A worms eye view of soil information

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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

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.

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.

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

Service database last updated: 28 March 2012

Handout available
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

bits and bytes

Information

derived useful outputs

Knowledge

= familiarity, information received

Wise decisions

Implemented plans that work well
Data

Data Input

Expert knowledge

New data

Legacy Soil maps

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 products

- spatial database (polygons)
- Point data (NSD)
- external databases (e.g. rainfall, geology)

Soil inference system

Data to Information Models
- Rule based/ Statistical
e.g.
Available water capacity
= f(depth, stones, clay, sand, C%)

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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

Contaminant management
- N leaching vulnerability
- P leaching vulnerability
- Runoff potential
- Bypass flow
Dairy effluent (FDE) risk category:

- Very High
- Not available
- Very Low
- Medium
- D
Knowledge

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

- **Accessibility** - Knowing information is here & where
- **Clarity** – web service design
- **New tools e.g. Paddock-download** directly from WWW into Overseer on laptop
- **Connect** - get your hands dirty!

Its not dirt!

Not just topsoil

Its critical natural capital

Soil-diversity

The soil serves us

Soil is beautiful!
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

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Maps & factsheets

Factsheets by soil name

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S-map Online Service Status

ok
Find your area

Type in address

Use zoom and navigate
Map soil attributes

Select attribute to map
Modify background

Select map background
View attribute glossary

Click on name of layer
View soil map

Turn on soil map
View soil variability

Select information button

Click on area of interest
View soil factsheets

Click on soil name
Soil factsheet

**S-map Soil Report**


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 blocks.

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

**S-map ref: Waikiw_26.1**

### Key physical properties
<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth class (diggability)</td>
<td>Moderately Deep (45 - 100 cm)</td>
</tr>
<tr>
<td>Texture profile</td>
<td>Silty Loam</td>
</tr>
<tr>
<td>Potential rooting depth</td>
<td>50 - 90 (cm)</td>
</tr>
<tr>
<td>Rooting barrier</td>
<td>Extremely gravelly</td>
</tr>
<tr>
<td>Topsoil stoniness</td>
<td>Moderately stony</td>
</tr>
<tr>
<td>Topsoil clay range</td>
<td>20 - 30 %</td>
</tr>
<tr>
<td>Drainage class</td>
<td>Well drained</td>
</tr>
<tr>
<td>Aeration in root zone</td>
<td>Slightly limited</td>
</tr>
<tr>
<td>Permeability profile</td>
<td>Moderate Over Slow</td>
</tr>
<tr>
<td>Depth to slowly permeable horizon</td>
<td>45 - 100 (cm)</td>
</tr>
<tr>
<td>Permeability of slowest horizon</td>
<td>Slow (&lt; 4 mm/hr)</td>
</tr>
<tr>
<td>Profile total available water</td>
<td>Moderate (52 mm)</td>
</tr>
<tr>
<td>Top 60 cm available water</td>
<td>Moderate (59 mm)</td>
</tr>
<tr>
<td>Top 30 cm available water</td>
<td>High (55 mm)</td>
</tr>
<tr>
<td>Dry bulk density, topsoil</td>
<td>1.09 (g/cm³)</td>
</tr>
<tr>
<td>Dry bulk density, subsoil</td>
<td>1.53 (g/cm³)</td>
</tr>
<tr>
<td>Depth to hard rock</td>
<td>No hard rock within 1 m</td>
</tr>
<tr>
<td>Depth to soft rock</td>
<td>No soft rock within 1 m</td>
</tr>
</tbody>
</table>

### Key chemical properties
<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topsoil P retention</td>
<td>Medium (43%)</td>
</tr>
</tbody>
</table>

### Overseer values
<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Order</td>
<td>Brown</td>
</tr>
<tr>
<td>Sand parent material</td>
<td></td>
</tr>
<tr>
<td>Topsoil soil texture</td>
<td></td>
</tr>
<tr>
<td>Depth</td>
<td></td>
</tr>
</tbody>
</table>

### Water management
- **Water logging vulnerability**: Very Low
- **Drought vulnerability**: 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 loading vulnerability**: not available yet
- **Runoff potential**: Very Low
- **Bypass flow**: Medium
- **Dairy effluent (FDE) risk category**: D

### Additional information
- **Soil classification**: Typic Brown Soils
- **Family**: Waikiwf
- **Sibling number**: 26
- **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:

<table>
<thead>
<tr>
<th>Functional Horizon</th>
<th>Thickness</th>
<th>Stones</th>
<th>Clay</th>
<th>Sand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stoney Loamy Weak</td>
<td>20 - 30 cm</td>
<td>5 - 25 %</td>
<td>20 - 30 %</td>
<td>5 - 10 %</td>
</tr>
<tr>
<td>Stoney Loamy Fine Silticry Fonding</td>
<td>25 - 50 cm</td>
<td>5 - 35 %</td>
<td>20 - 30 %</td>
<td>5 - 15 %</td>
</tr>
<tr>
<td>Very Stoney Clayey Compact</td>
<td>30 - 50 cm</td>
<td>50 - 70 %</td>
<td>35 - 50 %</td>
<td>15 - 30 %</td>
</tr>
</tbody>
</table>
Print soil map

Click on print
SOIL
the "critical zone" of interaction between atmosphere, hydrosphere, biosphere, and lithosphere

Atmosphere
- C storage
- NO2, CH4, CO2 emissions

Hydrology
- leaching, runoff, contaminant attenuation
- water storage, flood regulation

Ecosystems
- habitats and habitat diversity
- soil biology and biodiversity
- fertility, water supply, environmental domains

Economy, society
- soil natural capital, land value
- limits of intensification
- ecosystem services, Resource allocation, policy development and implementation

Engineering
- soil mechanics, foundations
- utilities routing, corrosion, drainage, water regime
- civil engineering works
- electrical earthing

Production
- land capability, fertility
- risk mitigation, forests, pasture, crops, horticulture

Geology
- regolith, erosion, slope stability
- hazards, geomorphology, weathering, landscape flows
- of sediments and nutrients'