# Soil Carbon In SA

## What builds it

## What loses it

## What you can influence

**Amanda Schapel**

25 March 2026

SOILS Collaboration Centre
Connected for better soil health

Government of South Australia
Department of Primary Industries and Regions

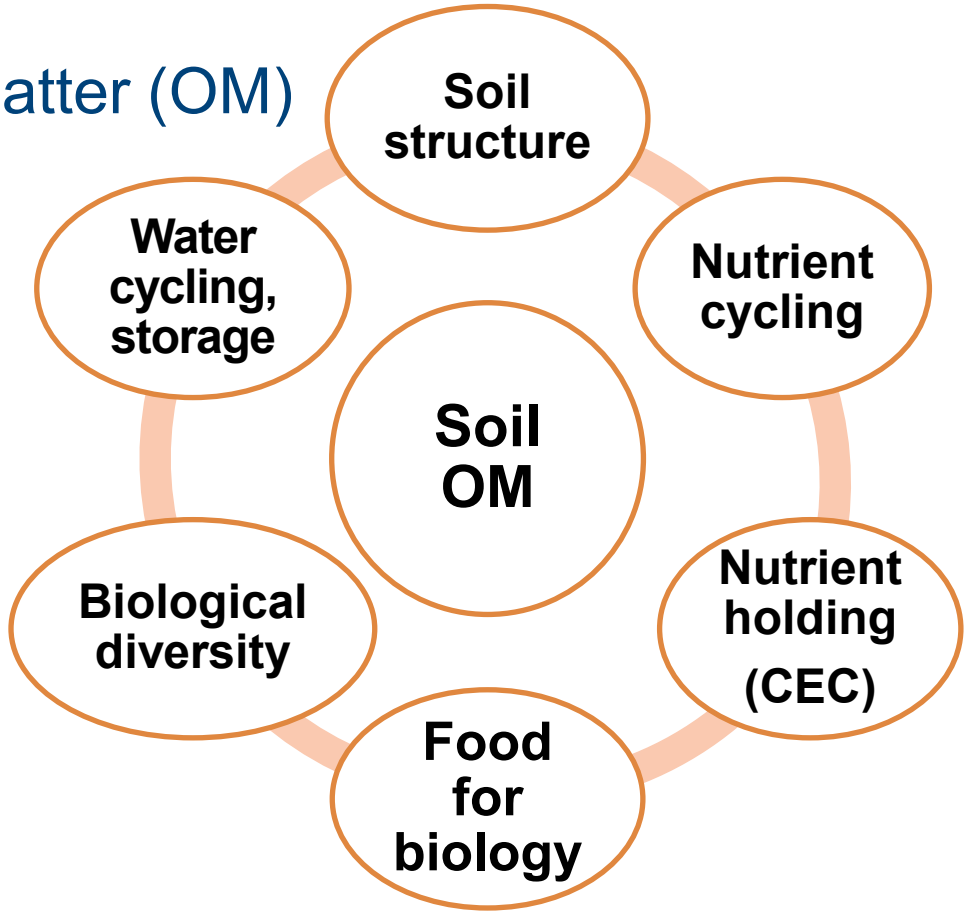
# Soil organic carbon – 5 key facts

1. Soil OC underpins how soils work
   It supports structure, water-holding, nutrients, biology and carbon storage
2. Rainfall sets the ceiling for soil OC
   In SA, areas above 550mm annual rainfall generally have higher soil OC
3. Clay helps soils hold onto soil OC
   More clay means more protection of longer-lasting OC
4. Stable soil OC is slow and hard to measure
   It varies across paddocks and seasons, and takes 5-10 years to confirm sustained change
5. Management changes show up first in the topsoil
   OC in the top 10cm is most responsive but changes also occur deeper

# Soil carbon - why it matters

Carbon is a part of organic matter (OM)

- Soil health and function
- Plant productivity
- Resilience
- Mitigate greenhouse gas emissions



# Forms of Organic Carbon (OC)

## FUNCTION

*Labile*
*Active*

Particulate
0.053 – 2 mm

*Fresh*

Dissolved
liquid

DOC – days to weeks
POC – years to decades

## LONG-TERM STORAGE

Mineral-Associated
< 0.053 mm

*Stable*
*Protected*

Recalcitrant
< 2 mm

*Charcoal*
*Biochar*

MAOC - decades to centuries
ROC – centuries but can be decomposed

# Factors affecting soil OC

**CLIMATE**
Rainfall,
Temperature

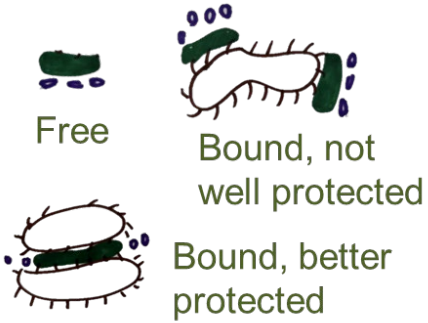
OM grown
Microbial activity

# Factors affecting soil OC

**CLIMATE**
Rainfall,
Temperature

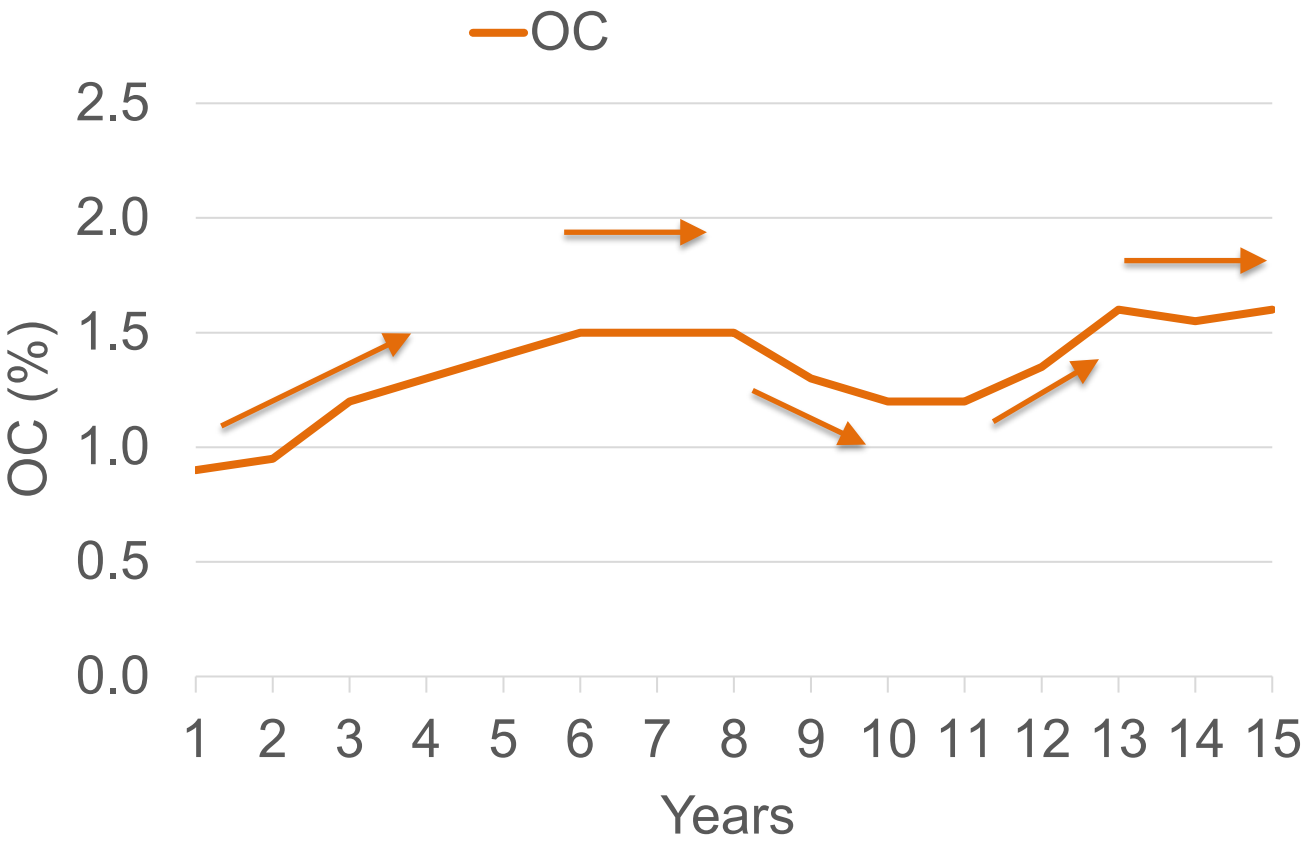
OM grown
Microbial activity

**SOIL**
Clay, Silt, Fe, Al,
Ca complexes
Aggregates




Minerals, complexes and aggregates determine OM protection from decomposition

# Soils capacity to stabilise OC




OC can be decomposed if not stabilised in soil

Expect loss of **70-90%** of OC inputs

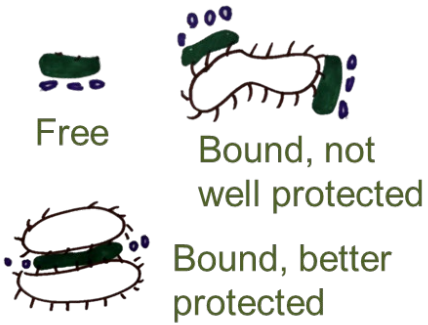
Stabilised by mineral surfaces clay, silt, Fe, Al, Ca (MAOC) and in aggregates

# Factors affecting soil OC

**CLIMATE**
Rainfall,
Temperature

OM grown
Microbial activity

**SOIL**
Clay, Silt, Fe, Al,
Ca complexes
Aggregates




Minerals, complexes and aggregates determine OM protection from decomposition

**MANAGEMENT**
Optimise OC inputs
Minimise OC loss

It's how you manage the practice not the management practice

# What we can do to maintain or improve SOC

## What builds OC

- grow/retain more biomass and roots & exudates
- add external OM; composts, manures, if $ allow

## What loses OC

- exposed soil surface = erosion
- unprotected OC not on mineral complexes

# Management of SOC

| Optimise OM | Minimise SOC loss |
|---|---|
| Maintain groundcover as long as possible – consider perennials * | Maximise groundcover<br>Minimise soil disturbance |
| Grow green plants for longer | |
| Optimise plant diversity / rotations | |
| Address soil limitations * | |
| Optimise nutrition | Maximise stabilisation of OC |
| Import OM * or apply amendments | Provide OM inputs to maintain OC |
| Grazing management to allow pasture recovery and root growth | |

* where possible

# What can management do to OC?

## COMPOSTS AND MULCHES

↑ food source microbes, nutrients, water retention and soil structure

Need to reapply to maintain OM source

Generally highest OC increase and cost

## GROUND COVER

↑ structure, water infiltration and retention, macro fauna and microbial activity, weed suppression,

↓ erosion, risk of dry saline land, temperature and moisture loss

## ADDRESS SOIL LIMITATIONS

↑ root access to moisture and nutrients by removing; constraining layer compaction, ameliorating pH, salinity or sodicity.

Consider $ and GHG costs

Beware: don't **overestimate** SOC change

# How can I tell if there is opportunity to store more OC in my soil?

# CSIRO – LOOC- C 0-30cm

## Indication of 0-30cm SOC Concentration of soils in 100km radius based on national soils grid

https://looc-c.farm/

Agricultural method

### Measurement of soil carbon sequestration

Close

Method Details | Estimate | Farm Co-benefits

**Australian Carbon Credit Units: 0** tCO2-e over 25 years

**Estimated 0-30 cm soil carbon content for your polygon:** 0.7%

This soil carbon value is based on data retrieved from the national soils grid.

**Actual 0-30 cm soil carbon content for your polygon:** 0.7 %

If you have data available that more accurately reflects the soil carbon, enter the average across the polygon here. It is not necessary to provide your own soil carbon data, however providing a more accurate value will improve the accuracy of the Australian Carbon Credit Units estimate.

**Your target 0-30 cm soil carbon content**

Please provide a soil carbon level that you would use as a target for an ERF project

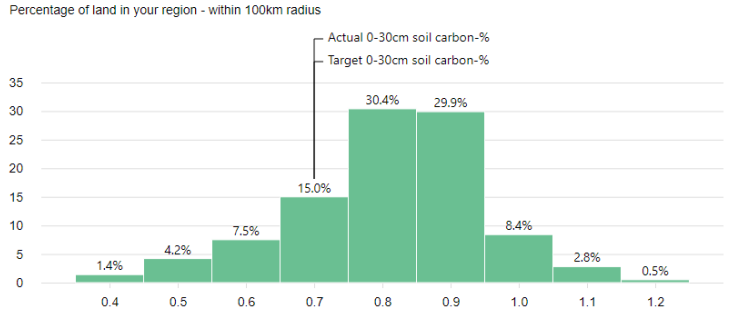
0 5 10 15

0.7 %

**Soil carbon indices for your location**

**Soil carbon in your region**

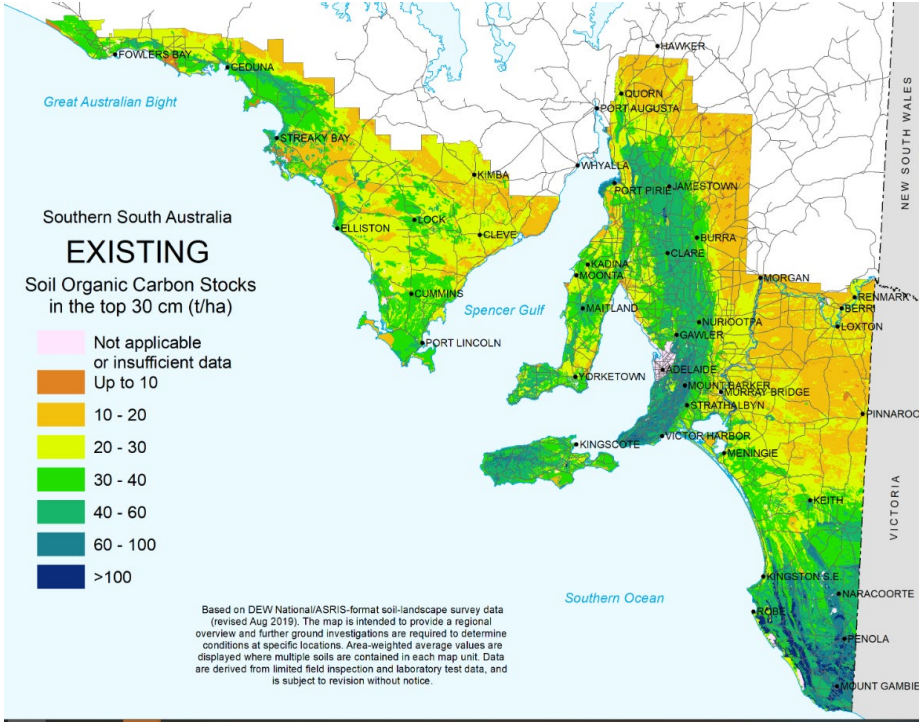
The chart below shows the range of soil carbon percentages within 100km radius of your proposed project, and where both estimates of your current soil carbon and your proposed soil carbon increases are within the range of your region. This chart does not warrant that you will be able to achieve your target concentration of soil carbon. Users will need to do their own research on activities that might increase soil carbon in their situation. Factors affecting soil carbon increases include soil type, climate and management activities.



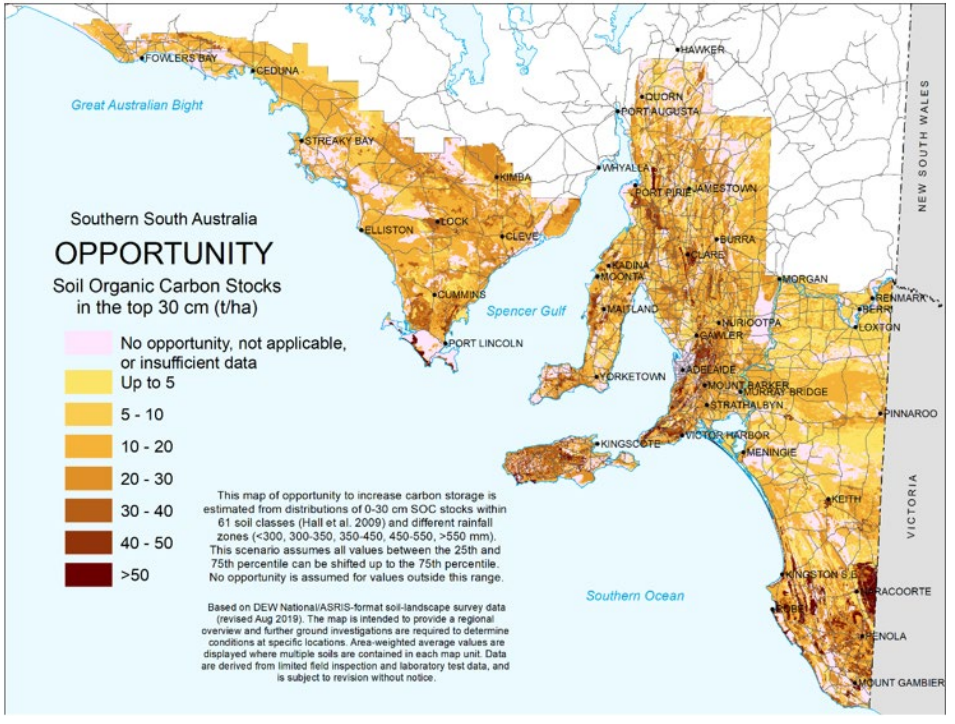

Government of South Australia
Department of Primary Industries and Regions

# DEW – OC Stocks 0-30cm

## OC stocks 1990-2010




## OC stocks MODELLED opportunity 1990-2010




Government of South Australia
Department for Environment and Water

Government of South Australia
Department of Primary Industries and Regions

# Soil OCwb Guidelines by Rainfall 0-10cm

| Annual Rainfall (mm) | SANDS | | | | SANDY LOAM | | | |
|---|---|---|---|---|---|---|---|---|
| | Lower limit | Mid point | Practical target | Stretch target | Lower limit | Mid point | Practical target | Stretch target |
| <300 | 0.35 | 0.40 | 0.50 | 0.75 | 0.40 | 0.60 | 0.80 | 1.00 |
| 300 -350 | 0.50 | 0.60 | 0.75 | 1.00 | 0.65 | 1.00 | 1.25 | 1.45 |
| 350 - 400 | 0.60 | 0.75 | 0.95 | 1.20 | 0.75 | 1.20 | 1.40 | 1.65 |
| 400 - 450 | 0.70 | 0.90 | 1.20 | 1.40 | 0.85 | 1.30 | 1.50 | 1.80 |
| 450 - 500 | 0.85 | 1.10 | 1.45 | 1.80 | 1.00 | 1.50 | 1.80 | 2.10 |
| 500 - 550 | 1.00 | 1.30 | 1.70 | 2.20 | 1.20 | 1.70 | 2.10 | 2.50 |
| 550 - 650 | 1.20 | 1.65 | 2.20 | 2.90 | 1.40 | 2.10 | 2.80 | 3.40 |
| 650 - 750 | 1.30 | 1.90 | 2.60 | 3.40 | 1.90 | 2.60 | 3.60 | 4.30 |
| > 750 | 1.40 | 2.10 | 2.80 | 3.60 | 2.10 | 2.80 | 3.80 | 4.50 |

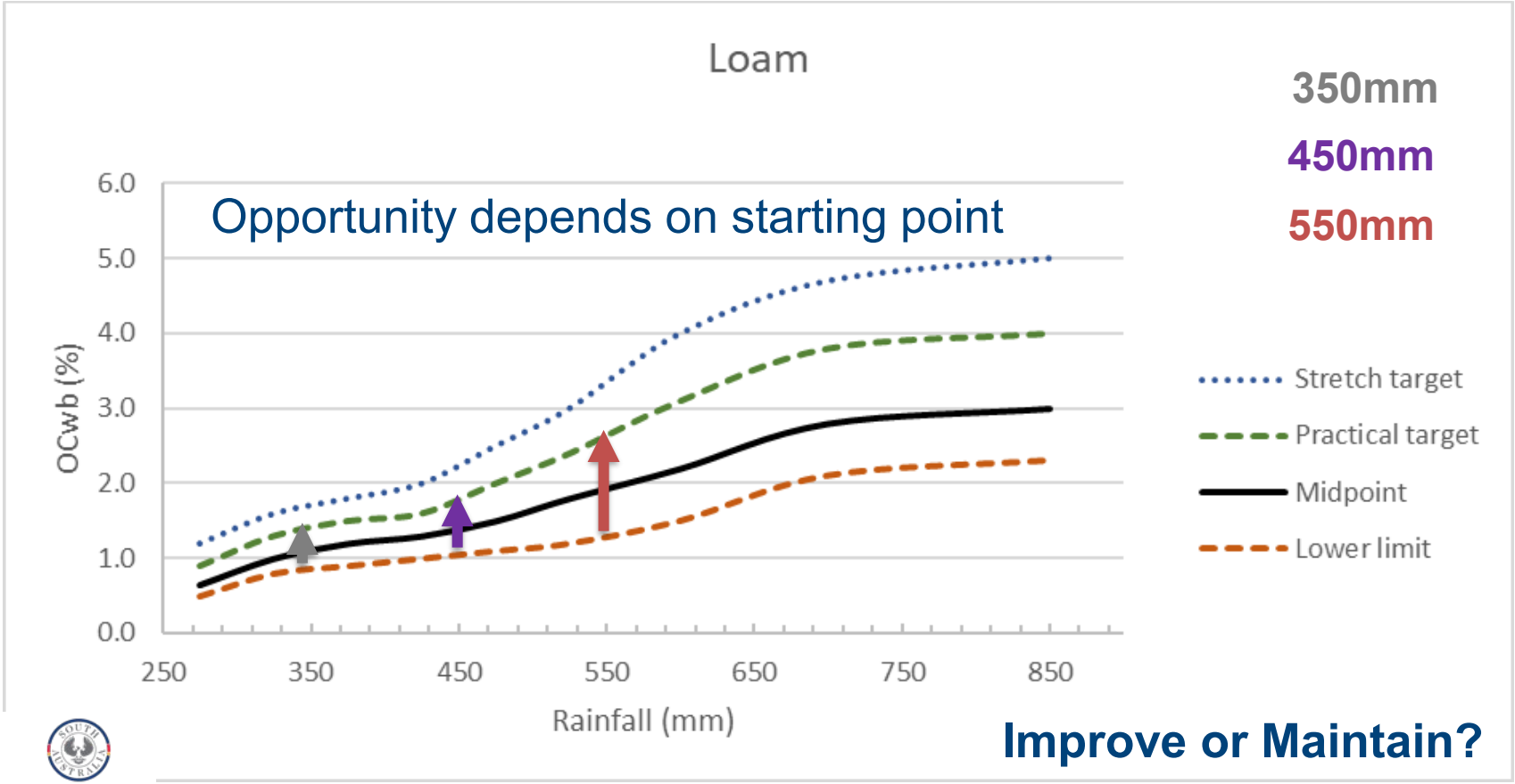
Government of South Australia
Department for Environment and Water

Full Guidelines

Website with Ag District Benchmarks

Government of South Australia
Department of Primary Industries and Regions

# Soil Organic Carbon Guidelines by Rainfall 0-10cm




**Improve or Maintain?**

# DEW-PIRSA SOC Guidelines 0-10cm OCwb

Difference in **0-10cm** soil OC concentration between the 25 and 75 percentile

## SOC GUIDELINES BY ANNUAL RAINFALL – OC Concentration and Estimated OC stock

| Range (mm) | Sands* | |
|---|---|---|
| | OC (%) | OC (tC/ha) |
| 250-300 | 0.15 | *2.1* |
| 300-350 | 0.25 | *3.5* |
| 350-400 | 0.35 | *4.9* |
| 400-450 | 0.50 | *7.0* |
| 450-500 | 0.60 | *8.4* |
| 500-550 | 0.70 | *9.8* |
| 550-650 | 1.00 | *14.0* |
| 650-750 | 1.30 | *18.2* |
| 750-1000 | 1.40 | *19.6* |

| Δ OC % |
|---|
| 0.0-0.5% |
| 0.5-0.75% |
| 0.75-1.0% |
| >1.0% |

**OC tC/ha**

OC%

BD =1.4 g/cm$^3$

Depth = 10cm

Government of South Australia

Department of Primary Industries and Regions

** Sands = sand and loamy sand*

*OC stock (tC/ha) = OC conc (%) x Bulk density (g/cm3) x depth (cm)*

# DEW-PIRSA SOC Guidelines 0-10cm OCwb

Difference in **0-10cm** soil OC concentration between the 25 and 75 percentile

## SOC GUIDELINES BY ANNUAL RAINFALL – OC Concentration and Estimated OC stock

| Range (mm) | Sands* | | Sandy loam | | Loam | | Clay loam | |
|---|---|---|---|---|---|---|---|---|
| | OC (%) | OC (tC/ha) | OC (%) | OC (tC/ha) | OC (%) | OC (tC/ha) | OC (%) | OC (tC/ha) |
| **250-300** | 0.15 | *2.1* | 0.40 | *5.6* | 0.40 | *5.6* | 0.70 | *9.8* |
| **300-350** | 0.25 | *3.5* | 0.60 | *8.4* | 0.50 | *7.0* | 0.70 | *9.8* |
| **350-400** | 0.35 | *4.9* | 0.65 | *9.1* | 0.60 | *8.4* | 0.60 | *8.4* |
| **400-450** | 0.50 | *7.0* | 0.65 | *9.1* | 0.60 | *8.4* | 0.60 | *8.4* |
| **450-500** | 0.60 | *8.4* | 0.80 | *11.2* | 0.90 | *12.6* | 0.75 | *10.5* |
| **500-550** | 0.70 | *9.8* | 0.90 | *12.6* | 1.20 | *16.8* | 0.90 | *12.6* |
| **550-650** | 1.00 | *14.0* | 1.40 | *19.6* | 1.60 | *22.4* | 1.10 | *15.4* |
| **650-750** | 1.30 | *18.2* | 1.70 | *23.8* | 1.70 | *23.8* | 2.00 | *28.0* |
| **750-1000** | 1.40 | *19.6* | 1.70 | *23.8* | 1.70 | *23.8* | 2.00 | *28.0* |

| Δ OC % |
|---|
| 0.0-0.5% |
| 0.5-0.75% |
| 0.75-1.0% |
| >1.0% |

**OC tC/ha**

OC%

BD =1.4 g/cm$^3$

Depth = 10cm

* *Sands = sand and loamy sand*

*OC stock (tC/ha) = OC conc (%) x Bulk density (g/cm3) x depth (cm)*

Government of South Australia

Department of Primary Industries and Regions

# Soil organic carbon – 5 key facts

1. **Soil OC underpins how soils work**
   It supports structure, water-holding, nutrients, biology and carbon storage
2. **Clay helps soils hold onto soil OC**
   More clay means more protection of longer-lasting OC
3. **Rainfall sets the ceiling for soil OC**
   In SA, areas above 550mm annual rainfall generally have higher soil OC
4. **Stable soil OC is slow and hard to measure**
   It varies across paddocks and seasons, and takes 5-10 years to confirm sustained change
5. **Management changes show up first in the topsoil**
   OC in the top 10cm is most responsive but changes also occur deeper

Government of South Australia
Department of Primary Industries and Regions

# Amanda Schapel

## Principal Officer, Soil Action

## South Australian Soils Collaboration Centre

## 0411 137 258

## amanda.schapel@sa.gov.au


Australian Government
Department of Agriculture, Fisheries and Forestry

SOILS Collaboration Centre
Connected for better soil health


Funded by the Australian Government
Partnering to Implement the National
Soil Action Plan 2023-2028


Government of South Australia
Department of Primary Industries and Regions