



Landcare Research
Manaaki Whenua

A worms eye view of soil information



Sam Carrick

Allan Hewitt

Landcare Research, Lincoln

hewitta@landcareresearch.co.nz

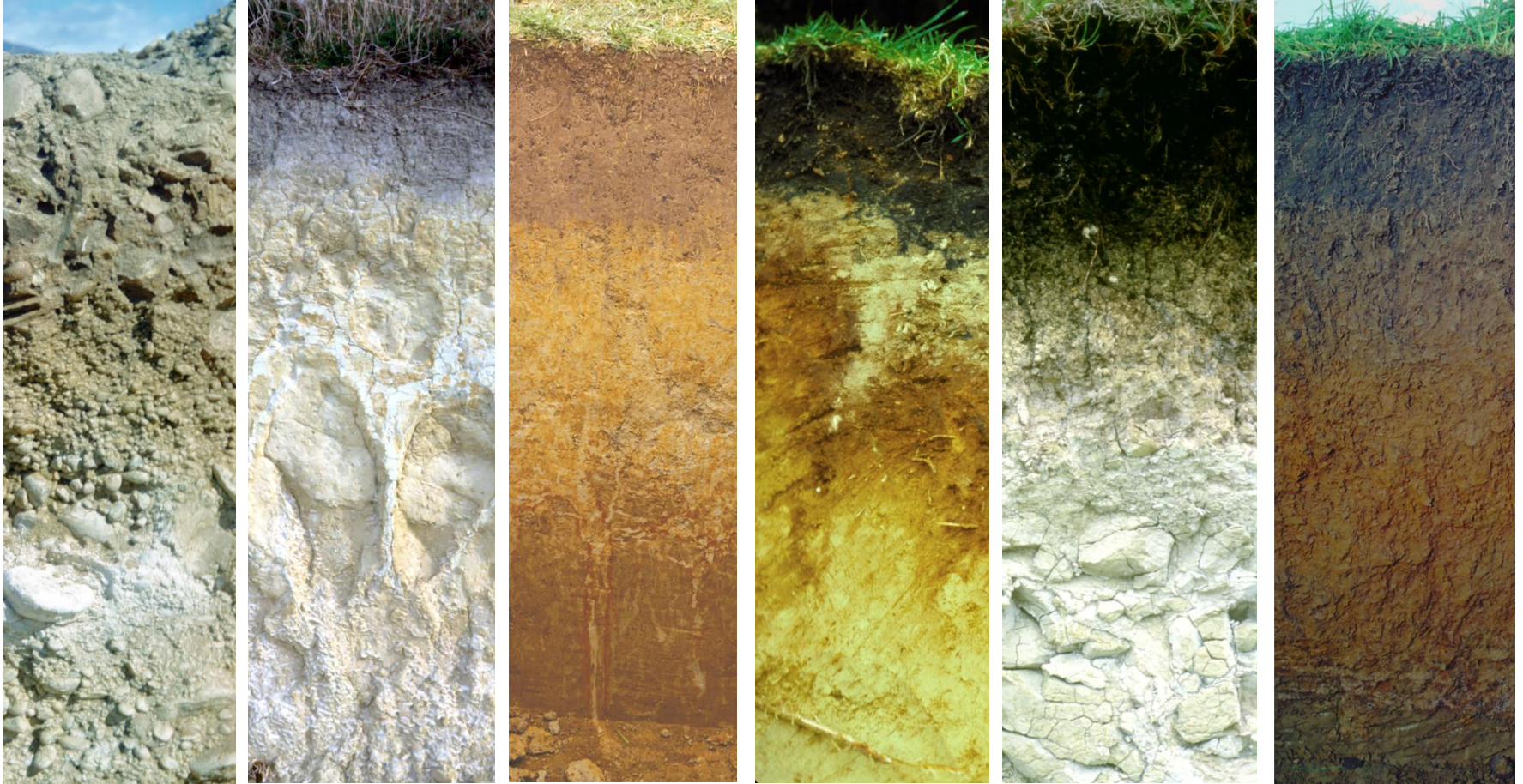


soil
How do you know that the / information
that feeds your land management
decision-making is sound?

by knowing its nature & origin
fitness for use, limitations & uncertainties
& by knowing the people who stand behind it.

- that's what this presentation is about -

What the worm sees



Large variety of soils - range of opportunities & risks
- information needed for effective use

S-map Demo

<http://smap.landcareresearch.co.nz/home>



S-mapOnline
Fast, simple access to New Zealand soils data



Landcare Research
Manaaki Whenua

[Home](#) | [Getting Started](#) | [About](#) | [Map](#) | [Factsheets](#) | [Glossary](#) | [Terms of Use](#) | [Data Provenance](#)



The digital soil map for New Zealand

S-map is the new national soils database. When completed, it will provide a seamless digital soil map coverage for New Zealand. S-map is designed to be applied at any scale from farm to region to nation.

The current extent of the S-map survey is shown on the map to the left.

[Maps & factsheets >](#) [Factsheets by soil name >](#)



What is S-map?

Existing soil databases are patchy in scale, age and quality. Many maps do not adequately describe the underlying properties of the soil types they represent. S-map integrates existing reports and digital information and updates soil maps where existing data are of low quality. Our goal is to provide comprehensive, quantitative soil information to support sustainable development and scientific modelling.

Service database last updated: 28 March 2012.

What is S-map Online?

Using S-map online you can:

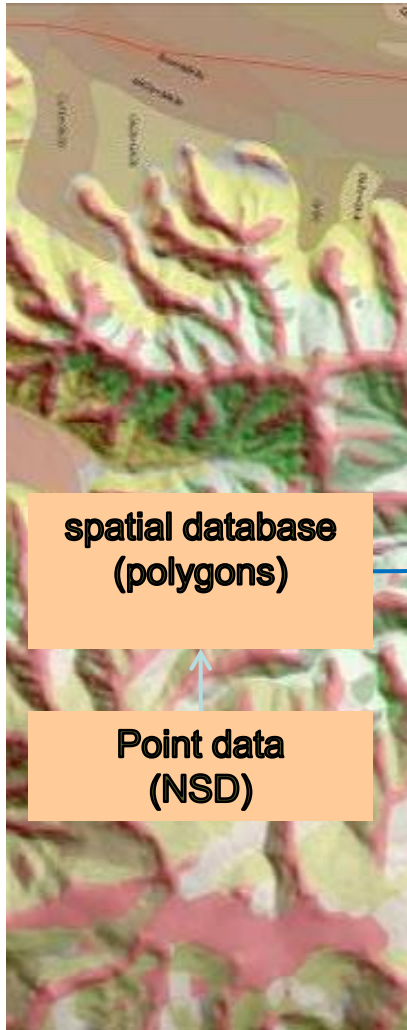
- Explore interactive soil maps
- Learn about the soil in your backyard or paddock
- View detailed information about a soil class or attribute
- Create custom PDF soil maps for printing
- Download soil factsheets for specific locations

S-map Online Service Status

ok

Handout available

Information



spatial database
(polygons)

Point data
(NSD)

information
products

Soil
inference
system

external
databases
(e.g. rainfall,
geology)



www

Report generated: 12-Jun-2008 from: <http://www.leik.com/soilfactsheets.htm>

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.

Soil: **Kaitiaki sandy loam**

Overview	
Family	Kaiti
Soil classification	Typic Ustic Altophagic Soils
Soil profile material	Typic, acid
Soil class of parent rock	Typic, acid
Rock class of floor north	From Kaitiaki Rock
Parent material depth	Typic
Texture	Loamy
Profile colour group	Loamy
Topsoil clay range	13 - 14 %

Key physical	
Parent material depth	Undefined
Rooting barrier	No significant barrier within 1 m
Topsoil structure	Typic, acid
Depth to stony layer class	No stony layer within 1 m
Drainage class	Undefined
Aerobic in root zone	Undefined
For reactivity profile	Acid
Depth to slowly permeable horizon	No slowly permeable horizon
Permeability at chosen horizon	High (100mm)
Profile with available water	High (100mm)
Profile readily available water	High (100mm)
Total available water	Moderate (30mm)
Readily available water	Moderate (30mm)

About this publication

- This information sheet does not describe the typical average properties of the specified soil.
- It is a summary of information obtained from the published data on soil.
- The sources were evaluated in good faith by Leik and within the time and budget constraints.
- Advice should be sought from soil and land use experts before making decisions on individual farms and paddocks.
- No warranty or liability can be taken for the accuracy of information and interpretation.

No warranties are expressed or implied unless stated.

Soilfactsheets.com.au
Leik Research
Innovation in Soil Science

Public
soil factsheets

Data to Information Models

- Rule based/ Statistical
- e.g.

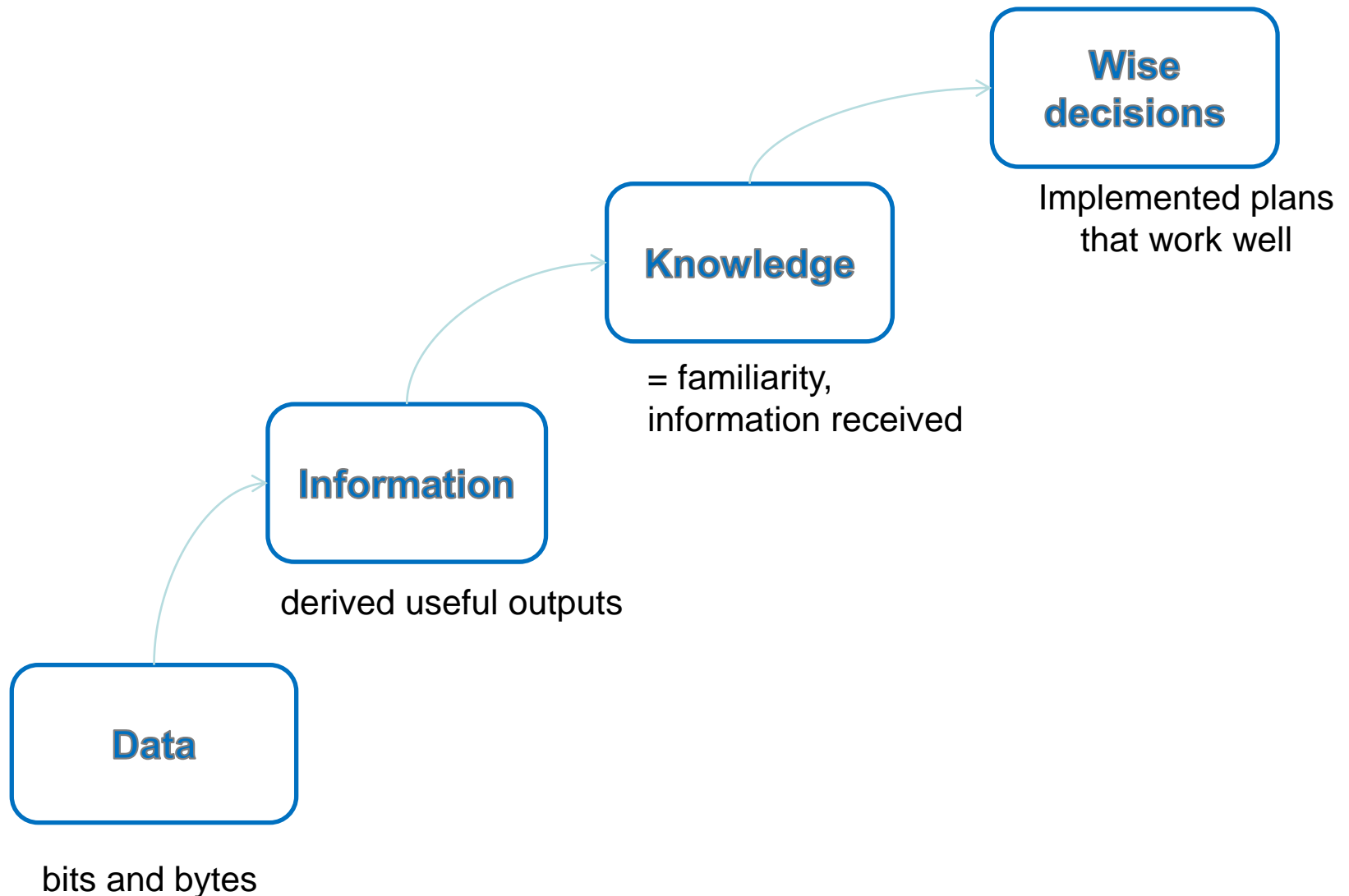
Available water capacity

$$= f(\text{depth, stones, clay, sand, C\%})$$

Development e.g.

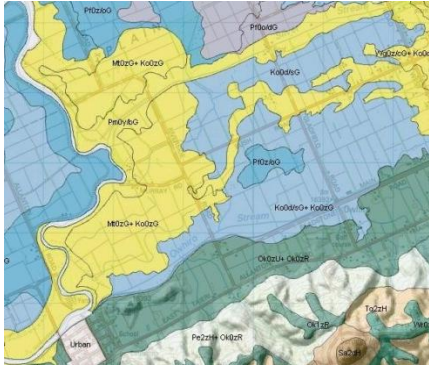
- More user-friendly factsheets
- Glossary
- Customised field application
- Extension tool for spatially relevant research
- Quantified soil natural capital and soil services

S-map information chain



Data

Data Input



Legacy
Soil
maps



Expert
knowledge

New data

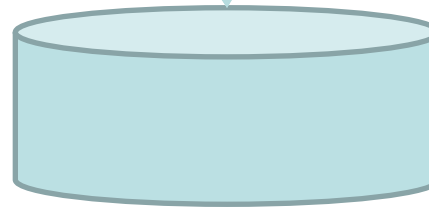


Legacy
Reports
Bulletins

Soil mapping



S-map
database



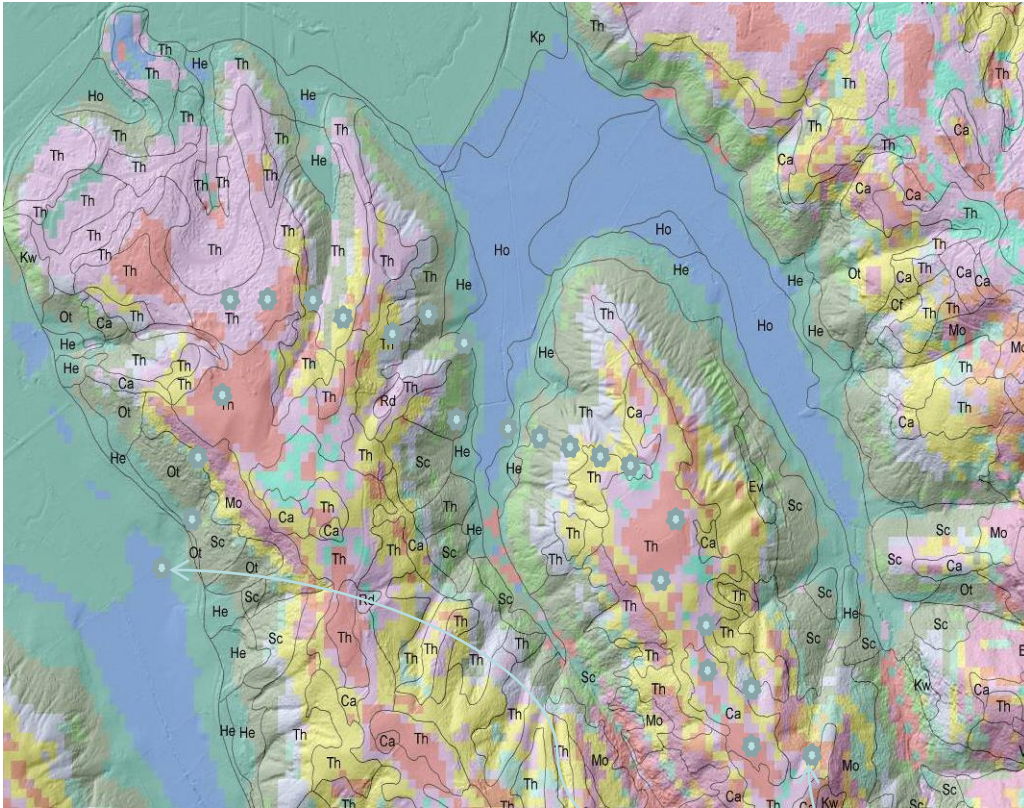
= Point data
& Map data

By itself → useless,

but applied & curated → a priceless foundation

The new data

- where it comes from



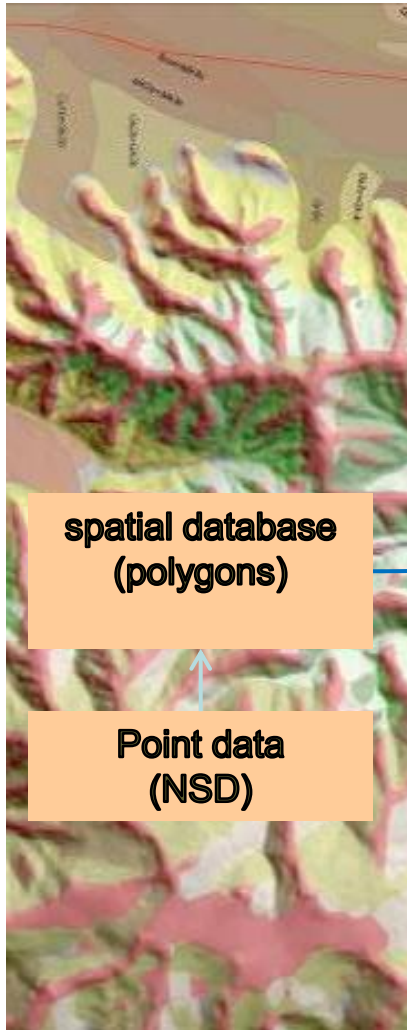
• **Sample points**
= pits or auger

Manual mapping
- Polygon outputs

Digital mapping
- Pixel outputs

**Field transect
of sample points**

Information



spatial database
(polygons)

Point data
(NSD)

information
products

Soil
inference
system

external
databases
(e.g. rainfall,
geology)



www

Report generated: 12-Jun-2008 from: <http://www.leik.com/soilfactsheets.htm>

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.

Soil: **Kaitaki sandy loam**

Overview	
Family	Kaiti
Soil classification	Typic Ustic Altophagic Soils
Soil profile material	Typic, acid
Soil class of parent rock	Typic, acid
Rock class of floor north	From Kaitaki Rock
Parent material depth	Typic
Texture	Loamy
Profile colour group	Loamy
Topsoil clay range	13 - 14%

Key physical	
Parent material depth	Undefined
Rooting barrier	No significant barrier within 1 m
Topsoil structure	Typic, acid
Depth to stony layer class	No significant stony layer within 1 m
Drainage class	Undefined
Aerobic in the root zone	Undefined
For availability profile	Rigid
Depth to slowly permeable horizon	No slowly permeable horizon
For availability of down to horizon	Rigid (100mm)
Profile with available water	High (100mm)
Profile readily available water	High (100mm)
Total available water	Moderate (100mm)
Readily available water	Moderate (100mm)

About this publication

- This information sheet does not describe the typical average properties of the specified soil.
- It is a summary of information obtained from the published data on soil.
- The sources were evaluated in good faith by Leik and within the time and budget constraints.
- Advice should be sought from soil and land use experts before making decisions on individual farms and paddocks.
- No warranty or liability can be taken for the accuracy of information and interpretation.

No warranties are expressed or implied unless stated.

Soilfactsheets.com.au
Leik Research
Innovation in Agriculture

Public
soil factsheets

Data to Information Models

- Rule based/ Statistical
- e.g.

Available water capacity

$$= f(\text{depth, stones, clay, sand, C\%})$$

Development e.g.

- More user-friendly factsheets
- Glossary
- Customised field application
- Extension tool for spatially relevant research
- Quantified soil natural capital and soil services

Customised soil information

- Dairy effluent risk category -

Application of dairy shed effluent must be carefully managed
it depends on soils capacity to absorb.

When the soil is too wet - effluent must be stored in a pond.

A pond is expensive - so pond size is critical

Effluent disposal risk model (AgR)

Information to manage effluent

Derives a dairy effluent risk category

Methods


1. **DIY** - using Dairy NZ field guide using a key to derive the risk class

2. **S-map**

Provided for all soils
by soil factsheet

Dairy NZ field guide clip

Does it have low infiltration rate?
if, yes → Category B High Risk
if, no → Keep working through this step



Dark coloured top soil indicating a well aerated well drained topsoil which is likely to have a good infiltration rate

Soil with medium structure with signs of moderate to low infiltration then soil risk Category B High Risk

Pale grey soil colours with distinct large orange and grey mottles of a poorly drained soil with a low infiltration rate then soil risk Category B High Risk

Contaminant management

Soil Factsheet clip

N leaching vulnerability

Very High

P leaching vulnerability

not available

Runoff potential

Very Low

Bypass flow

Medium

Dairy effluent (FDE) risk category:

D

Knowledge

Wouldn't it be great if the basics of the hidden soil were widely appreciated

*Its not
dirt!*

Not just topsoil

Soil-diversity

The soil serves us

It's critical natural capital

Soil is beautiful!

- **Accessibility** - Knowing information is here & where
- **Clarity** – web service design  **S-mapOnline**
Fast, simple access to New Zealand soils data
- **New tools e.g. Paddock-download** directly from WWW into Overseer on laptop
- **Connect - get your hands dirty!**

Wise decisions

1. Know the information and its nature

But also

2. The providers role is not just to provide information

It is also to be involved, as needed, in forming plans and judging their implications
an involvement based on
relationships of trust between science & policy specialists

It's easy for science to misunderstand how the real world works

It's easy for policy to misinterpret the information

We can make confident decisions together

A spin-off is the creation of new data applications and new tools

This is not news, but how often does it really happen?

- based on Linda Lilburne's ECan secondment

Cost/benefit of soil variability information

- By tuning management to soil variability -

Catchment scale - Matura valley,

What is the value of knowing nitrogen leaching rate

Being able to target mitigation practices to areas of high and low rate under dairy

- saved farmers \$17/kg of nitrogen applied, and
- benefitted the community by \$25/kg nitrogen applied through reduced leaching to ground water.

Cost-benefit ratio of 1:6 in the first year.

Precision irrigation - Canterbury

Variable-rate, centre pivot irrigators, dairying

delivering the right amount of water to each soil type.

- water savings between 20-36% with no negative impact on yield at trial sites.
- water saved on-farm was diverted to un-irrigated areas – with increased pasture production

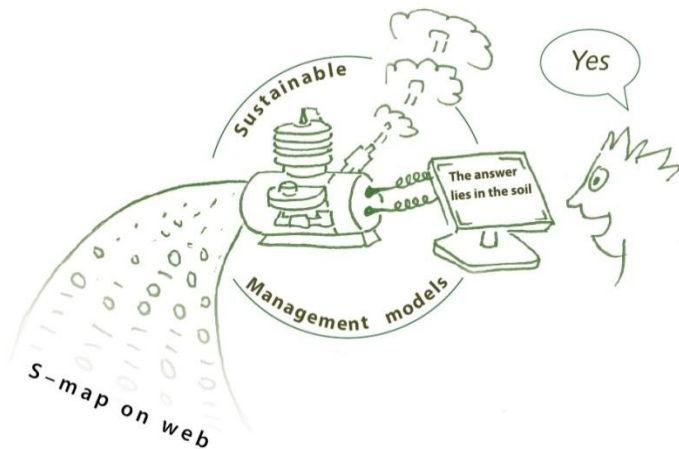
Current return on investment for the farmer of 1-5 years

S-map supporting models

- Investment in more sophisticated management models
- They need accurate soil data inputs.

S-map provides critical information E.g.

- Nutrient management tools – Overseer, Dairy effluent risk category
- Soil process models SPASMO, APSIM,
- Specialist crop calculators – wheat calculator, ent storage calculator.
- Land evaluation



Applications in:

Water quantity; water quality
Carbon sequestration
Nutrient management
GHG emissions
Land environment mitigations
Land evaluation and land capability
Erosion control
Soil quality monitoring

State of environment reporting
Whole farming planning
Regional futures modelling
Land restoration and rehabilitation
Land vulnerability assessment
Catchment management
Hydrological modelling

Applications

- Value of adding better data e.g. LIC
- Scale and resolution (spatial & information)
- Point verses block data
- High resolution - Variable rate irrigation – precision agr.- mapping/monitoring/automation/multiple benefits
- Regional - Nutrient caps – matching use/management to capability / soil natural capital



Landcare Research
Manaaki Whenua



S-mapOnline

Fast, simple access to New Zealand soils data



Accessing S-map online



S-mapOnline
Fast, simple access to New Zealand soils data

Landcare Research
Manaaki Whenua

Home | Getting Started | About | Map | Factsheets | Glossary | Terms of Use | Data Provenance

The digital soil map for New Zealand

S-map is the new national soils database. When completed, it will provide a seamless digital soil map coverage for New Zealand. S-map is designed to be applied at any scale from farm to region to nation.

The current extent of the S-map survey is shown on the map to the left.

[Maps & factsheets](#) [Factsheets by soil name](#)

What is S-map?



Existing soil databases are patchy in scale, age and quality. Many maps do not adequately describe the underlying properties of the soil types they represent. S-map integrates existing reports and digital information and updates soil maps where existing data are of low quality. Our goal is to provide comprehensive, quantitative soil information to support sustainable development and scientific modelling.

Service database last updated: 28 March 2012.

What is S-map Online?

Using S-map online you can:

- Explore interactive soil maps
- Learn about the soil in your backyard or paddock
- View detailed information about a soil class or attribute
- Create custom PDF soil maps for printing
- Download soil factsheets for specific locations

S-map Online Service Status

ok

Find your area

The screenshot displays the S-mapOnline web application interface. At the top, the logo "S-mapOnline" is accompanied by the tagline "Fast, simple access to New Zealand soils data". Navigation tabs for "Home", "Getting Started", "About", "Map", and "Factsheet" are visible. The main interface is divided into several sections:

- Tools:** Includes "Navigate", "Zoom Box", and "Feature Information". A scale bar shows "1 : 8,000,000".
- Location Search:** A search box with the instruction "Search for a place (e.g. Te Anau), address or by entering a [UTM](#) or a [latitude-longitude](#) coordinate (e.g. 1890671, 5819114)." A red arrow points to this search box with the text "Type in address".
- Layers:** A list of map layers with checkboxes:
 - Labels, hydrology and roads (checked)
 - Cartographic Text (checked)
 - Transport (unchecked)
 - Water Group (unchecked)
 - Soils (unchecked)
 - S-map Polygons & Labels (unchecked)
 - Soil Drainage (unchecked)
 - Depth To Hard Soil / Gravel / Rock (unchecked)
 - Soil Moisture - Profile Available Water (unchecked)
 - Basemap (checked)
 - Simple Coastal Outline (radio button)
 - Monochrome Terrain Map (radio button)
 - Landcover Terrain Map (radio button)
 - Monochrome Topographic (radio button)
 - Colour Topographic (radio button, selected)
- Map:** A map of New Zealand with major cities labeled: Auckland, Gisborne, New Plymouth, Palmerston North, Wellington, Greymouth, Christchurch, Queenstown, Dunedin, and Invercargill. A red arrow points to the "Zoom Box" and "Navigate" controls with the text "Use zoom and navigate".

Map soil attributes



Landcare Research
Manaaki Whenua

Home Getting Started About Map Factsheets Glossary Terms of Use Data Provenance

Tools
Navigate Zoom Box Feature Information 1:100,000 Start Again Print

Location Search
Search by place (e.g. Te Anau), address or by entering a NZTLI or a latitude-longitude coordinate (e.g. 1890671, 5819114).

Layers

- Labels, hydrology and roads
 - Cartographic Text
 - Transport
 - Water Group
- Soils
 - S-map Polygons & Labels
 - Soil Drainage
 - Depth To Hard Soil / Gravel / Rock
 - Soil Moisture - Profile Available Water
 - Very Low
 - Low
 - Moderate to Low
 - Moderate
 - Moderate to High
 - High
 - Very High
- Basemap
 - Simple Coastal Outline
 - Monochrome Terrain Map
 - Landcover Terrain Map
 - Monochrome Topographic
 - Colour Topographic

© S-Map Maps - Creative Commons NZ License (BY-ND). Base map contains data sourced from LINZ. Crown Copyright Reserved

Select attribute to map

Modify background

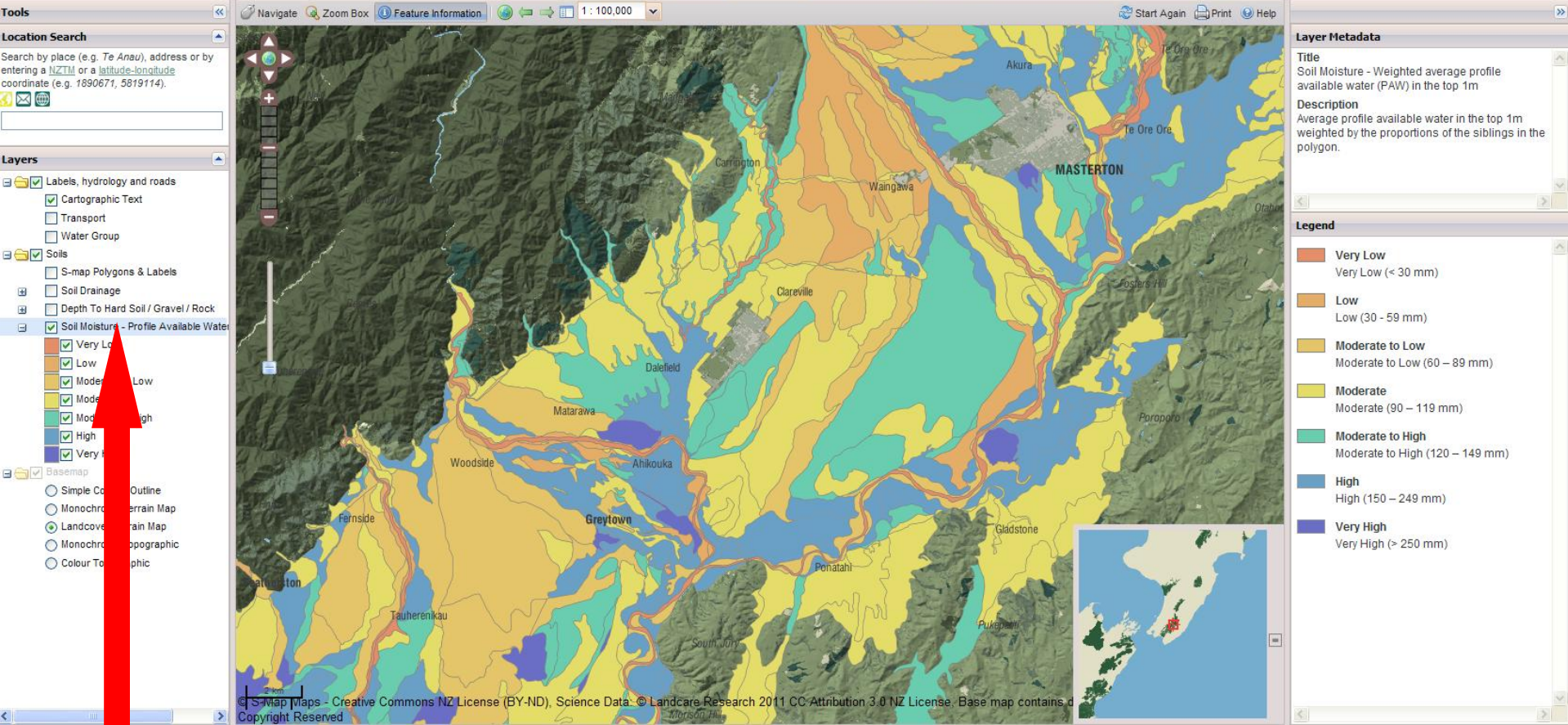


Home Getting Started About Map Factsheets Glossary Terms of Use Data Provenance

A screenshot of the S-mapOnline web application interface. The main map area displays a topographic map of the Masterton region in New Zealand, overlaid with various soil data layers. The layers are color-coded: Very Low (red), Low (orange), Moderate to Low (yellow), Moderate (light green), Moderate to High (green), High (dark green), and Very High (blue). The map includes labels for various locations such as Masterton, Matarawa, Greytown, and Woodside. On the left side, there is a 'Layers' panel with a tree view of map layers. A red arrow points to the 'Basemap' section of the layers panel, which contains several radio button options: 'Simple Coastal Outline', 'Monochrome Terrain Map', 'Landcover Terrain Map' (which is selected), 'Monochrome Topographic', and 'Colour Topographic'. The top of the interface features a navigation bar with a search box, a zoom box, and a scale indicator (1:100,000). The bottom of the interface contains a copyright notice: "© S-Map Maps - Creative Commons NZ License (BY-ND). Science Data: © Landcare Research 2011 CC Attribution 3.0 NZ License. Base map contains data sourced from LINZ. Crown Copyright/Reser".

Select map background

View attribute glossary



Tools | [Navigate](#) | [Zoom Box](#) | [Feature Information](#) | [1: 100,000](#) | [Start Again](#) | [Print](#) | [Help](#)

Location Search
Search by place (e.g. Te Anau), address or by entering a NZTM or a latitude-longitude coordinate (e.g. 1890671, 5819114).

Layers

- Labels, hydrology and roads
 - Cartographic Text
 - Transport
 - Water Group
- Soils
 - S-map Polygons & Labels
 - Soil Drainage
 - Depth To Hard Soil / Gravel / Rock
 - Soil Moisture - Profile Available Water
 - Very Low
 - Low
 - Moderate to Low
 - Moderate
 - Moderate to High
 - High
 - Very High
- Basemap
 - Simple Colour Outline
 - Monochrome Terrain Map
 - Landcover Rain Map
 - Monochrome Topographic
 - Colour Topographic

Layer Metadata

Title
Soil Moisture - Weighted average profile available water (PAW) in the top 1m

Description
Average profile available water in the top 1m weighted by the proportions of the siblings in the polygon.

Legend

- Very Low**
Very Low (< 30 mm)
- Low**
Low (30 - 59 mm)
- Moderate to Low**
Moderate to Low (60 - 89 mm)
- Moderate**
Moderate (90 - 119 mm)
- Moderate to High**
Moderate to High (120 - 149 mm)
- High**
High (150 - 249 mm)
- Very High**
Very High (> 250 mm)

© S-map Maps - Creative Commons NZ License (BY-ND), Science Data: © Landcare Research 2011 CC-Attribution 3.0 NZ License. Base map contains d
Copyright Reserved

Click on name of layer

View soil map

S-mapOnline
Fast, simple access to New Zealand soils data

Landcare Research
Manaaki Whenua

Home Getting Started About Map Factsheets Glossary Terms of Use Data Provenance

Tools
Navigate Zoom Box Feature Information 1 : 50,000 Start Again Print Help

Location Search
Search by place (e.g. Te Anau), address or by entering a NZTM or a latitude-longitude coordinate (e.g. 1890671, 5819114).

Layers

- Labels, hydrology and roads
- Cartographic Text
- Transport
- Water Group
- Soils
- S-map Polygons & Labels
- Soil Drainage
- Depth To Hard Soil Level / Rock
- Soil Moisture - Prof Available Water
- Basemap
 - Simple Coastal O
 - Monochrome T
 - Landcover Terrain
 - Monochrome Topo
 - Colour Topograph

© S-Map Maps - Creative Commons NZ License (BY-ND). Base map contains data sourced from LINZ. Crown Copyright Reserved

Turn on soil map

View soil variability

Select information button

S-mapOnline
Fast, simple access to New Zealand soils data

Home Getting Started About Map Factsheets Glossary Terms of Use Data Provenance

Tools: Navigate Zoom Box **Feature Information** 1: 50,000 Start Again Print Help

Location Search
Search by place (e.g. Te Anau), address or by entering a [NZTM](#) or a [latitude-longitude](#) coordinate (e.g. 1890671, 5819114).

Layers

- Labels, hydrology and roads
 - Cartographic Text
 - Transport
 - Water Group
- Soils
 - S-map Polygons & Labels
 - Soil Drainage
 - Depth To Hard Soil / Gravel / Rock
 - Soil Moisture - Profile Available Water
- Basemap
 - Simple Coastal Outline
 - Monochrome Terrain Map
 - Landcover Terrain Map
 - Monochrome Topographic
 - Colour Topographic

S-Map soil summary table
NZTM coordinates: 1807374, 5453553

Soil name (factsheet)	%	Key soil properties	Confidence
Waikw# (Sib 28)	20	moderately deep, well...	Medium
Longbeach# (Sib...	30	moderately deep, poor...	Medium
Kohinuif# (Sib 4)	20	shallow, well drained,...	Medium
PeelForest# (Sib...	30	moderately deep, impe...	Medium

Click on a soil name above to get a PDF factsheet.

© S-Map Maps - Creative Commons NZ License (BY-ND). Base map contains data sourced from LINZ. All Rights Reserved

Click on area of interest

View soil factsheets



Home Getting Started About Map Factsheets Glossary Terms of Use Data Provenance

Tools: Navigate, Zoom Box, Feature Information, 1:50,000, Start Again, Print, Help

Location Search: Search by place (e.g. Te Anau), address or by entering a [LiZTM](#) or a [latitude-longitude](#) coordinate (e.g. 1890671, 5819114).

Layers: Labels, hydrology and roads; Cartographic Text; Transport; Water Group; S-map; Soil Polygons & Labels; Soil Drainage; Depth To Hard Soil / Gravel / Rock; Soil Moisture - Profile Available Water; Basemap; Simple Coastal Outline; Monochrome Terrain Map; Landcover Terrain Map; Monochrome Topographic; Colour Topographic

S-Map soil summary table

NZTM coordinates: 1807374, 5453553

Soil name (factsheet)	%	Key soil properties	Confidence
Waikiwī (Sib 28)	20	moderately deep, well...	Medium
Longbeach (Sib...)	30	moderately deep, poor...	Medium
Kohinui (Sib 4)	20	shallow, well drained,...	Medium
PeelForest (Sib...)	30	moderately deep, impe...	Medium

Click on a soil name above to get a PDF factsheet.

© S-Map Maps - Creative Commons NZ License (BY-ND). Base map contains data sourced from LINZ. Crown Copyright Reserved

Click on soil name

Soil factsheet



Landcare Research
Manaaki Whenua

S-map Soil Report

Report generated: 2-Jul-2012 from <http://smap.landcareresearch.co.nz>

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.

Waikiwif

Waiki2z (20% of the mapunit at location (5453553, 1807374), Confidence: Medium)

S-map ref: Waiki_28.1

Key physical properties

Depth class (diggability)	Moderately Deep (45 - 100 cm)
Texture profile	Silty Loam
Potential rooting depth	50 - 90 (cm)
Rooting barrier	Extremely gravelly
Topsoil stoniness	Moderately stony
Topsoil clay range	20 - 30 %
Drainage class	Well drained
Aeration in root zone	Slightly limited
Permeability profile	Moderate Over Slow
Depth to slowly permeable horizon	45 - 100 (cm)
Permeability of slowest horizon	Slow (< 4 mm/h)
Profile total available water	(0 - 100cm) Moderate (92 mm)
Top 60 cm available water	(0 - 60cm) Moderate (89 mm)
Top 30 cm available water	(0 - 30cm) High (55 mm)
Dry bulk density, topsoil	1.09 (g/cm ³)
Dry bulk density, subsoil	1.53 (g/cm ³)
Depth to hard rock	No hard rock within 1 m
Depth to soft rock	No soft rock within 1 m

Key chemical properties

Topsoil P retention	Medium (43%)
---------------------	--------------

Overseer values

Soil Order	Brown
Sand parent material	
Topsoil soil texture	
Depth	

Waikiwif

Waiki2z (20% of the mapunit at location (5453553, 1807374), Confidence: Medium)

S-map ref: Waiki_28.1

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

Erodibility of soil material	Moderate
Vulnerability to rill and slip erosion	not available yet
Structural vulnerability	Low (0.49)
Pugging vulnerability	not available yet

Water management

Water logging vulnerability	Very Low
Drought vulnerability - if not irrigated	Moderate
Bypass flow	Medium
Hydrological soil group	B
Irrigability	Flat to very gently undulating land with good drainage/permeability and soils with moderate PAW

Contaminant management

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

Additional information

Soil classification	Typic Firm Brown Soils
Family	Waikiwif
Sibling number	28
Dominant texture 0 - 60 cm	Silty
Soil profile material	Moderately deep soil
Rock class of stones/rocks	From Hard Sandstone Rock
Rock origin of fine earth	From Hard Sandstone Rock
Parent material origin	Loess on Alluvium

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

Functional Horizon	Thickness	Stones	Clay	Sand
Stony Loamy Weak	20 - 30 cm	5 - 25 %	20 - 30 %	5 - 10 %
Stony Loamy Fine Slightly Firm	25 - 50 cm	5 - 35 %	20 - 30 %	5 - 15 %
Very Stony Clayey Compact	30 - 50 cm	50 - 70 %	35 - 50 %	15 - 30 %

Print soil map



- Home
- Getting Started
- About
- Map
- Factsheets
- Glossary
- Terms of Use
- Data Provenance

A screenshot of the S-mapOnline web application interface. The main map area shows a soil moisture map of a region in New Zealand, with various soil moisture levels color-coded. A 'Print Map' dialog box is open in the center, providing instructions on how to create a printable PDF map. The dialog box includes fields for 'Title', 'Layout' (set to 'A4 Portrait'), and 'Scale' (set to '1:100,000'). There is a 'Create and download PDF' button and a 'Close' button. The interface also features a 'Tools' bar at the top with options like 'Navigate', 'Zoom Box', and 'Feature Information'. On the left, there are 'Location Search' and 'Layers' panels. On the right, there are 'Layer Metadata' and 'Legend' panels. A red arrow points to the 'Print' icon in the top right corner of the application window.

Click on print

Utility of soil information

