AGFIRST

Independent
Agriculture
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Consultant
Network

Versatile Soils

Prepared for
- Kiwi Properties

Clint Gulliver
20th October 2019

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1.0 EXECUTIVE SUMMARY

Kiwi Properties are proposing to rezone the farm located at 120 Flanagan Road, Drury from a Future Urban Zone to a mixture of Metropolitan Centre and Mixed-Use zones. Currently the farm is being run as a dry stock property on Prime Land (LUC 2). AgFirst have been contacted to prepare a report to address if the plan change area covers versatile soils.

The soil types that are found on the property have moderate to poor drainage capacity, good fertility levels and are supporting a dry stock farming operation currently. Issues that have arisen from poor drainage on the farm were viewed during the visit and are further discussed in the report.

It is appropriate to rezone the farm for urban use as the farm is limited in what it can produce as a result of the drainage issues and the implementation of the new National Policy Statement for Freshwater Management.

2.0 PROPERTY SUMMARY

- 52.7 ha Current Farming Operation
- 1.8ha being used as a site to store heavy machinery
- Estimated 45 ha of effective cropping area
- Located on the outskirts of Drury, Auckland
- Volcanic Soils that are predominately moderate to poorly drained
- Flat to rolling contour
- 3 Houses on the property – not inspected
- The property is zoned Future Urban Zone under Auckland Unitary Plan (AUP)

Key points noted during property inspection:

- Infrastructure (fencing water buildings etc) is adequate for the current farming operation
- Older pasture species on the property as a result of minimal cropping being done
- Noticeable amount of pugging damage around suggesting poorly drained soils
- Rivers fenced off and planted and have been well maintained

3.0 FARMING ACTIVITY

The farm is been run as a dairy farm milking 100 Mixed Age (MA) cows until the end of the 2017/18 season (June 2017 - May 2018) at which time supply ceased. All youngstock left the property post weaning to be grazed off farm returning as pregnant in-calf heifers 18 months later. The farm is now running dry stock with numbers on the property tallying up to 100 head of cattle at times during the year to match pasture production on farm. Similar levels of grass silage bales are made year on year to support the stock on farm during the colder months. Soil tests have been completed on the block which indicate optimum soil fertility levels for the property (soils test results can be found in the appendix).

4.0 SOILS

S-Maps has been used to gain a better understanding of the soil types following the visit to the property.

Currently there are 3 main soil types on the property that is predominately rolling contour. Figure 1 below gives a brief description of each of the soil types and the percentage of the block that they cover.

Figure 1: Soils Information (OverseerED v6.3.2 in conjunction with S-Maps)

The versatility of rural land in the Auckland Region can be classified as either Elite Land (LUC 1) or Prime Land (LUC 2, LUC3) under the AUP. These definitions have been put in place to protect further subdivision of high-class land.
The farm currently has an LUC rating of 2w3 which indicates that it would be classed as a Prime land under the AUP.
Prime Land is defined as *"Land identified as land use capability classes two and three (LUC2, LUC3) with slight-moderate physical limitations for arable use."* Factors contributing to this classification are:

- Readily available water
- Favourable climate
- Favourable topography
- Good Drainage
- Versatile soils adapted to a wide range of agricultural uses

Further investigation helped to better understand why this farms' main form of soil limitation was wetness. This is outlined in Figure 2 on the next page.

Figure 2: Soil Profile on farm

This was representative of other soil profiles dug on farm during my visit. Each showed either one or both points highlighted in Figure 2 supporting NZLRI classification. The presence of the Iron Pan will limit drainage as shown by the mottling that is occurring above the iron pan in the photo. This has occurred as a result of the land being waterlogged for more time than it is not
Other soil profiles dug around the farm also showed a significant level of compaction as a result of the type of operation that was being carried out at the time.

5.0 SUITIBILITY FOR AGRICULTURE OR HORTICULTURAL PURPOSES

In a modified state that farm could be open to a number of options - both horticultural and agricultural. These operations will be governed by the latest National Policy Statement for Freshwater Management which aims to minimise any further intensification of the property.

Any intensification of land use (e.g. vegetable production) to the current system would need resource consent. If that land use change showed no adverse effects to the environment, then consent for this would likely be granted.

In practical terms vegetable production could occur on approximately 6-12ha of the property. The remaining area of the property (40-46ha) would be suitable for dry stock farming only contour and drainage issues would limit any further intensification.

While the soils and contour of the block would be suitable for either agricultural or horticultural purposes, the practical likelihood of changing land use on some/all of the property would be unlikely due to the increased level of N loss as a result of the land intensification.

Continuing with the current farming operation is not going to be a profitable either due to the size of the farm and the constraints placed on it by the soil types.

6.0 IMPACT OF PLANNED SUBDIVISION

Environmental constraints outlined in the new National Policy Statement for Freshwater management as well as current soil types will limit any land use change to intensify the farm from its current farming practices. As the current soil types and their moderate to poor drainage abilities will mean that significant capital expenditure would be required to complete a land use change, which in my opinion would not be likely by the current or future owners.

7.0 AUCKLAND UNITARY PLAN

The farm and surrounding properties are currently being rated as lifestyle blocks by Auckland Council. The farm is zoned Future Urban Zone under the AUP. Therefore, the likelihood of this land being rezoned as Rural and being classed as a Prime soil again is very unlikely.

8.0 APPENDIX

Hill Laboratories
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R J Hill Laboratories Limited
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Hamilton 3240 New Zealand

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E mail@hill-labs.co.nz
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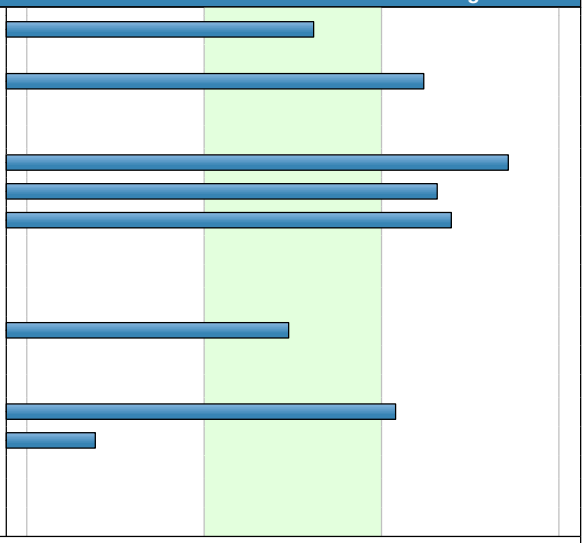
Certificate of Analysis

Client:	AgFirst Waikato (2016) Limited	**Lab No:**	2256674 shvpv1
Address:	PO Box 9078 Hamilton 3240	**Date Received:**	10-Oct-2019
		Date Reported:	15-Oct-2019
		Quote No:	
		Order No:	
		Client Reference:	Kiwi Properties
		Add. Client Ref:	
Phone:	07 839 2683	**Submitted By:**	Clint Gulliver

Sample Name: Kiwi Properties **Lab Number:** 2256674.1
Sample Type: SOIL Mixed Pasture, Dry Stock (Ash) (S185)

Analysis		Level Found	Medium Range
pH	pH Units	6.0	5.8 - 6.2
Olsen Phosphorus	mg/L	42	20 - 30
Anion Storage Capacity*	%	55	
Potassium	me/100g	1.15	0.35 - 0.50
Calcium	me/100g	13.2	4.0 - 10.0
Magnesium	me/100g	2.35	0.40 - 0.60
Sodium	me/100g	0.25	
CEC	me/100g	25	
Total Base Saturation	%	67	50 - 85
Volume Weight	g/mL	0.79	
Sulphate Sulphur	mg/kg	15	10 - 12
Extractable Organic Sulphur*	mg/kg	9	15 - 20
Soil Sample Depth*	mm	0-75	
Soil Type*		Ash	



Base Saturation %	K 4.5	Ca 52	Mg 9.3	Na 1.0
MAF Units	K 19	Ca 13	Mg 42	Na 9

The above nutrient graph compares the levels found with reference interpretation levels. NOTE: It is important that the correct sample type be assigned, and that the recommended sampling procedure has been followed. R J Hill Laboratories Limited does not accept any responsibility for the resulting use of this information. IANZ Accreditation does not apply to comments and interpretations, i.e. the 'Range Levels' and subsequent graphs.

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Soil Analysis Results

Sample Name:		Kiwi Properties
Lab Number:		2256674.1
Sample Type:		SOIL Mixed Pasture, Dry Stock (Ash)
Sample Type Code:		S185
pH	pH Units	6.0
Olsen Phosphorus	mg/L	42
Anion Storage Capacity*	%	55
Potassium	me/100g	1.15
Potassium	%BS	4.5
Potassium	MAF units	19
Calcium	me/100g	13.2
Calcium	%BS	52
Calcium	MAF units	13
Magnesium	me/100g	2.35
Magnesium	%BS	9.3
Magnesium	MAF units	42
Sodium	me/100g	0.25
Sodium	%BS	1.0
Sodium	MAF units	9
CEC	me/100g	25
Total Base Saturation	%	67
Volume Weight	g/mL	0.79
Sulphate Sulphur	mg/kg	15
Extractable Organic Sulphur*	mg/kg	9
Soil Sample Depth*	mm	0-75
Soil Type*		Ash

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Analyst's Comments

Samples 1-2 Comment:
The medium or optimum range guidelines shown in the histogram report relate to sampling protocols as per Hill Laboratories' crop guides and are based on reference values where these are published. Results for samples collected to different depths than those described in the crop guide should be interpreted with caution.
For pastoral soils, the medium ranges are specific for a 75mm sample depth, but if a 150mm sampling depth is used the nutrient levels measured may appear low against these ranges, as nutrients are typically more concentrated in the top of the soil profile. These soil profile differences are altered upon cultivation or contouring.

Samples 1-2 Comment:
While soil Mg MAF levels of 8-10 (0.4 - 0.6 me/100g) are sufficient for pasture production, soil levels of 25-30 (1 - 1.6 me/100g) are required to ensure adequate Mg content in pasture for animal health (greater than 0.22% in the herbage).

Samples 1-2 Comment:
Anion Storage Capacity (also known as Phosphate Retention) is an inherent property of the soil type and does not change. Phosphorus and sulphur fertiliser recommendations should take this value into account. Soils may be classified as Low (less than 30%), Medium (30-60%) or High (greater than 60%) ASC.

Samples 1-2 Comment:
For intensive farm systems with high stocking-rate and/or high-production/ha, increasing the soil Olsen P optimum ranges to 30-40 (ash and sedimentary soils) and 45-55 (pumice and peat soils) may be justified.

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.
Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Soil

Test	Method Description	Default Detection Limit	Sample No
Sample Registration*	Samples were registered according to instructions received.	-	1-2
Soil Prep (Dry & Grind)*	Air dried at 35 - 40°C overnight (residual moisture typically 4%) and crushed to pass through a 2mm screen.	-	1-2
pH	1:2 (v/v) soil:water slurry followed by potentiometric determination of pH. In-house.	0.1 pH Units	1-2
Olsen Phosphorus	Olsen extraction followed by Molybdenum Blue colorimetry. In-house method.	1 mg/L	1-2
Sulphate Sulphur	0.02M Potassium phosphate extraction followed by Ion Chromatography. In-house.	1 mg/kg	1-2
Extractable Organic Sulphur*	Determined by NIR, calibration based on; 0.02M Potassium phosphate extraction. Total extractable S determined by ICP-OES from which the Sulphate-S is subtracted.	2 mg/kg	1-2
Anion Storage Capacity*	Determined by NIR, calibration based on; Equilibration with 1000 mg/L P solution followed by colorimetric analysis.	10 %	1-2
Potassium	1M Neutral ammonium acetate extraction followed by ICP-OES. In-house.	0.01 me/100g	1-2
Calcium	1M Neutral ammonium acetate extraction followed by ICP-OES. In-house.	0.5 me/100g	1-2
Magnesium	1M Neutral ammonium acetate extraction followed by ICP-OES. In-house.	0.04 me/100g	1-2
Sodium	1M Neutral ammonium acetate extraction followed by ICP-OES. In-house.	0.05 me/100g	1-2

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		Add. Client Ref:	
Phone:	07 839 2683	**Submitted By:**	Clint Gulliver

Sample Type: Soil

Test	Method Description	Default Detection Limit	Sample No
CEC	Summation of extractable cations (K, Ca, Mg, Na) and extractable acidity. May be overestimated if soil contains high levels of soluble salts or carbonates. In-house.	2 me/100g	1-2
Total Base Saturation	Calculated from Extractable Cations and Cation Exchange Capacity.	5 %	1-2
Volume Weight	The weight/volume ratio of dried, ground soil. In-house.	0.01 g/mL	1-2

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

W.M.Homewood

Wendy Homewood
Operations Support - Agriculture

Manaaki Whenua
Landcare Research

S-map Soil Report

Report generated: 31-Oct-2019 from https://smap.landcareresearch.co.nz

S-map maps soils at a nominal scale of 1:50,000. At this scale it is common to identify two or more soil siblings that are likely to be present at the selected location. A more detailed resolution is needed to produce map units comprising a single soil sibling. Therefore, it is recommended that users consider the characteristics of each of the identified siblings, the expected proportion of each, and select the S-map sibling that best matches their field observations of the paddock. If no local information is available then it is common practice to select the dominant S-map sibling, i.e. the first listed sibling.

This information sheet describes the typical average properties of the specified soil to a depth of 1 metre, and should not be the primary source of data when making land use decisions on individual farms and paddocks.

Morrinsville*f*

Typic Orthic Granular Soil

Morr_8a.1 (40% of the mapunit at location (1773349, 5891208), Confidence: High)

Key physical properties

Depth class (diggability)		Deep (> 1 m)
Texture profile		Clay
Potential rooting depth		Unlimited
Rooting barrier		No significant barrier within 1 m
Topsoil stoniness		Stoneless
Topsoil clay range		50 - 70 %
Drainage class		Moderately well drained
Aeration in root zone		Unlimited
Permeability profile		Moderate
Depth to slowly permeable horizon		No slowly permeable horizon
Permeability of slowest horizon		Moderate (4 - 72 mm/h)
Profile available water	(0 - 100cm or root barrier)	Moderate (111 mm)
	(0 - 60cm or root barrier)	Moderate (67 mm)
	(0 - 30cm or root barrier)	Moderate (34 mm)
Dry bulk density, topsoil		1.08 g/cm³
Dry bulk density, subsoil		1.26 g/cm³
Depth to hard rock		No hard rock within 1 m
Depth to soft rock		No soft rock within 1 m
Depth to stony layer class		No significant stony layer within 1 m

Key chemical properties

Topsoil P retention	Medium (46%)

About this publication

- This information sheet describes the *typical average properties* of the specified soil to a depth of 1 metre.
- For further information on individual soils, contact Landcare Research New Zealand Ltd: www.landcareresearch.co.nz
- Advice should be sought from soil and land use experts before making decisions on individual farms and paddocks.
- The information has been derived from numerous sources. It may not be complete, correct or up to date.
- This information sheet is licensed by Landcare Research on an "as is" and "as available" basis and without any warranty of any kind, either express or implied.
- Landcare Research shall not be liable on any legal basis (including without limitation negligence) and expressly excludes all liability for loss or damage howsoever and whenever caused to a user of this factsheet.

Morrinsville*f*

S-map ref: Morr_8a.1

Morr_8a.1 (40% of the mapunit at location (1773349, 5891208), Confidence: High)

Additional factors to consider in choice of management practices

Vulnerability classes relate to soil properties only and do not take into account climate or management

Soil structure integrity

Structural vulnerability	Very low (0.32)
Pugging vulnerability	not available yet

Water management

Water logging vulnerability	Very low
Drought vulnerability - if not irrigated	Moderate
Bypass flow	High
Hydrological soil group	A
Irrigability	Gently undulating land with good drainage/permeability and soils with moderate PAW

Contaminant management

N leaching vulnerability	Medium
P leaching vulnerability	not available yet
Bypass flow	High
Dairy effluent (FDE) risk category	D
Relative Runoff Potential	Very Low

Additional information

Soil classification	Typic Orthic Granular Soils
Family	Morrinsville*f*
Sibling number	8
Profile texture group	Clayey
Soil profile material	Tephric soil
Rock class of stones/rocks	Not Applicable
Rock origin of fine earth	From Rhyolitic Rock
Parent material origin	Tephra

Characteristics of functional horizons in order from top to base of profile:

Functional Horizon	Thickness	Stones	Clay*	Sand*
Clayey Fine Sl Firm, Acidic Tephric	15 - 25 cm	0 %	50 - 70 %	5 - 15 %
Clayey Fine Sl Firm, Acidic Tephric	35 - 65 cm	0 %	70 - 92 %	1 - 10 %
Clayey Fine Firm, Acidic Tephric	25 - 35 cm	0 %	80 - 95 %	1 - 10 %

* clay and sand percent values are for the mineral fines (excludes stones). Silt = 100 - (clay + sand)

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Soil information for OVERSEER

The following information can be entered in the OVERSEER® Nutrient Budget model. This information is derived from the S-map soil properties which are matched to the most appropriate OVERSEER categories. Please read the notes below for further information.

Soil description page

1. Select **Link to S-map**
2. Under S-map sibling data enter the S-map name/ref: **Morr_8a.1**

Considerations when using Smap soil properties in OVERSEER

- The soil water values are estimated using a regression model based on soil order, parent rock, soil functional horizon information (stone content, soil density class), as well as texture (field estimates of sand, silt and clay percentages). The model is based on laboratory - measured water content data held in the National Soils Database and other Manaaki Whenua datasets. Most of this data comes from soils under long-term pasture and may vary from land under arable use, irrigation, etc.

- Each value is an estimate of the water content of the whole soil within the target depth range or to the depth of the root barrier (if this occurs above the base of the target depth). Where soil layers contain stones, the soil water content has been decreased according to the stone content.

- S-map only contains information on soils to a depth of 100 cm. The soil water estimates in the > 60 cm depth category assume that the bottom functional horizon that extends to 100 cm, continues down to a depth of 150cm. Where it is known by the user that there is an impermeable layer or non-fractured bedrock between 100 and 150 cm, this depth should be entered into OVERSEER. Where there is a change in the soil profile characteristics below 100 cm, the user should be aware that the values provided on this factsheet for the > 60 cm depth category will not reflect this change. For example, the presence of gravels at 120 cm would usually result in lower soil water estimates in the > 60 cm depth category. Note though that this assumption only impacts on a cropping block, as OVERSEER uses soil data from just the top 60 cm in pastoral blocks.

- OVERSEER requires the soil water values to be non-zero integers (even though zero is a valid value below a root barrier), and the wilting point value must be less than the field capacity value which must be less than the saturation value. The S-map water content estimates supplied by the S-map web service have been rounded to integers and may be assigned minimal values to meet these OVERSEER requirements. These modifications will result in a slightly less accurate estimate of Available Water to 60 cm (labelled PAW in OVERSEER) than that provided on the first page of this factsheet, but this is not expected to lead to any significant difference in outputs from OVERSEER .

Manaaki Whenua
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This information sheet describes the typical average properties of the specified soil to a depth of 1 metre, and should not be the primary source of data when making land use decisions on individual farms and paddocks.

Puni*f*

Mottled Orthic Granular Soil

Puni_1a.1 (60% of the mapunit at location (1773349, 5891208), Confidence: High)

Key physical properties

Depth class (diggability)		Deep (> 1 m)
Texture profile		Clay
Potential rooting depth		Unlimited
Rooting barrier		No significant barrier within 1 m
Topsoil stoniness		Stoneless
Topsoil clay range		50 - 65 %
Drainage class		Imperfectly drained
Aeration in root zone		Moderately limited
Permeability profile		Moderate
Depth to slowly permeable horizon		No slowly permeable horizon
Permeability of slowest horizon		Moderate (4 - 72 mm/h)
Profile available water	(0 - 100cm or root barrier)	Moderate to high (121 mm)
	(0 - 60cm or root barrier)	Moderate (77 mm)
	(0 - 30cm or root barrier)	Moderate (44 mm)
Dry bulk density, topsoil		1.08 g/cm³
Dry bulk density, subsoil		1.26 g/cm³
Depth to hard rock		No hard rock within 1 m
Depth to soft rock		No soft rock within 1 m
Depth to stony layer class		No significant stony layer within 1 m

Key chemical properties

Topsoil P retention	Medium (46%)

About this publication

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- Landcare Research shall not be liable on any legal basis (including without limitation negligence) and expressly excludes all liability for loss or damage howsoever and whenever caused to a user of this factsheet.

Puni*f*

S-map ref: Puni_1a.1

Puni_1a.1 (60% of the mapunit at location (1773349, 5891208), Confidence: High)

Additional factors to consider in choice of management practices

Vulnerability classes relate to soil properties only and do not take into account climate or management

Soil structure integrity

Structural vulnerability	Very low (0.37)
Pugging vulnerability	not available yet

Water management

Water logging vulnerability	Moderate
Drought vulnerability - if not irrigated	Low
Bypass flow	High
Hydrological soil group	B
Irrigability	Gently undulating land with slight drainage/permeability restrictions and soils with moderate PAW

Contaminant management

N leaching vulnerability	Medium
P leaching vulnerability	not available yet
Bypass flow	High
Dairy effluent (FDE) risk category	B
Relative Runoff Potential	Very Low

Additional information

Soil classification	Mottled Orthic Granular Soils
Family	Puni*f*
Sibling number	1
Profile texture group	Clayey
Soil profile material	Tephric soil
Rock class of stones/rocks	Not Applicable
Rock origin of fine earth	From Rhyolitic Rock
Parent material origin	Tephra

Characteristics of functional horizons in order from top to base of profile:

Functional Horizon	Thickness	Stones	Clay*	Sand*
Clayey Fine Sl Firm, Acidic Tephric	12 - 20 cm	0 %	50 - 65 %	7 - 15 %
Clayey Fine Sl Firm, Acidic Tephric	40 - 60 cm	0 %	60 - 95 %	1 - 10 %
Clayey Fine Firm, Acidic Tephric	25 - 45 cm	0 %	70 - 95 %	1 - 8 %

* clay and sand percent values are for the mineral fines (excludes stones). Silt = 100 - (clay + sand)

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Soil description page

1. Select **Link to S-map**
2. Under S-map sibling data enter the S-map name/ref: **Puni_1a.1**

Considerations when using Smap soil properties in OVERSEER

- The soil water values are estimated using a regression model based on soil order, parent rock, soil functional horizon information (stone content, soil density class), as well as texture (field estimates of sand, silt and clay percentages). The model is based on laboratory - measured water content data held in the National Soils Database and other Manaaki Whenua datasets. Most of this data comes from soils under long-term pasture and may vary from land under arable use, irrigation, etc.

- Each value is an estimate of the water content of the whole soil within the target depth range or to the depth of the root barrier (if this occurs above the base of the target depth). Where soil layers contain stones, the soil water content has been decreased according to the stone content.

- S-map only contains information on soils to a depth of 100 cm. The soil water estimates in the > 60 cm depth category assume that the bottom functional horizon that extends to 100 cm, continues down to a depth of 150cm. Where it is known by the user that there is an impermeable layer or non-fractured bedrock between 100 and 150 cm, this depth should be entered into OVERSEER. Where there is a change in the soil profile characteristics below 100 cm, the user should be aware that the values provided on this factsheet for the > 60 cm depth category will not reflect this change. For example, the presence of gravels at 120 cm would usually result in lower soil water estimates in the > 60 cm depth category. Note though that this assumption only impacts on a cropping block, as OVERSEER uses soil data from just the top 60 cm in pastoral blocks.

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