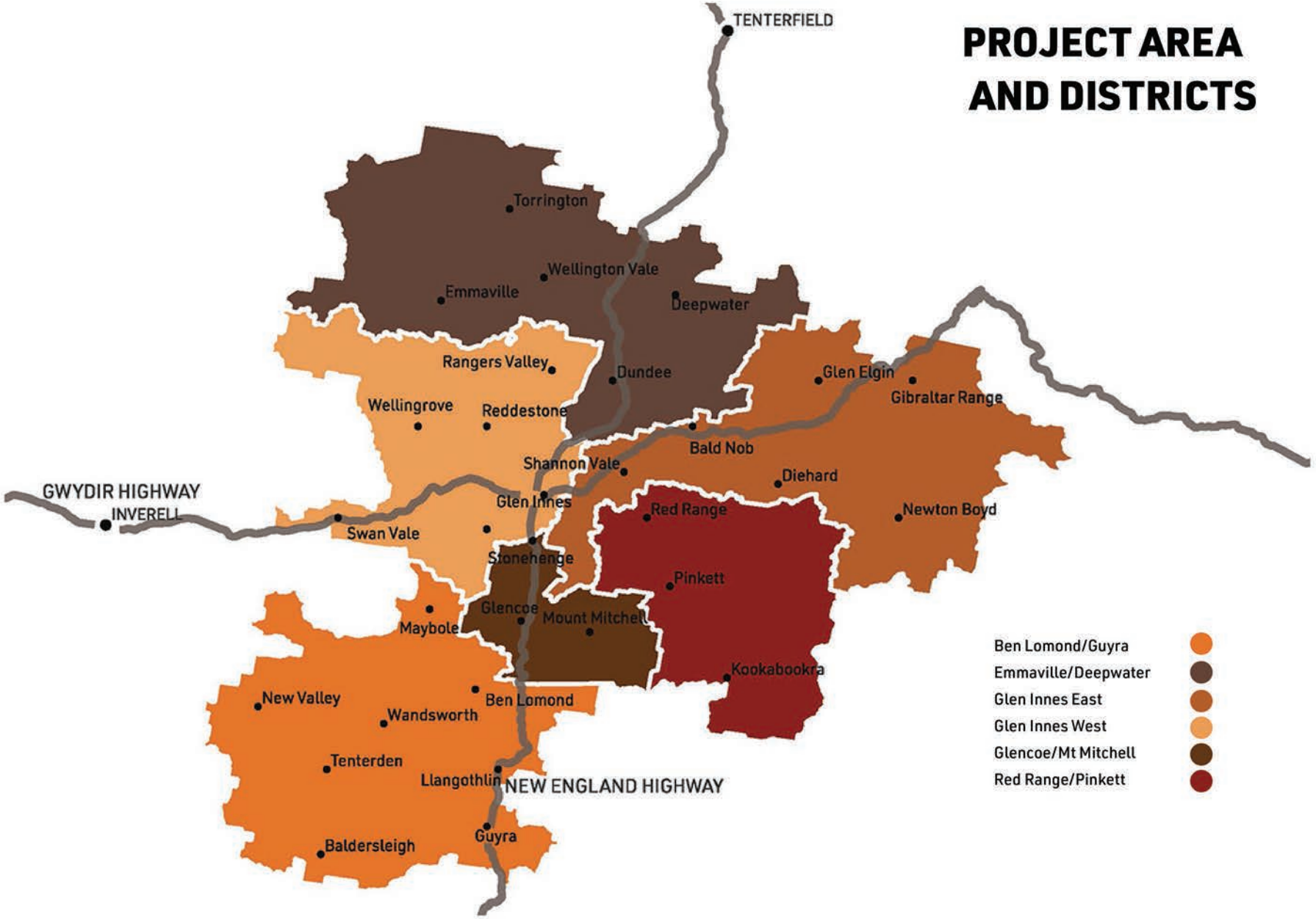
TABLE OF CONTENTS

The Glen Innes Soils in the Spotlight project

The **Soils in the Spotlight** is part of GLENRAC's *Smart Farms Small Grants Soils in the Spotlight Glen Innes* project that is working with landholders in the Glen Innes region to increase their understanding about soil health and soil fertility status.

Soils are the basis of our environment and agricultural production, and maintaining healthy soils is vital to our natural resources. Information presented here is collated from many sites on over 100 properties which have taken part in the project. The results have been compiled to show key indicators for health and fertility of soils with different characteristics. Along with target benchmarks, the information on these key soil indicators provides a starting point for landholders to monitor the soil on their property and for their enterprise.

PROJECT AREA AND DISTRICTS



Soils of the Glen Innes Area

The soil types of the Glen Innes area have arisen from the different underlying geology of the region: basalt, sedimentary (trap rock) and granite. **Soil types** have key properties, such as **texture** and **cation exchange capacity (CEC)**, that don't change greatly under management. These properties come from the minerals that form a soil, the parent material. It is important to know your soil types for long-term management decisions.

In the Glen Innes region basalt landscapes typically weather into fertile, strongly structured clay soils. Trap rock soils are often loamy soils derived from metamorphosed sedimentary rock and are generally low to moderately low in natural fertility. Soils formed on granite can vary depending on the topography. Hilly areas will develop coarse sandy, well-drained soils, but in the valleys the soils may accumulate more clay and organic matter.

Texture, the proportion of sand, silt and clay in a soil, strongly influences some important soil properties including soil structure, water infiltration and water holding capacity. There are three broad soil textures in the region: Heavy Soils have a clay texture; Medium Soils have a clay loam texture and Light Soils have a sandy texture.

CEC describes the capacity of a soil to hold and exchange its positively charged nutrient elements, called cations. Important cations include calcium and potassium. CEC is largely influenced by the amount of clay particles in the soil. Texture is generally related to CEC. It's important to know your CEC as it can influence key soil management decisions such as liming and acidity management. Different soils will have a large, medium or small sized CEC. In this report soil CECs over 15 are considered large; between 5 and 15 are considered medium; and below 5 are considered small.

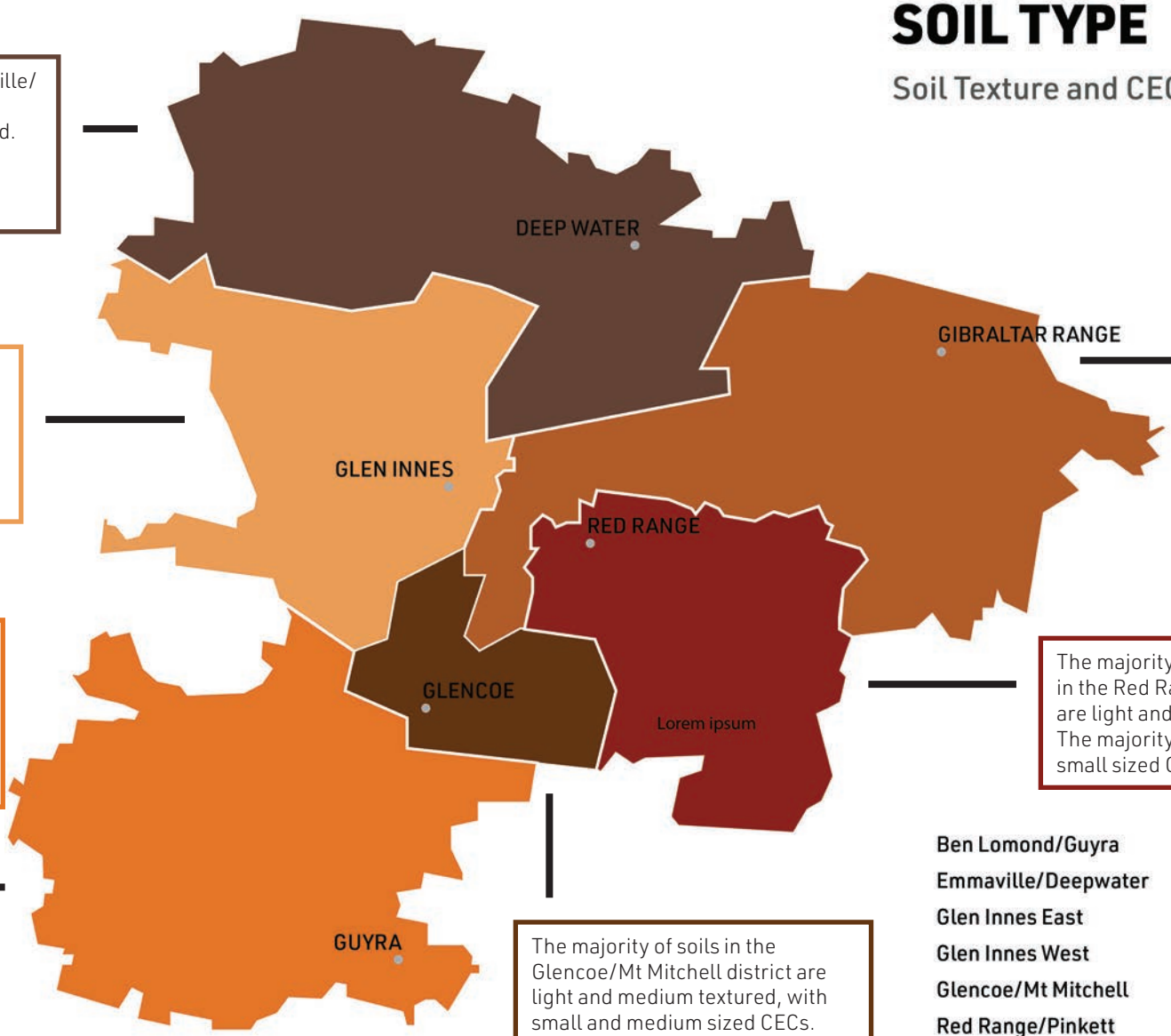
SOIL TYPE

Soil Texture and CEC

The soils of the Emmaville/ Deepwater district are mainly medium textured. The majority of soils sampled have medium sized CECs.

The majority of the soils sampled in the Glen Innes West district are heavy textured. The majority of soils sampled have large sized CECs.

The soils of the Ben Lomond/Guyra district are mainly heavy and medium textured. The majority of soils sampled have large and medium sized CECs.



The majority of the soils sampled in the Glen Innes East district are light textured. The majority of soils sampled have small sized CECs.

The majority of the soils sampled in the Red Range/Pinkett district are light and medium textured. The majority of soils sampled have small sized CECs.

The majority of soils in the Glencoe/Mt Mitchell district are light and medium textured, with small and medium sized CECs.

- Ben Lomond/Guyra
- Emmaville/Deepwater
- Glen Innes East
- Glen Innes West
- Glencoe/Mt Mitchell
- Red Range/Pinkett

Soil Health Indicators

Soil health describes the state of a soil system. Healthy soil helps make farming and grazing businesses more resilient, efficient and profitable in the long term. Well managed soil leads to better agricultural productivity, improved water quality and healthy landscapes.

A soil that is healthy has key chemical, biological and physical properties in balance. Some important aspects of soil health include well developed soil structure, balanced soil pH, adequate levels of soil organic carbon and good root and biological activity.

The key indicators of soil health used for this report include: soil organic carbon (OC); soil pH; the proportion of exchangeable aluminium (ex.Al) in the top soil and sub soil and the proportion of exchangeable sodium (ex.Na) in the topsoil.

The soil health information on the following maps has been gathered from properties across the district. You can compare your soil health results against the results in your district. The soil benchmarks provided give you an idea of what is a good result and what is poor in terms of soil health.

Organic Carbon (OC)

What is it?

Soil organic carbon (OC) is primarily made up of decomposing organic material. Roots, stems and leaves of crops or pasture grasses all cycle into the soil and decompose, where some remains as soil organic carbon.

Why it's important

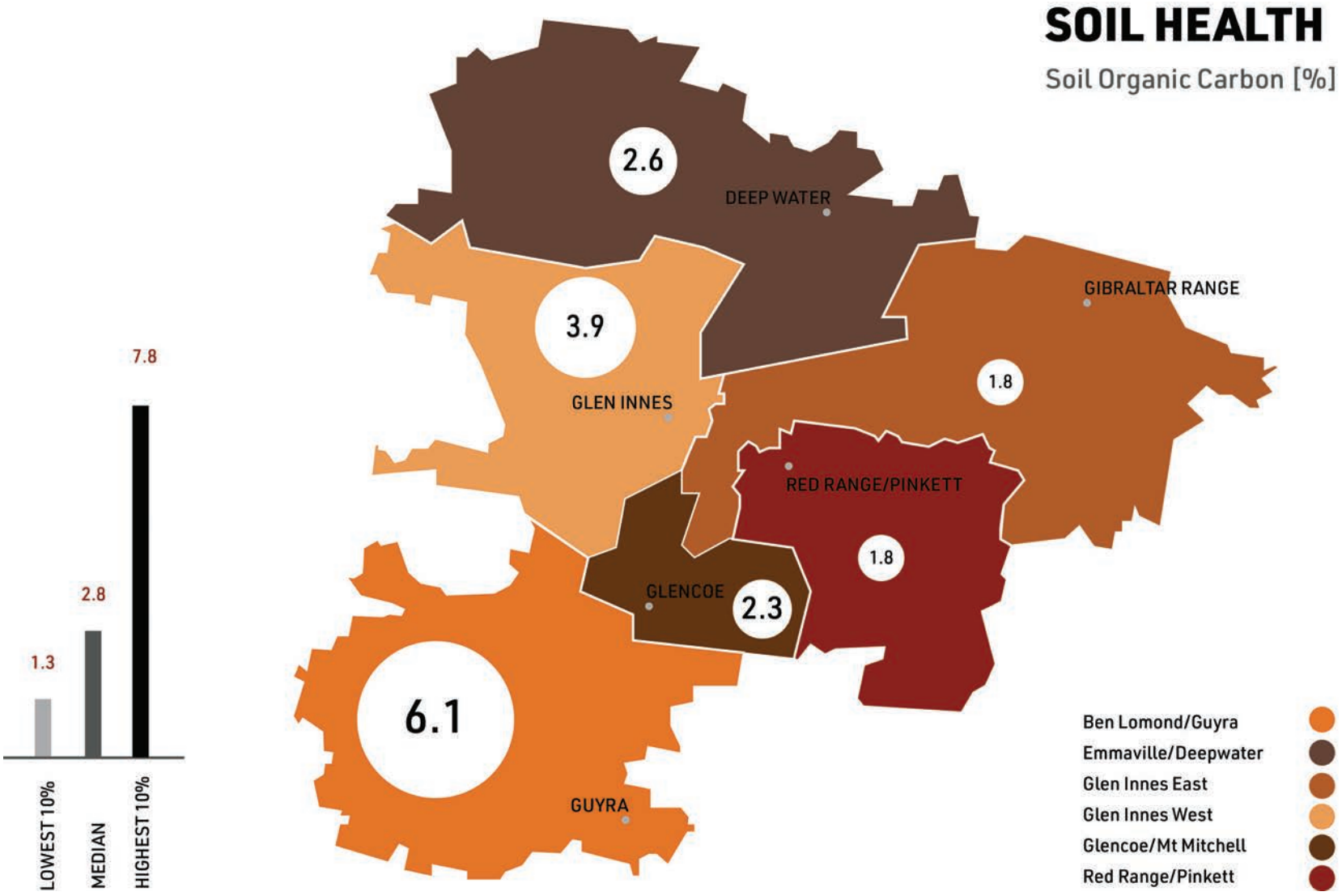
Soil organic carbon plays a critical role in the soil's physical, chemical and biological processes. For example:

- It provides energy for biological processes and releasing nutrients.
- It improves soil structure which helps water infiltration, water holding capacity and plant growth.
- It buffers soil temperature.
- It contributes to cation exchange capacity.

Understanding the map

The circles show the median %OC from project properties by district. 50% of results are above this level and 50% are below

- Lowest 10% - the lowest 10% of soil organic carbon results are below this number.
- Highest 10% - the highest 10% of soil organic carbon results are above this number.



Soil Carbon Benchmarks

Heavy Soil	Medium Soil	Light Soil
>3%	*>2.5%*	*>2%*

pH

What is it?

pH indicates the overall acidity or alkalinity of the soil resulting from soil biochemical processes that occur daily. It is measured on a scale of 0-14. pH levels are influenced primarily by soil type and long-term annual rainfall, but management and farm inputs, like nitrogen fertilisers, also play a key role.

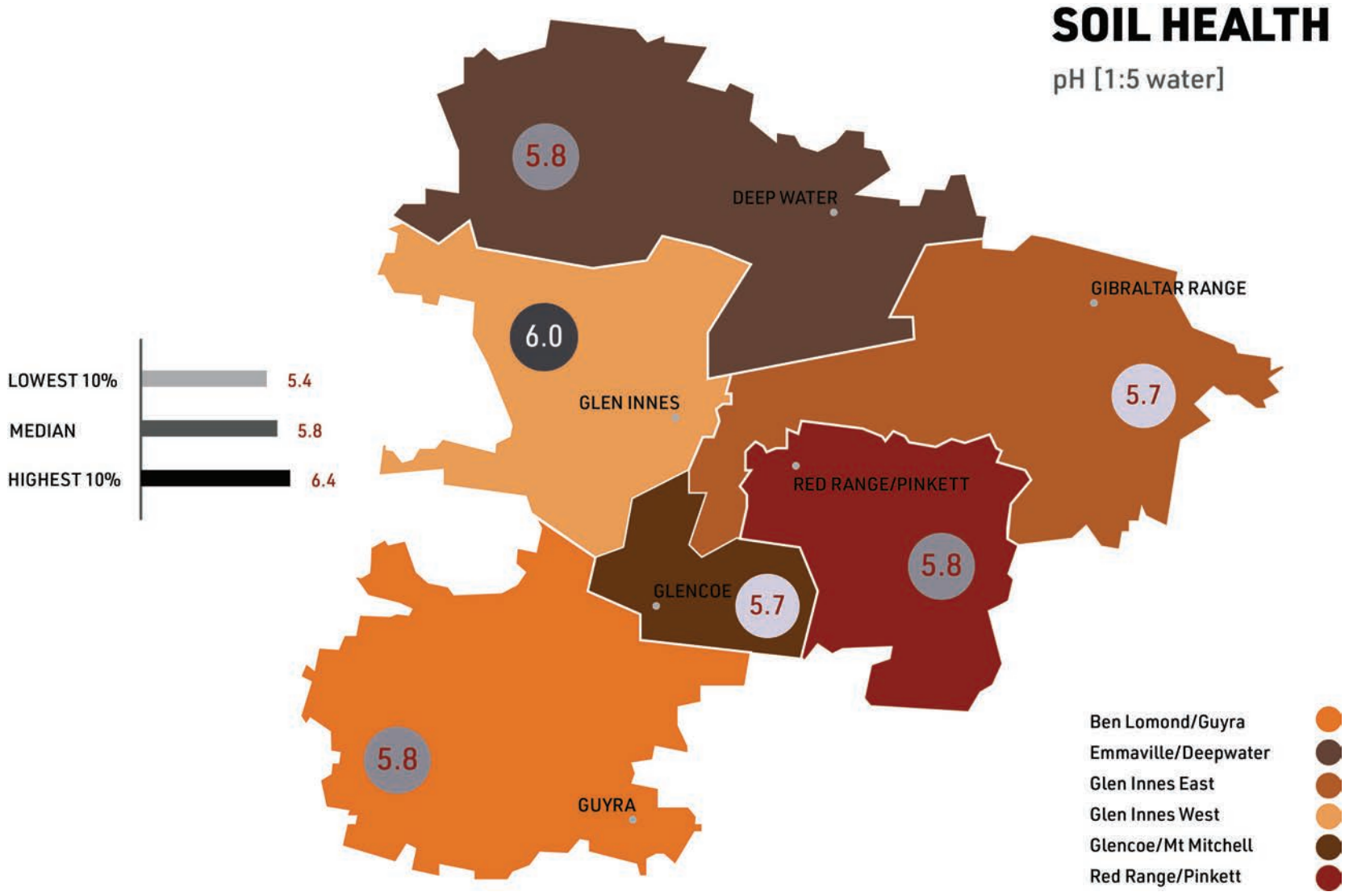
Why it's important

Soil pH influences many soil processes like nutrient cycling and the soil biological community balance. At extreme pH, some nutrients may become tied up and unavailable for plant uptake. Under acidic conditions elements such as aluminium may also get released from the soil minerals, creating toxic conditions for plant growth.
Many native pasture species are tolerant of a wide range of pH. Many crops, legumes and introduced pastures prefer a soil pH of over 6 (pH measured by 1:5 water method).

Understanding the map

The circles show the median pH from project properties by district. 50% of results are above this level and 50% are below

- Lowest 10% - the lowest 10% of soil pH results are below this number.
- Highest 10% - the highest 10% of soil pH results are above this number.



Benchmark for pH (1:5 water): Between 5.5 and 8.5

Exchangeable Aluminium (Ex.Al)

What is it?

Aluminium (Al) is a natural element in all soils. In some situations, when a soil becomes acidic, it can become available as a toxic acid cation resulting from weathering of the soil's parent rock. It becomes available (exchangeable) at low pH (acidic soils). It can be an issue in granite derived soil types. Toxic aluminium conditions can also occur in subsoils on some light soil types.

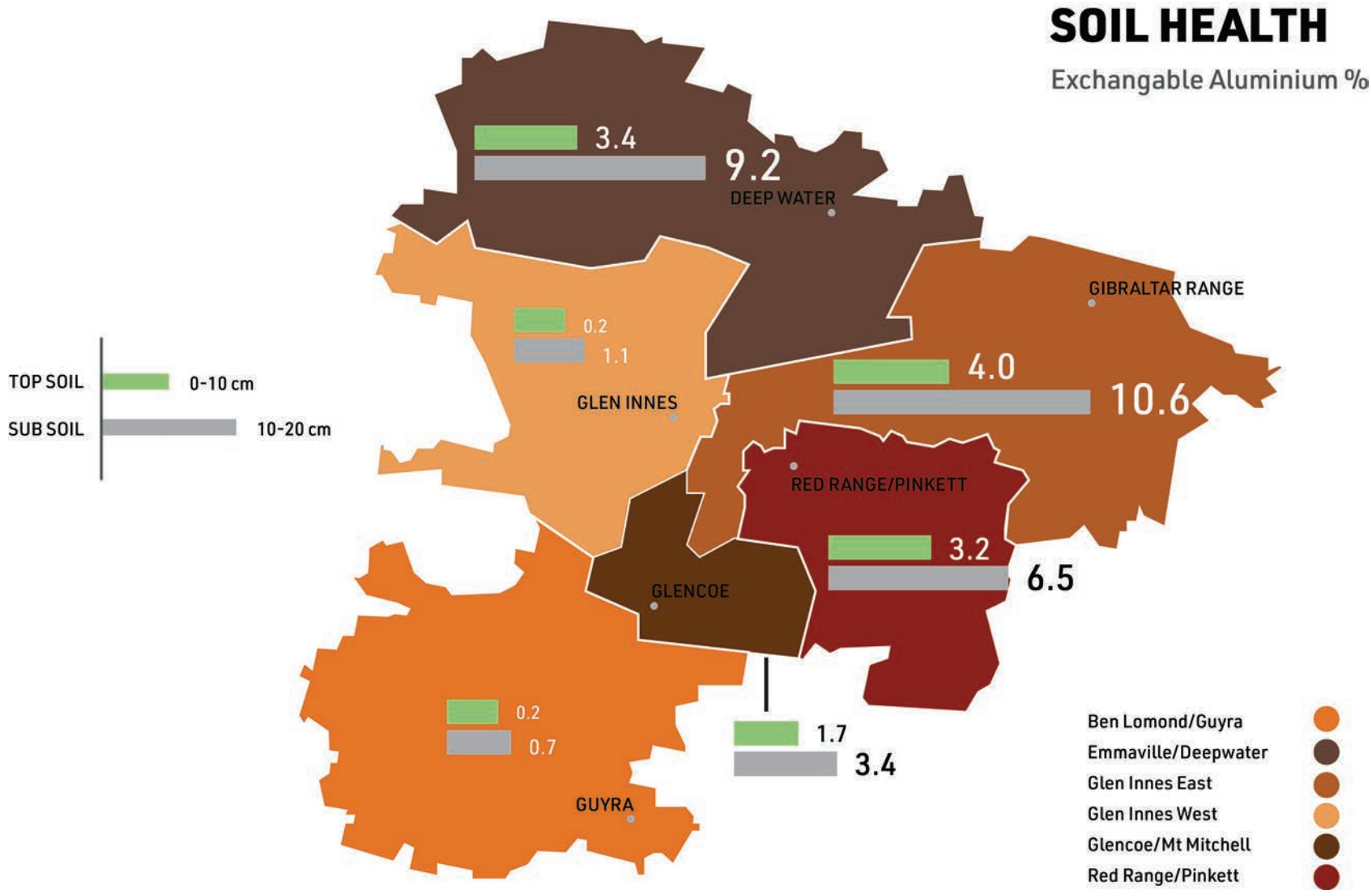
Why it's important

At high exchangeable levels, aluminium can be toxic and a major soil constraint for crop and pasture growth. Aluminium can also bond with phosphorus, creating a phosphorus deficiency in your crop.

Maintaining pH over 5.5 to 6 (pH measured by 1:5 water method) will keep exchangeable aluminium levels low and maintain soil health.

Understanding the map

On the map, the symbols show the median %Ex.Al from project properties by district. 50% of soil results are above this number and 50% are below.



Benchmark for exchangeable aluminium (%Ex.Al): Less than 5%

Exchangeable Sodium (Ex.Na)

What is it?

High levels of exchangeable sodium (Na) can occur when sodium is dominant in the clay minerals of some soil types. These clay minerals have come from the parent material that forms the soil's minerals. Soils with a relatively high proportion of exchangeable sodium are called sodic soils. They can often be found in the subsoil in some land types.

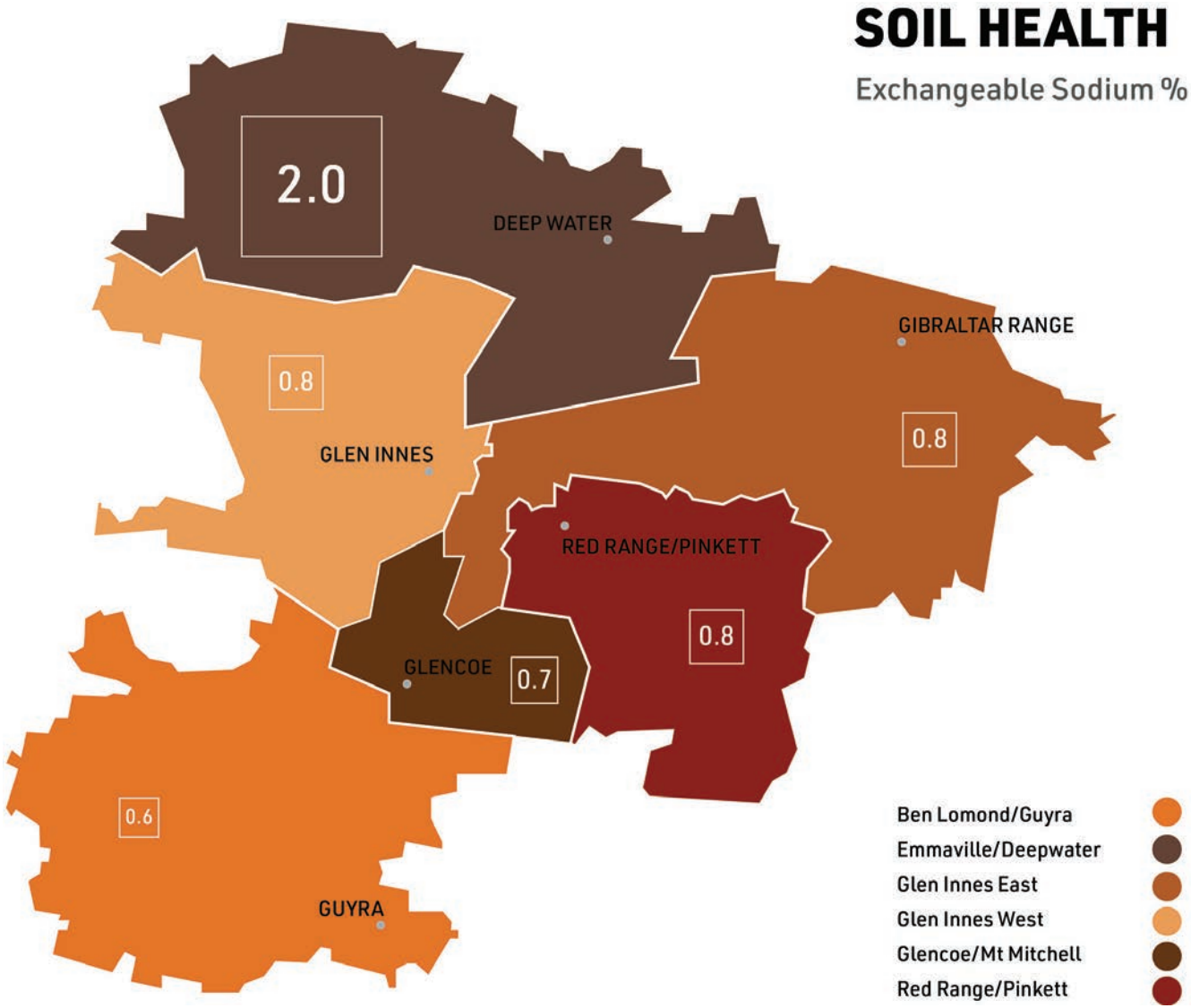
Why it's important

Sodic soils disperse and are highly prone to rill and gully erosion, as the clay in it is unstable. It can also compromise the growth of many plants.

Sodic soils can function well with adequate levels of organic matter and if biological health is good.

Understanding the map

On this map, the squares show the median percentage of exchangeable sodium (%Ex.Na) from project properties by district. 50% of soil results are above this number and 50% are below.



Benchmark for exchangeable sodium (%Ex.Na): < 5%

Soil Fertility Indicators

Soil fertility is the level of nutrient elements in a soil. Your soil needs to cycle and make key nutrients available to ensure pasture/crop growth and productivity. Some indicators of fertility from the Soils in the Spotlight project are available phosphorus (P) and available sulphur (S).

Your enterprise production goals will greatly influence how much fertility you need, but for agricultural production there are minimum targets you need to hit for reasonable productivity.

The information on the following maps has been gathered from properties across the district. You can compare your soil fertility results against the results in your district. The soil benchmarks provided give you an idea of what are adequate levels and what is deficient in terms of soil fertility.

It is important to remember that your soil fertility targets will be determined in part by your enterprise goals. Moderately fertile soils can be productive and profitable when managed well.

Available P (Phosphorus)

Phosphorus is a key element for plant and animal growth. It is needed by cells for energy and is also important for cell walls. It is therefore important to have adequate phosphorus cycling and available in the soil.

A key measure of available phosphorus used in the Glen Innes area is 'Colwell phosphorus'. Colwell phosphorus is the measure used in this report.

The availability of phosphorus in a soil is influenced in part by the soil's texture. Soils with a high proportion of clay minerals may quite easily bind up phosphorus in unavailable forms. For example, basalt soils bind strongly to phosphorus, but sandy soils less so.

Land management practices can also influence P availability.

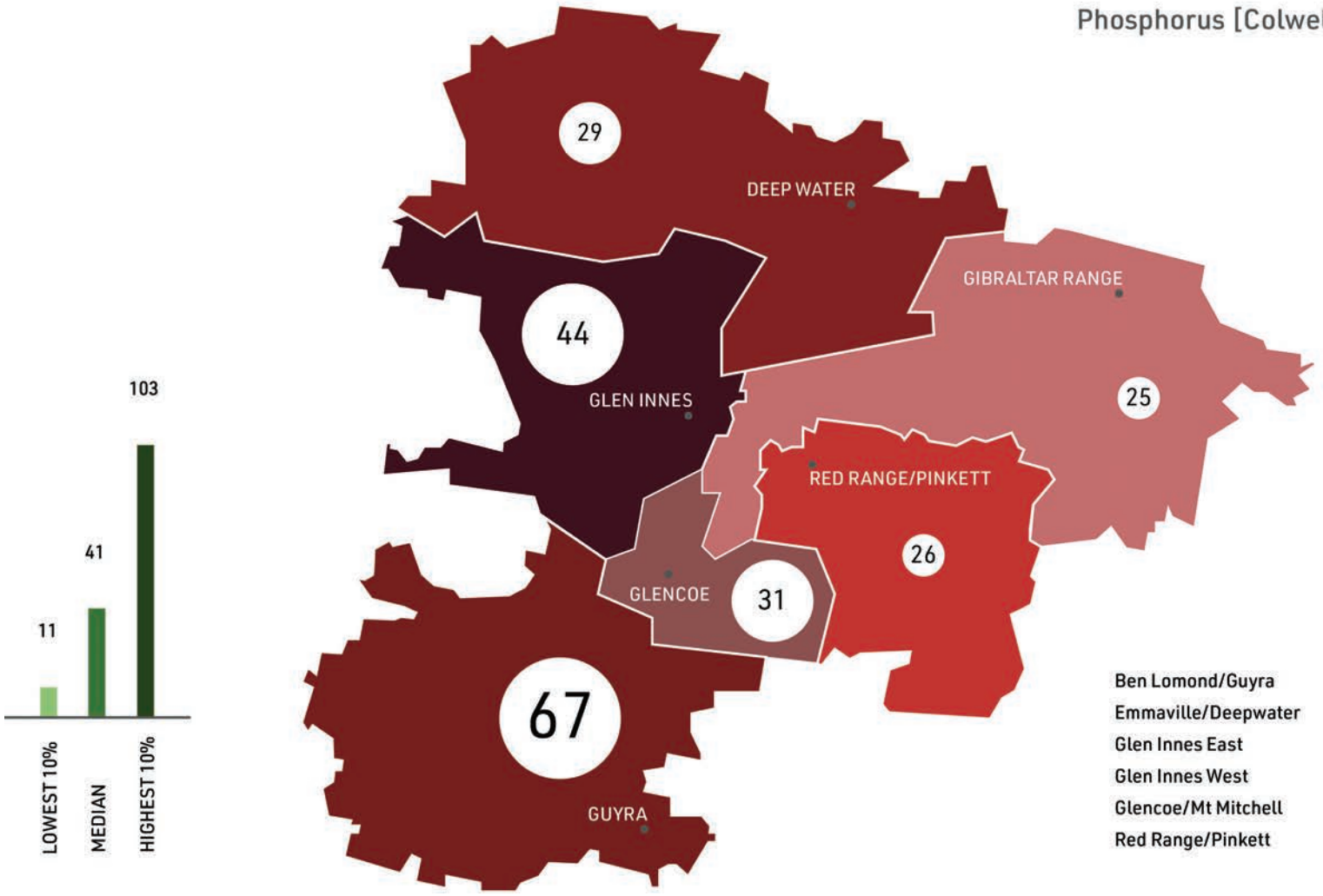
Understanding the map

The circles show the median phosphorus from project properties by district. 50% of results are above this level and 50% are below

- Lowest 10% - the lowest 10% of available P results are below this number.
- Highest 10% - the highest 10% of available P results are above this number

SOIL FERTILITY

Phosphorus [Colwell]mg/kg



Benchmark for available P >20 mg/kg Colwell P

Available S (Sulphur)

Sulphur helps plants to develop chlorophyll, which is why sulphur-deficient plants may appear yellow. It also helps the plants to metabolise nitrogen.

Sulphur is found in two main forms in soils; in a mineral form as elemental sulphur, and in an organic form as part of soil organic matter. It must be mineralised via microbial activity to become plant available. Its plant available form can leach readily from lighter soils with low organic matter. These soils are the most likely to be deficient in sulphur. A key measure of available sulphur used in the Glen Innes area is "sulphate sulphur" as measured with a potassium chloride (KCl) extractant. This is the measure used in this report.

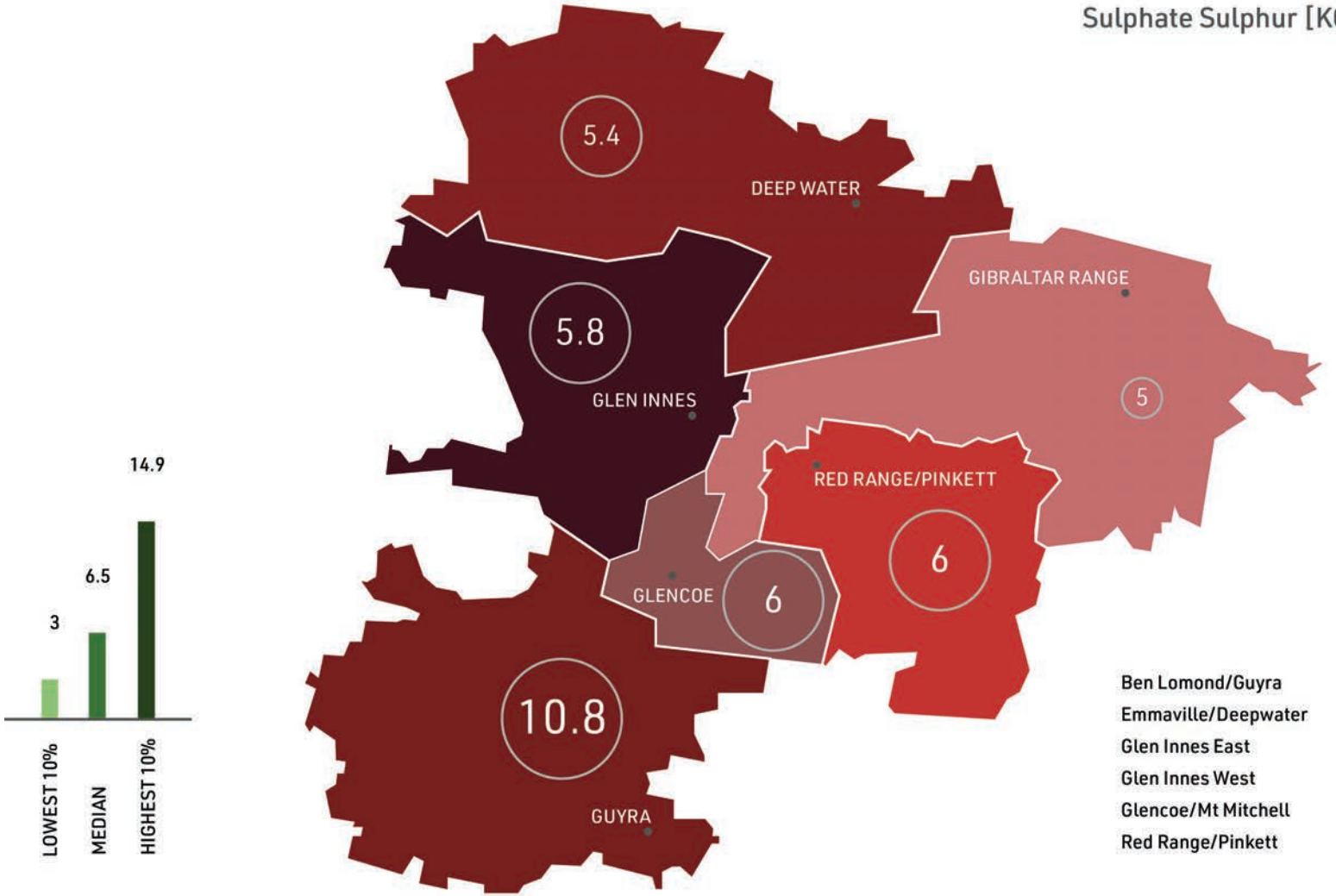
Understanding the map

The circles show the median sulphur from project properties by district. 50% of results are above this level and 50% are below

- Lowest 10% - the lowest 10% of available S results are below this number.
- Highest 10% - the highest 10% of available S results are above this number

SOIL FERTILITY

Sulphate Sulphur [KCl40] mg/kg



Benchmark for available S > 7mg/kg KCl

Technical Notes

- This report is based on soil test results taken across a number of projects and analysed by different labs. All results have been measured by ASPAC NATA accredited labs.
- Data collated for this project was from CSBP, EAL and Incitec.
- Sampling depth 0-10cm, 10-20cm only included for Ex Al data
- Organic carbon has been measured by two different methods, Walkley Black (WB) and LECO. The results have been combined for this report. Generally the LECO results will be slightly higher than the WS results due to it being a more modern, accurate method.
- Soil pH has been measured in water. Due to gaps in the data, the calcium chloride method has not been used.
- Exchangeable aluminium and sodium have been measured using the standard ammonium acetate method.
- Available phosphorus and sulphur have been measured with the Colwell and KCl methods.

References

Charman & Murphy (eds) (2000): Soils: their properties and management (2nd Ed). Oxford University Press, Melbourne.

Earl & Kahn (2005) Pasture Management Checklist for the Northern Tablelands of NSW(3rd Ed) UNE.

Hazelton & Murphy (2016). Interpreting soil test results – CSIRO.

Peverill *et al.* (1999). Soil Analysis: An Interpretation Manual, CSIRO Publishing.

Price (ed) (2006) Australian Soil Fertility Manual, CSIRO Press.

Stirling *et al.* (2016): Soil Health, Soil Biology, Soil Borne Diseases & Sustainable Agriculture: A guide. CSIRO Press.