



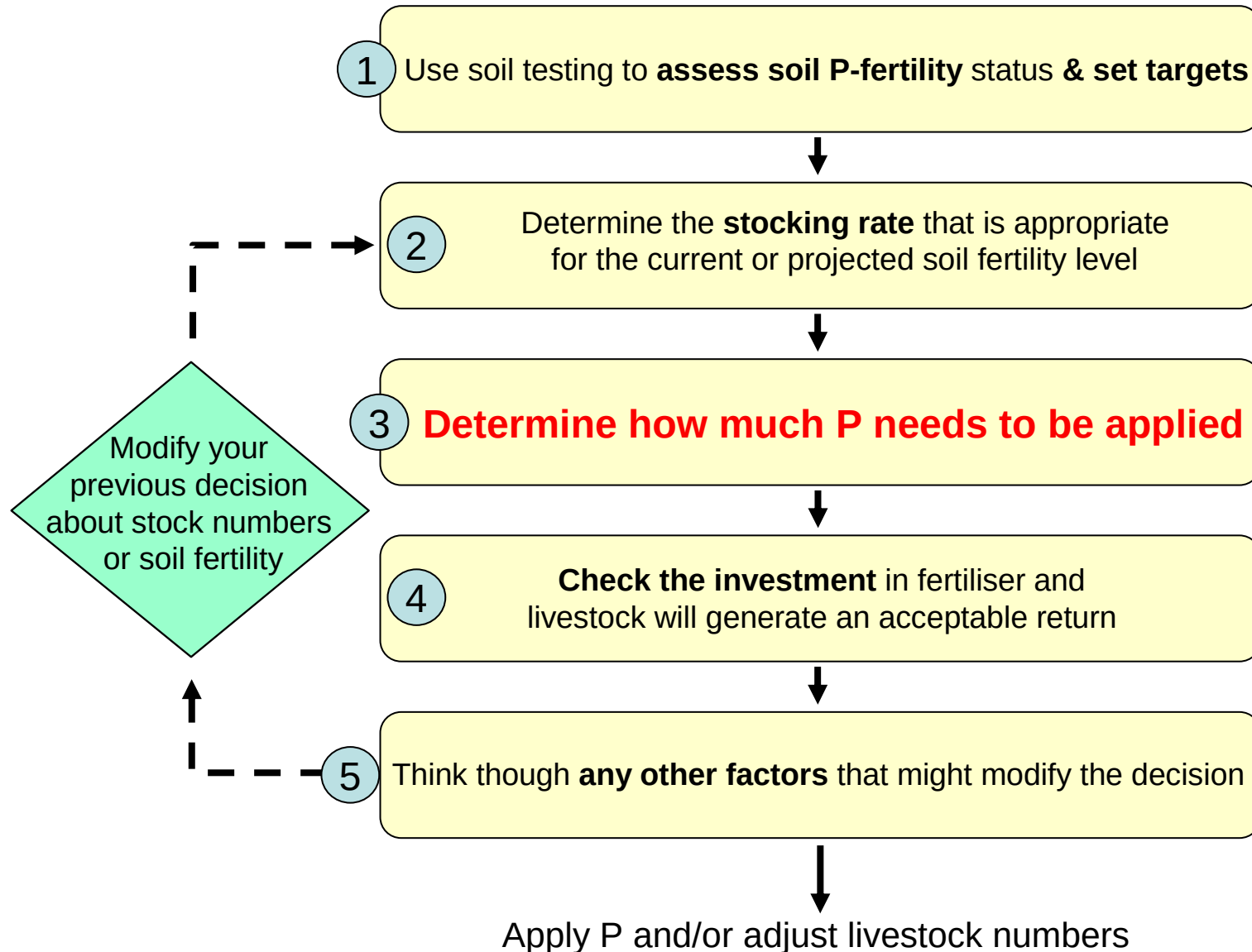
Putting a soil fertility management plan into practice

Five Easy Steps

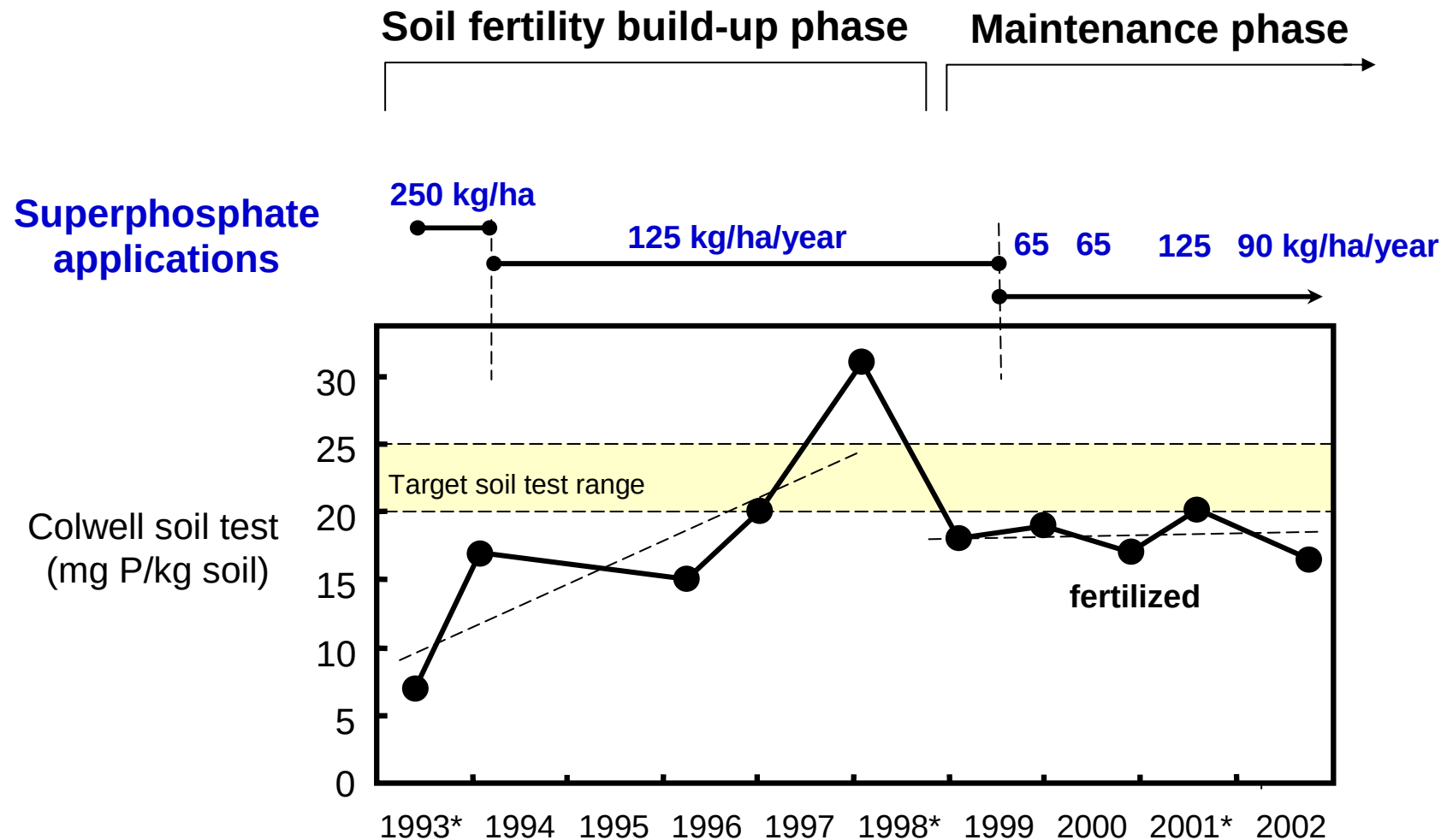
Richard Simpson
CSIRO Sustainable Agriculture Flagship

Luke Pope
NSW Industry and Investment

Five Easy Steps



To calculate how much P you need to apply, you first need to have developed the soil fertility management plan for the year to come. This can be done assembling the information required for the Table in Appendix 3 of the “Five EASY Steps...” booklet. For example let’s re-visit the planning needed to lift stocking rate over 5 years from 6 DSE/ha on unfertilised pasture to 13 DSE/ha with superphosphate at the Bookham Grazing Demonstration.



5 Easy Steps

Step 1: Use soil tests to assess the P-fertility status of your soil

Location: “Kia-Ora”, Bookham, NSW; currently running 6 wethers/ha

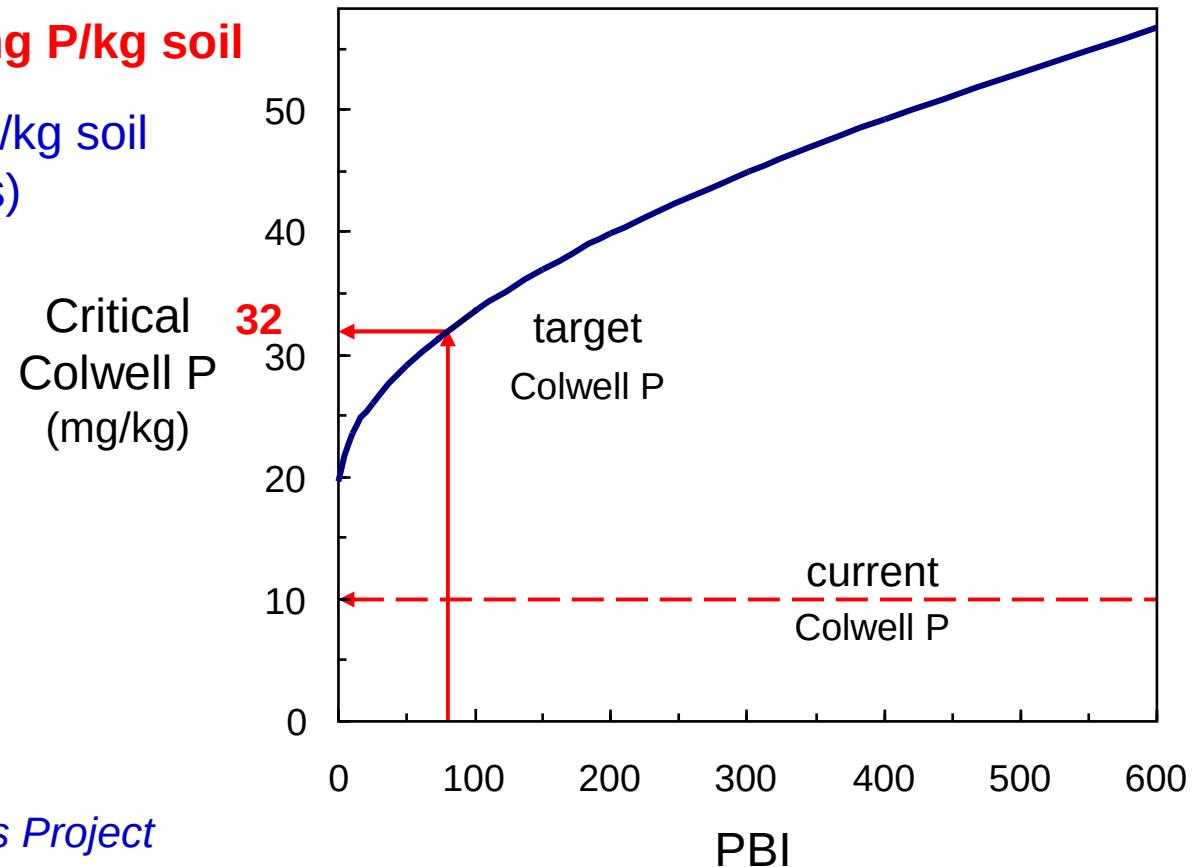
Soil test results

Current Colwell P: 10 mg P/kg soil (Alternatively: **Olsen P** = 5 mg/kg)

Phosphorus Buffering Index (PBI): 80

Target Colwell P: 30-35 mg P/kg soil

Target Olsen P: ~15 mg P/kg soil
(always)

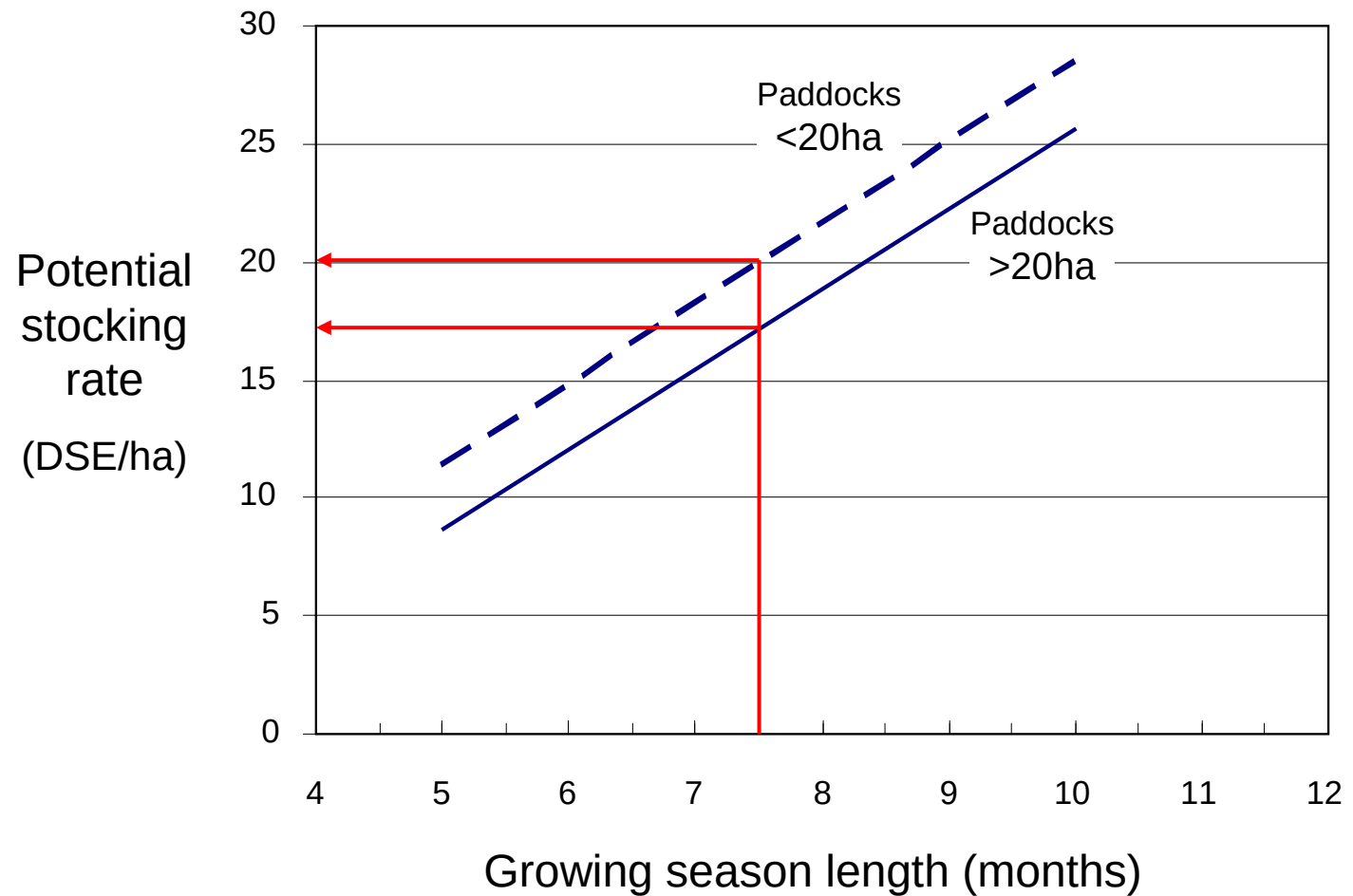


from: Gourley et al. 2007

Better Fertiliser Decisions Project

Step 2: Determine the appropriate stocking rate

Length of growing season: 7.5 months



from: Saul and Kearney (2002)

Wool Technology and Sheep breeding 50, 492-498

(*"Triple P" extension program*)

Current soil fertility
Colwell P = 10 mg P/kg

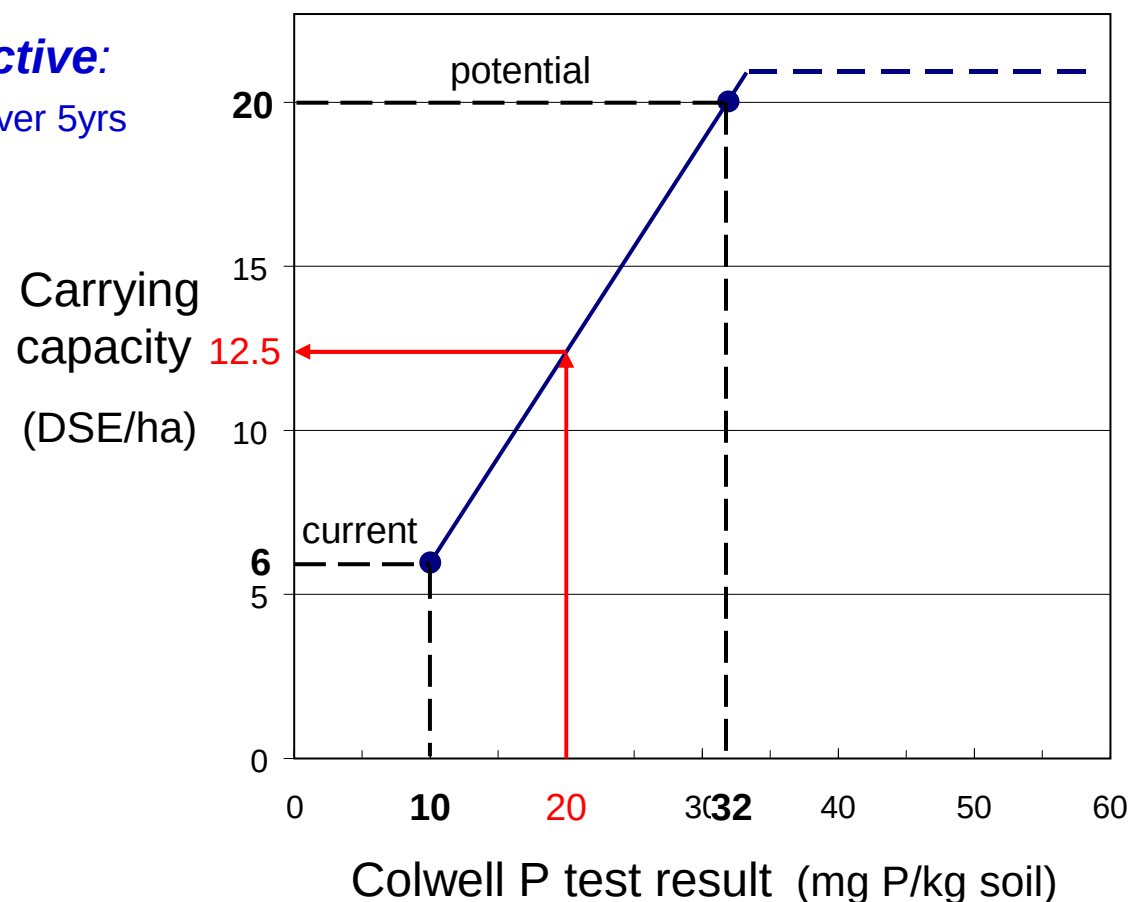
Current carrying capacity
6 DSE/ha (6 Merino wethers/ha)



**Critical Colwell P
for near max. pasture growth**
= 32 mg P/kg soil

Potential carrying capacity
20 DSE/ha (GS = 7.5 mths)

Soil fertility management objective:
raise Colwell P to ~20 mg P/kg over 5yrs



Current soil fertility
Colwell P = 10 mg P/kg

Current carrying capacity
6 DSE/ha (6 Merino wethers/ha)

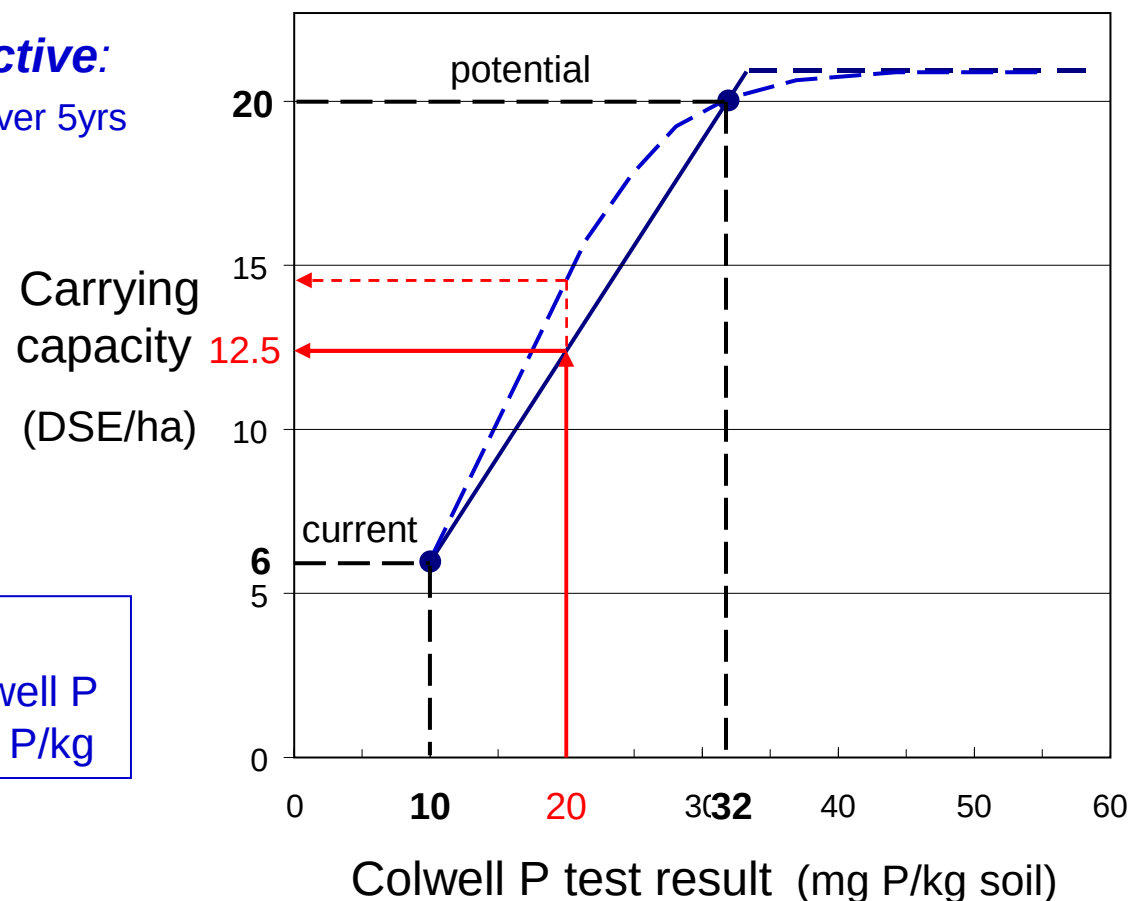


**Critical Colwell P
for near max. pasture growth**
= 32 mg P/kg soil

Potential carrying capacity
20 DSE/ha (GS = 7.5 mths)

Soil fertility management objective:
raise Colwell P to ~20 mg P/kg over 5yrs

What actually happened?
14.6 DSE/ha was carried when Colwell P
was maintained at just under 20 mg P/kg



We now have a soil fertility management plan:

Soil fertility plan raise Colwell P from: 10  20 mg P/kg over 5yrs

Stocking rate plan lift stock numbers from: 6  13 DSE/ha (1.4DSE/ha/yr)

This allows you to do

Step 3: Determine how much P needs to be applied

The amount of P to be applied has two components:

(1) the amount needed to hold your current position (*maintenance P*)

Two components to maintenance:

“soil loss factors” – *P that is fixed, adsorbed or leached*

“animal loss factors” – *P exported in products or transferred to camps*

PLUS

(2) the amount of P needed to increase soil P fertility (*capital P*)

The amount of P needed is affected by the PBI of the soil

(1) + (2) = the total amount of P required each year

Soil fertility plan raise Colwell P from: 10 → 20 mg P/kg over 5yrs

Stocking rate plan lift stock numbers from: 6 → 13 DSE/ha (1.4DSE/ha/yr)

Tables required for these calculations are in Step 3 from page 10 of the “Five Easy Steps...” booklet
Alternatively, use the computer tool.

(i) Maintenance fertiliser calculation

Average rainfall: 700 mm
Pasture: unimproved
Soil: yellow podzolic soil
Soil loss factor: medium
Animal Loss factor: v.low-low

Table 3: Predicted kg P/DSE (for calculating maintenance P applications)

Soil loss factor	Animal Loss factor	Poor pasture Annual rainfall (mm)			Improved pasture (Annual rainfall mm)		
		400	600	800	400	600	800
Low	very low	0.42	0.45	0.48	0.43	0.48	0.53
	low	0.54	0.58	0.62	0.55	0.62	0.68
	medium	0.65	0.70	0.75	0.67	0.75	0.83
	high	0.77	0.83	0.89	0.80	0.89	0.98
Medium	very low	0.61	0.65	0.70	0.63	0.70	0.77
	low	0.72	0.78	0.84	0.75	0.83	0.92
	medium	0.84	0.91	0.97	0.87	0.97	1.07
	high	0.96	1.03	1.11	0.99	1.11	1.22
High	very low	0.80	0.86	0.92	0.82	0.92	1.01
	low	0.91	0.98	1.05	0.94	1.05	1.16
	medium	1.01	1.11	1.19	1.06	1.19	1.31
	high	1.15	1.24	1.32	1.18	1.32	1.46

Year 1
7.4 DSE x 0.74 = 5.4

Year 5
13 DSE x 0.74 = 9.6

Average 7.5 kg P/ha

from: Cayley & Quigley 2005

Phosphorus for sheep and beef pastures (Hamilton long-term P trial)

(ii) Capital fertiliser calculation (for 2 unit/year increase)

Soil PBI = 80

Table 1. Estimating the amount of P/ha required in excess of the maintenance P application for 1 unit increase

PBI value of topsoil (0-10 cm depth)	50	100	200	300	400	500	600
Extra P* (kg P/ha) needed to raise Colwell soil test by 1 mg P/kg soil.	2.7	2.7	2.9	3.0	3.1	3.2	3.4

* P in excess of the amount of "maintenance P" that must also be applied

2 x 2.7 = 5.4 kg P/ha/yr

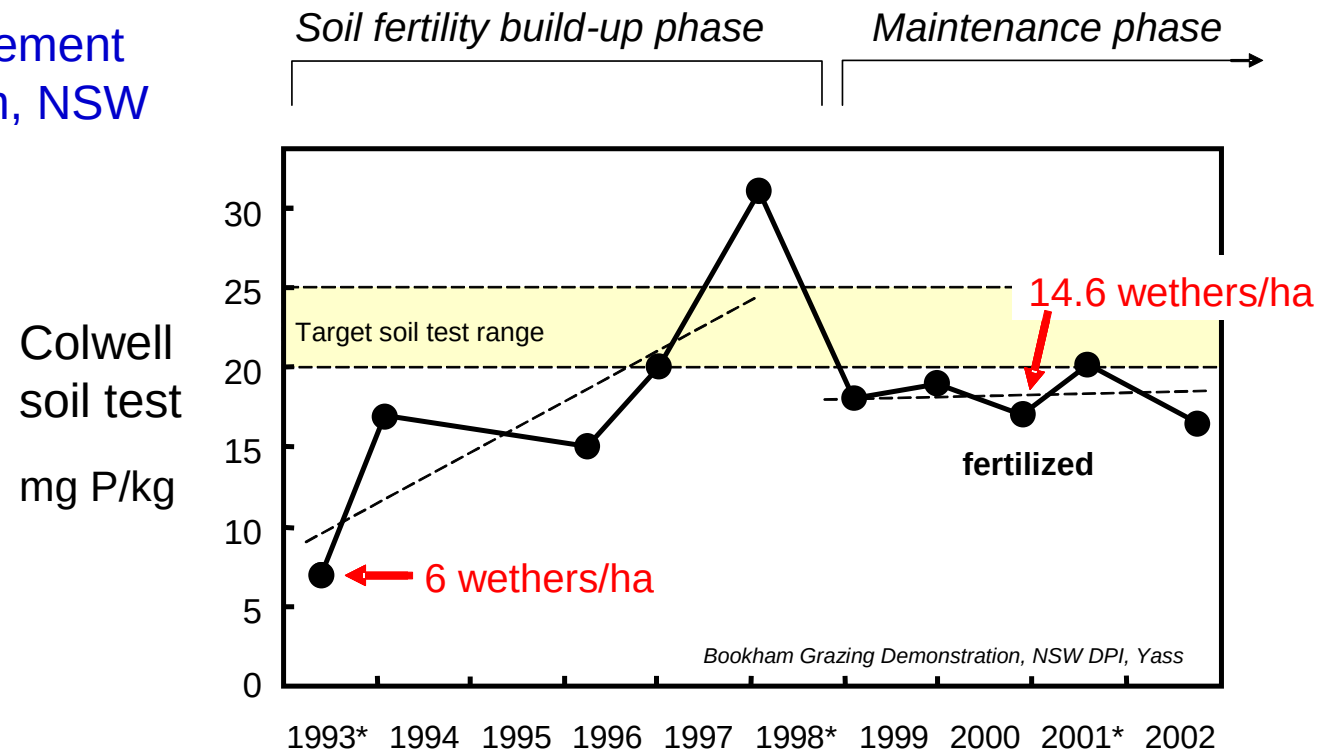
Total P applicn rate = 12.9 kg P/ha/yr

from: Burkitt *et al.* 2001; Burkitt *et al.* 2002).

Calculation predicts: Apply 143 kg superphosphate/ha/yr for 5 yrs,
then shift to maintenance applications of 107 kg super/ha/yr

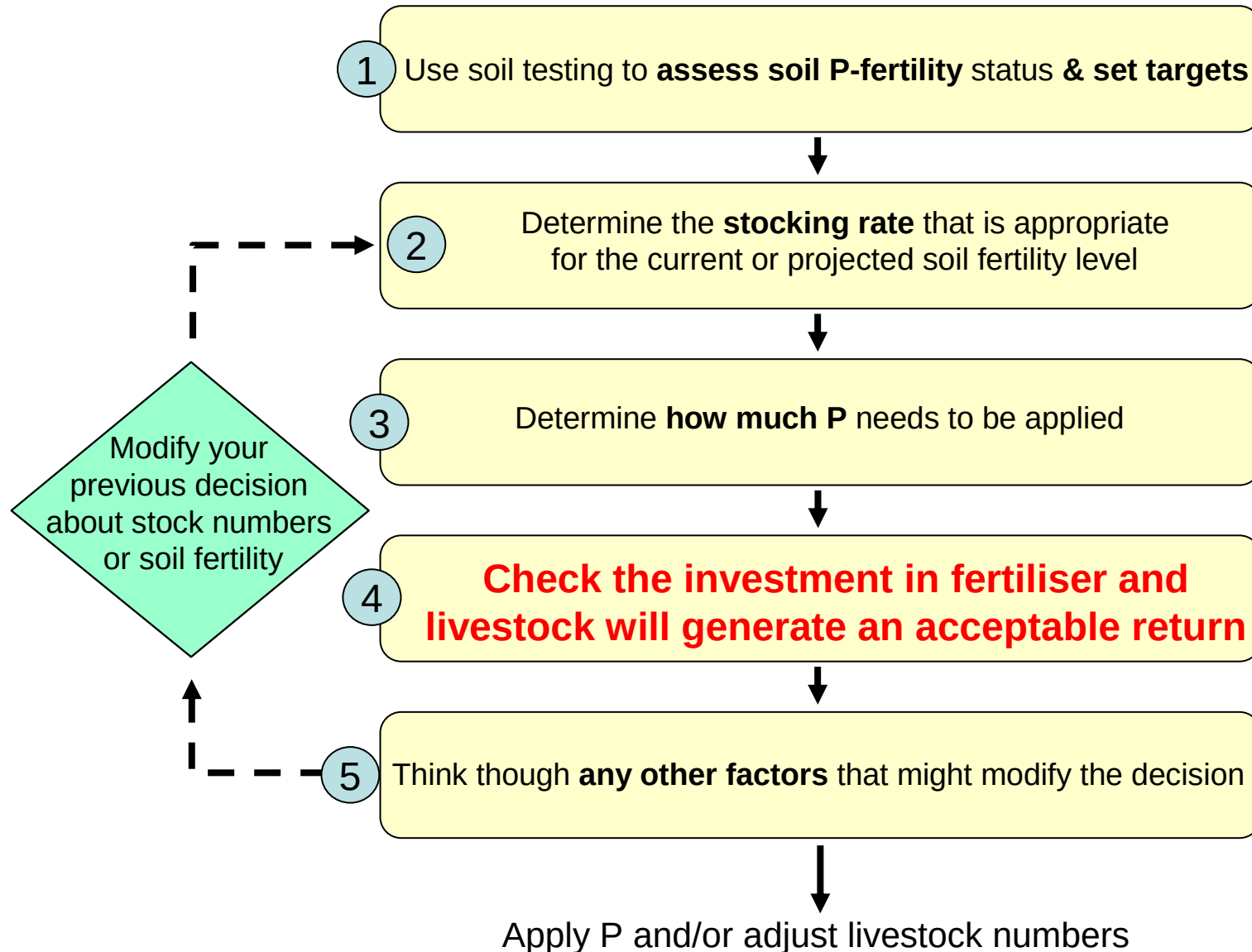
What actually happened: Average 150 kg superphosphate/ha/yr applied for 5 yrs,
then, average maintenance applications: 86 kg super/ha/yr

Soil P fertility management
at “Kia-Ora”, Bookham, NSW



How do you know that you got your calculation right?

Five Easy Steps



Step 4: Check the fertiliser and livestock investment using the cash flow tool

STEP 4: Cash flow analysis

Assumption: Existing pasture will repond to fertiliser and doesn't need rejuvenation.

Data entry (yellow cells)

Area of pasture (ha)

Timeframe - to achieve new soil fertility & stocking rate targets (years)

Step 1

Current soil P test (mg P/kg)

Critical soil test level for near maximum pasture growth (mg P/kg)

Preferred target for soil P management (mg P/kg)

Planned increase in soil P test (mg P/kg per year)

Step 2

Carrying capacity - current (DSE/ha)

Potential carrying capacity with optimal soil fertility (DSE/ha)

Carrying capacity - at preferred target for soil fertility management (DSE/ha)

Carrying capacity - yearly increase (DSE/ha)

Step 3

Current fertiliser rate (kg fertiliser/ha)

Fertiliser rate needed to increase soil P at required rate (kg/ha/yr)

Maintenance fertiliser rate at target carrying capacity (kg/ha/yr)

Step 4

Gross margin - current (\$/DSE)

Gross margin - projected (\$/DSE)

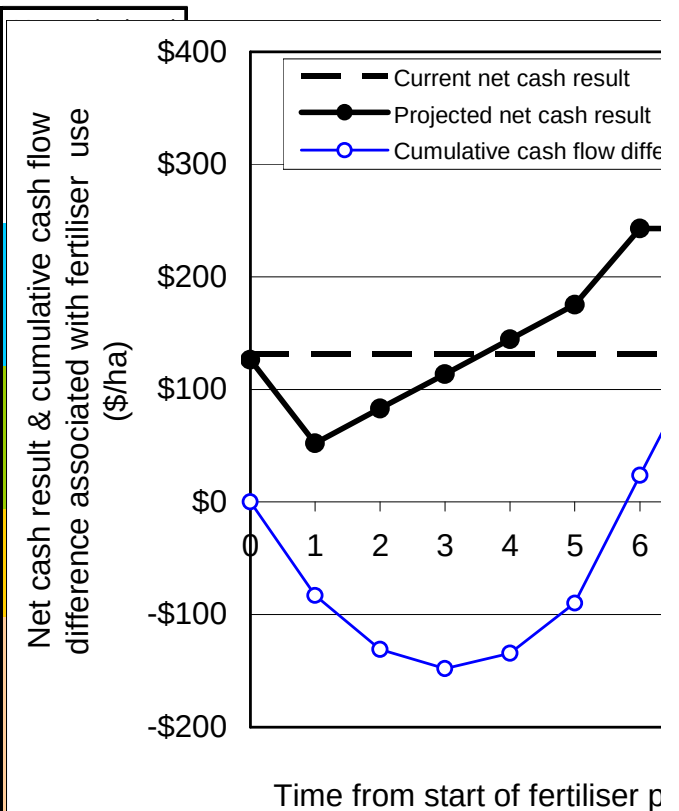
Capital cost of extra livestock (\$/DSE)

Fertiliser cost (\$/tonne)

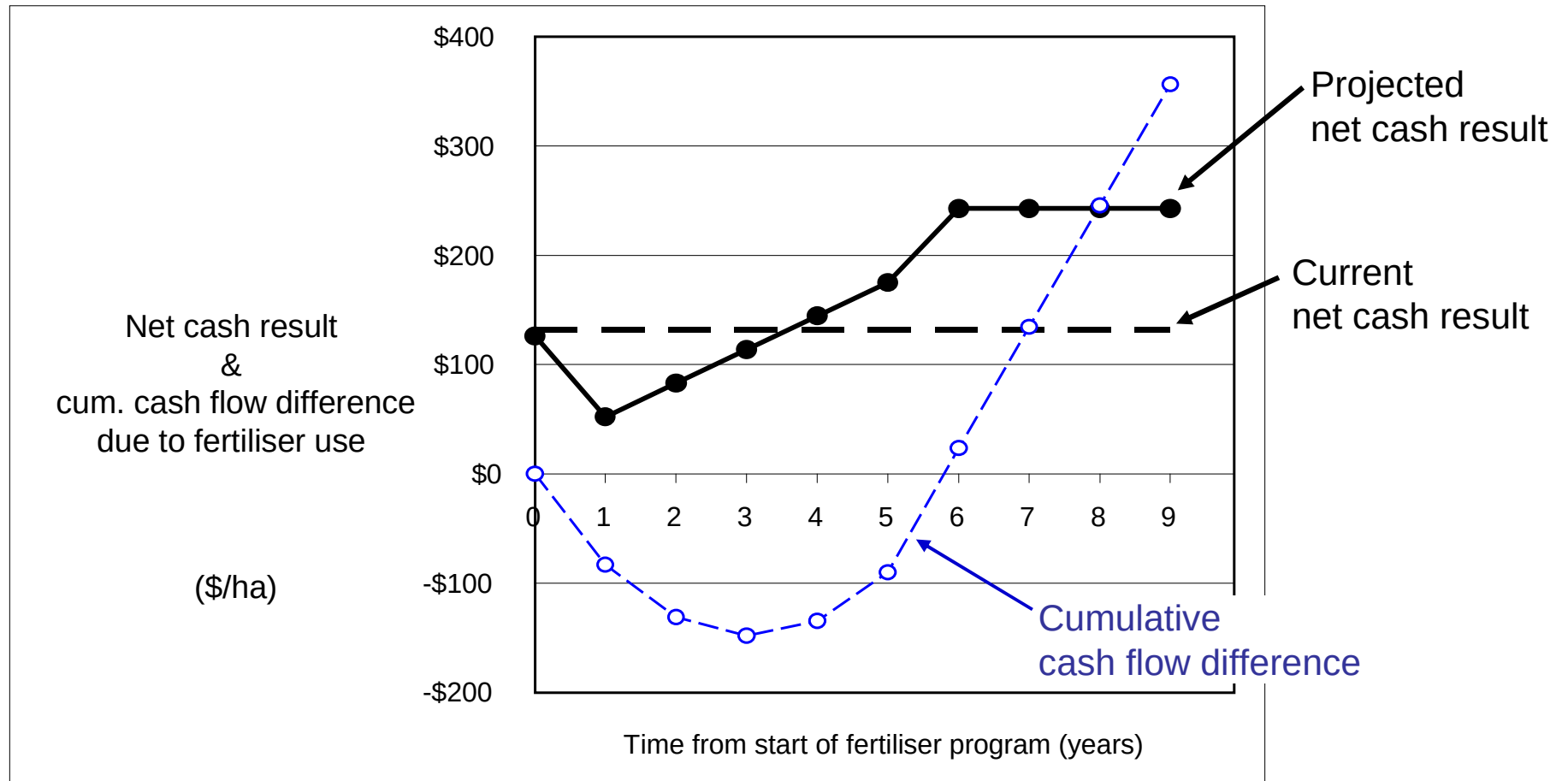
Fertiliser spreading cost (\$/ha)

Interest on debt (\$)

100
5
10
32
20
2
6
13.0
1.4
0
140
107
\$22.00
\$22.00
\$40.00
\$350.00
\$5.70
8%

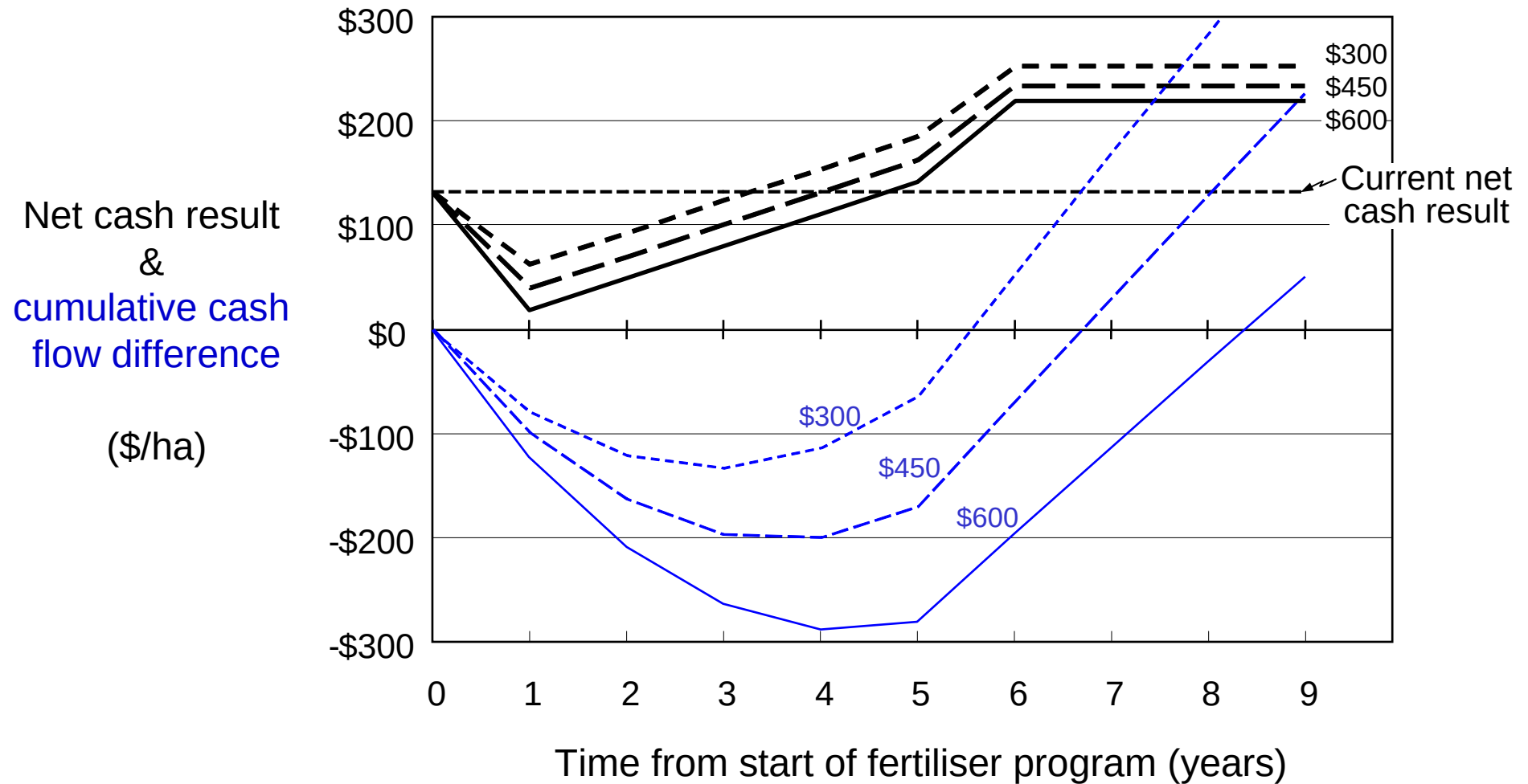


Cash flow results: 5-year soil fertility improvement program (Bookham, NSW)



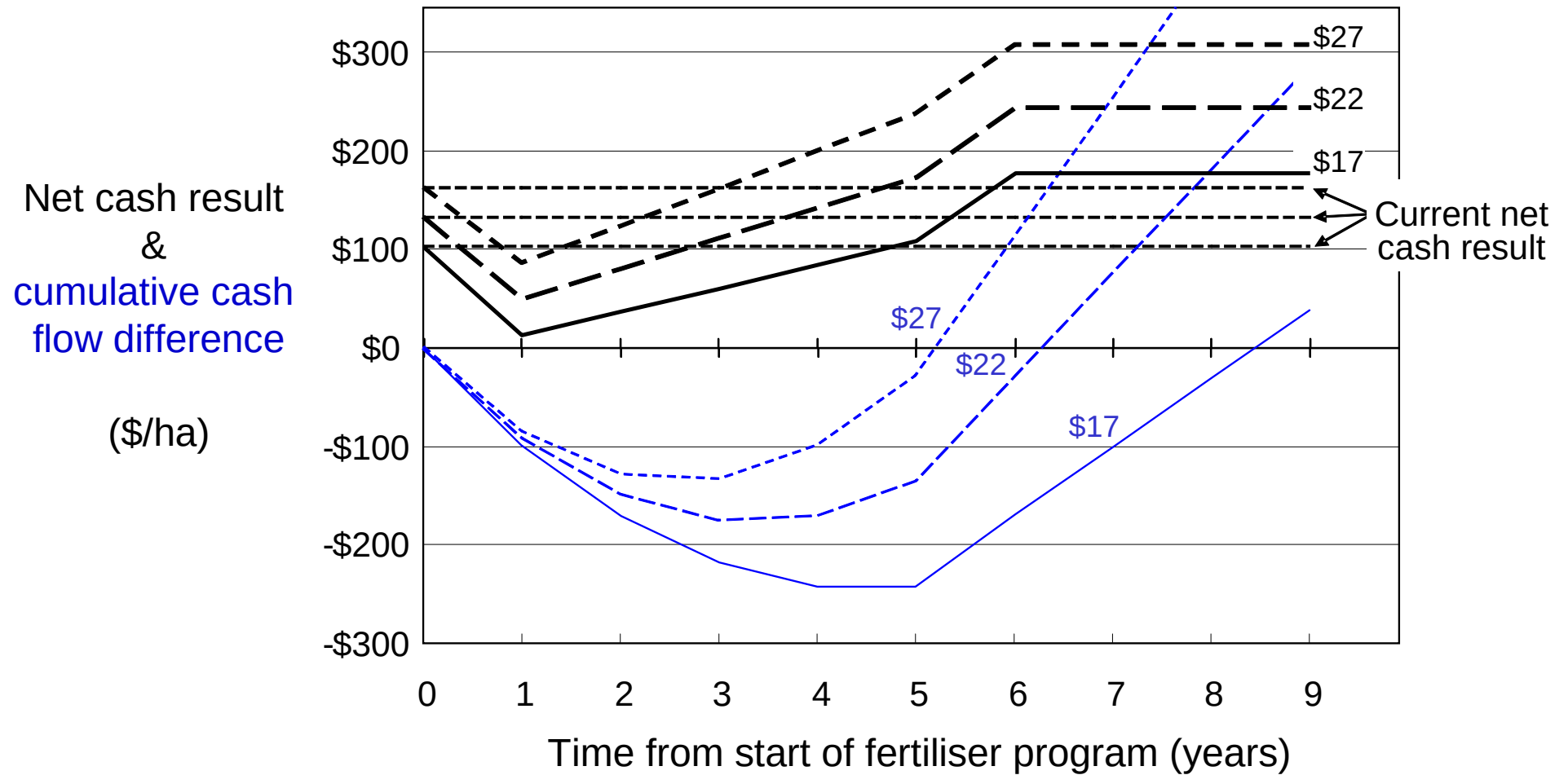
Using the cash flow tool to examine options

- *impact of changes in fertiliser price*

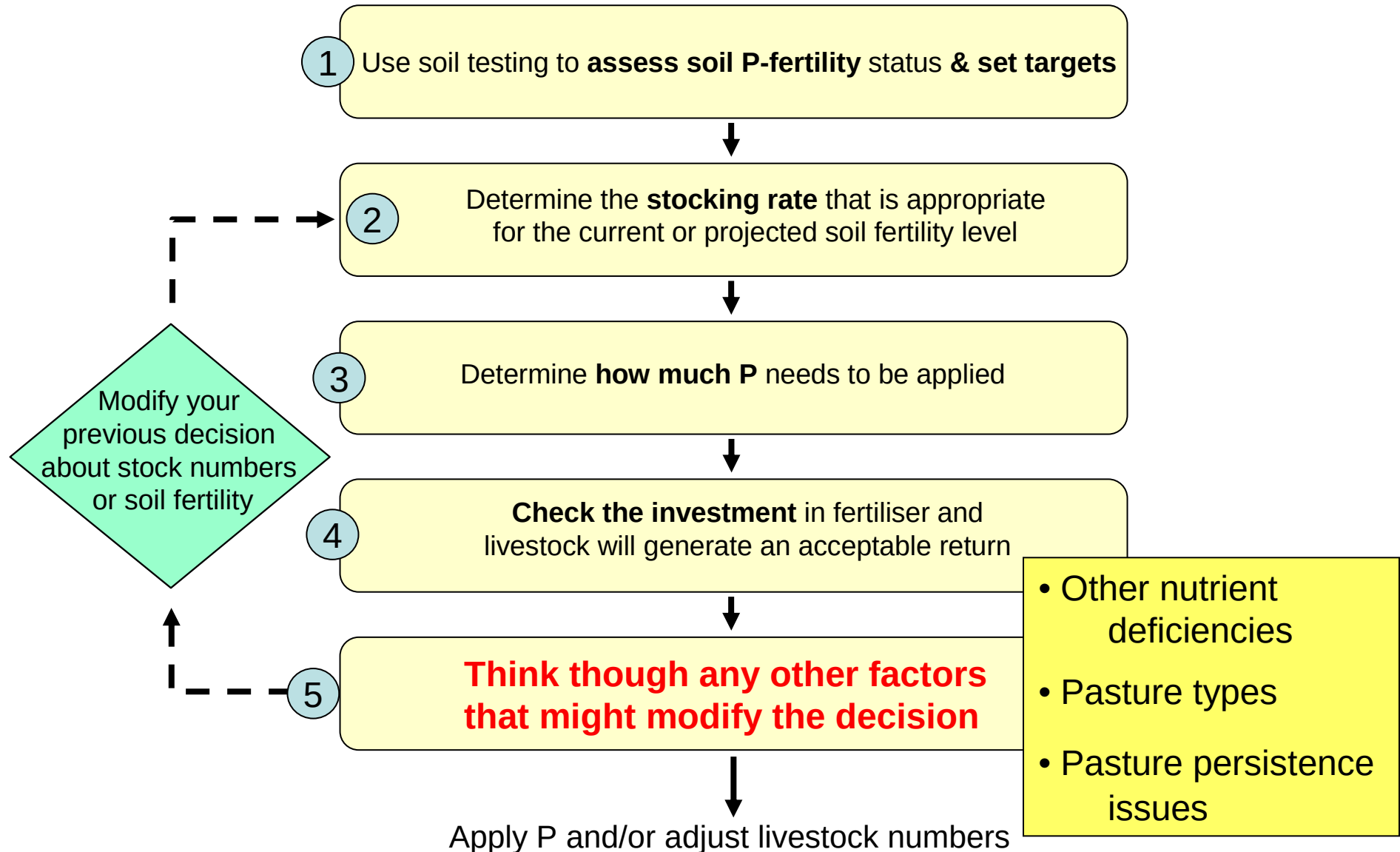


Using the cash flow tool to examine options

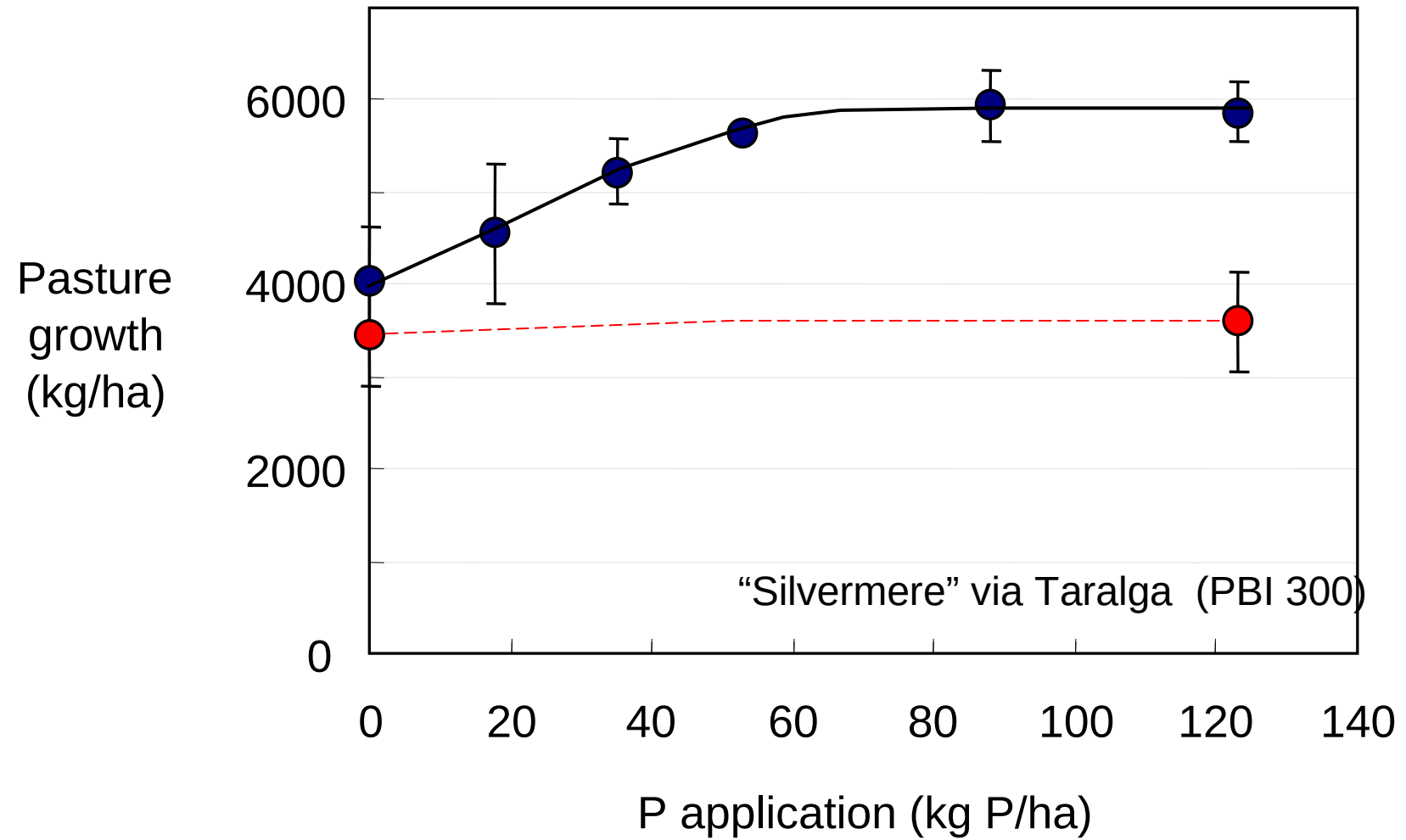
- *impact of sheep genetics (gross margin/DSE)*



Five Easy Steps



Other nutrient limitations?



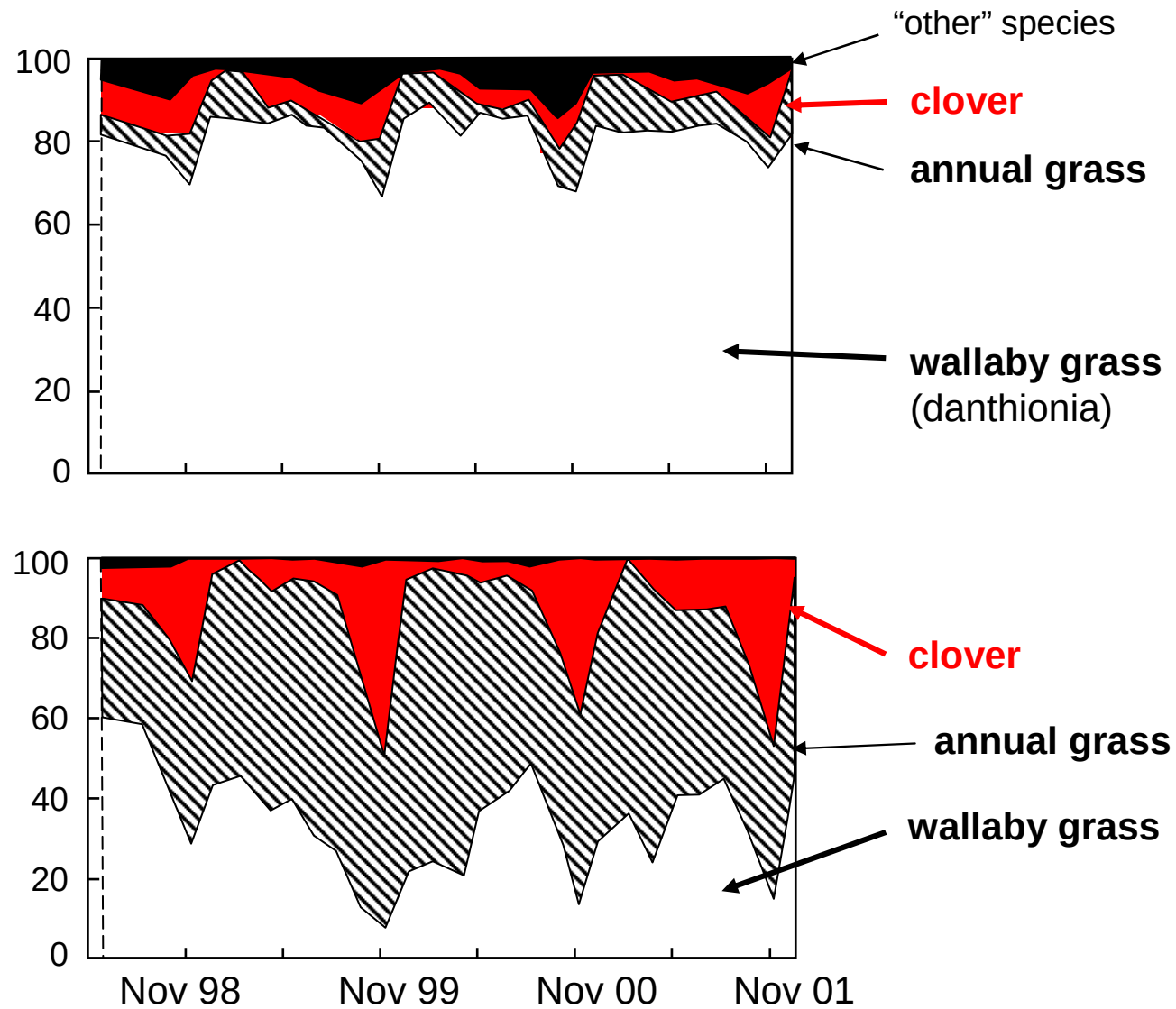
Pasture composition and resilience

Danthonia pasture: “Otterbourne”, Yass

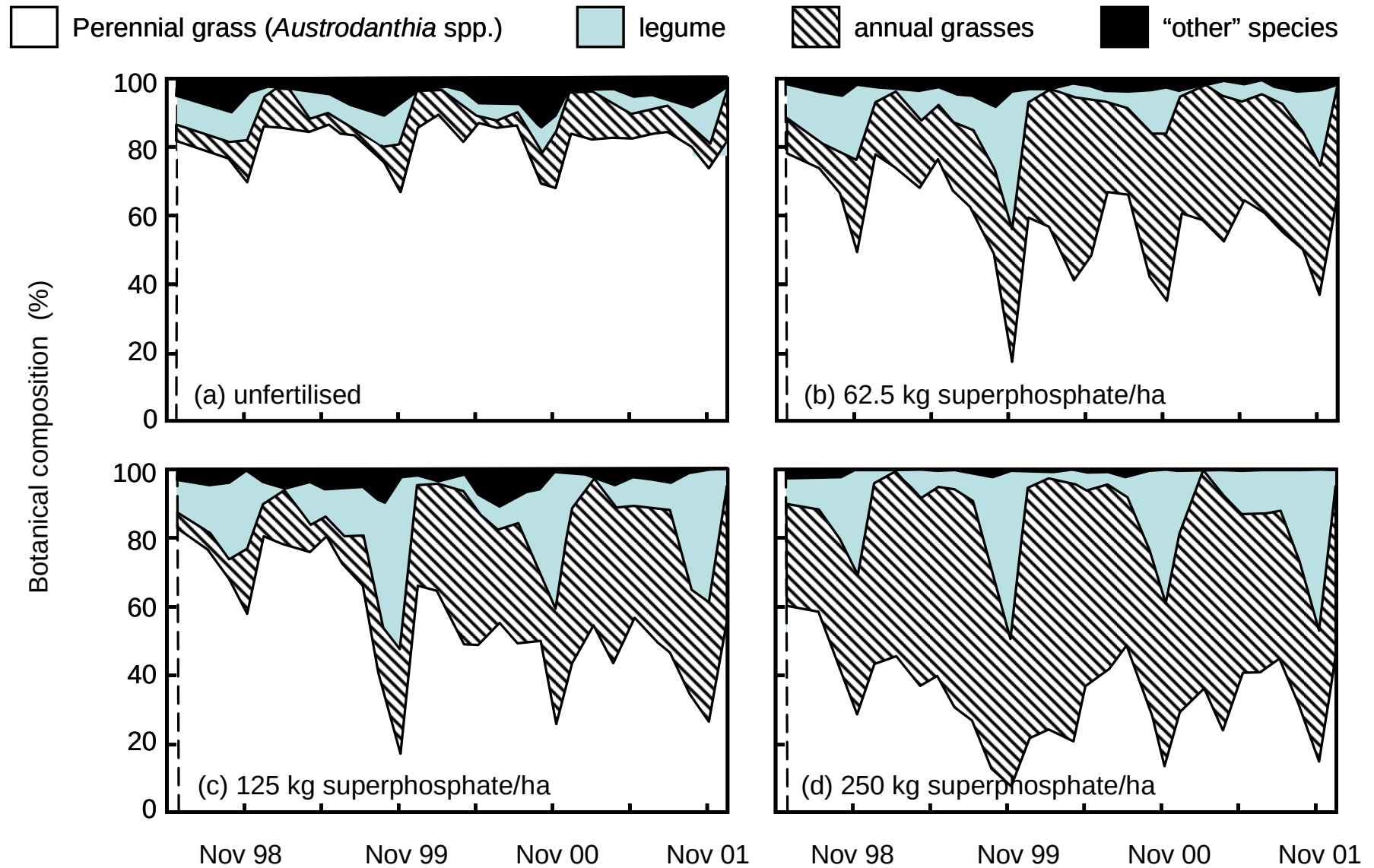
unfertilised
7.3 wethers/ha

Pasture
composition
(%)

250 kg super/ha/yr
13.6 wethers/ha



Danthonia pasture, "Otterbourne" north of Yass



(data from Garden and Bolger)

Other features of the **Five Easy Steps** guide

- Outlines the confidence we have in data supporting each step (*why?*)
- Discusses some alternative ways to check/estimate the parameters (*why?*)
- Outlines how and why P-fertiliser use can be modified after droughts
- Briefly outlines soil test methods and their practical application
- Farm scale planning for fertiliser use

Acknowledgements

The booklet and computer tool are a compilation of research results and knowledge generated by many people in Departments of Agriculture, CSIRO, and Universities across Australia.

Compiled by: Richard Simpson, Phillip Graham, Lloyd Davies and Eric Zurcher

Financial support:



Industry &
Investment



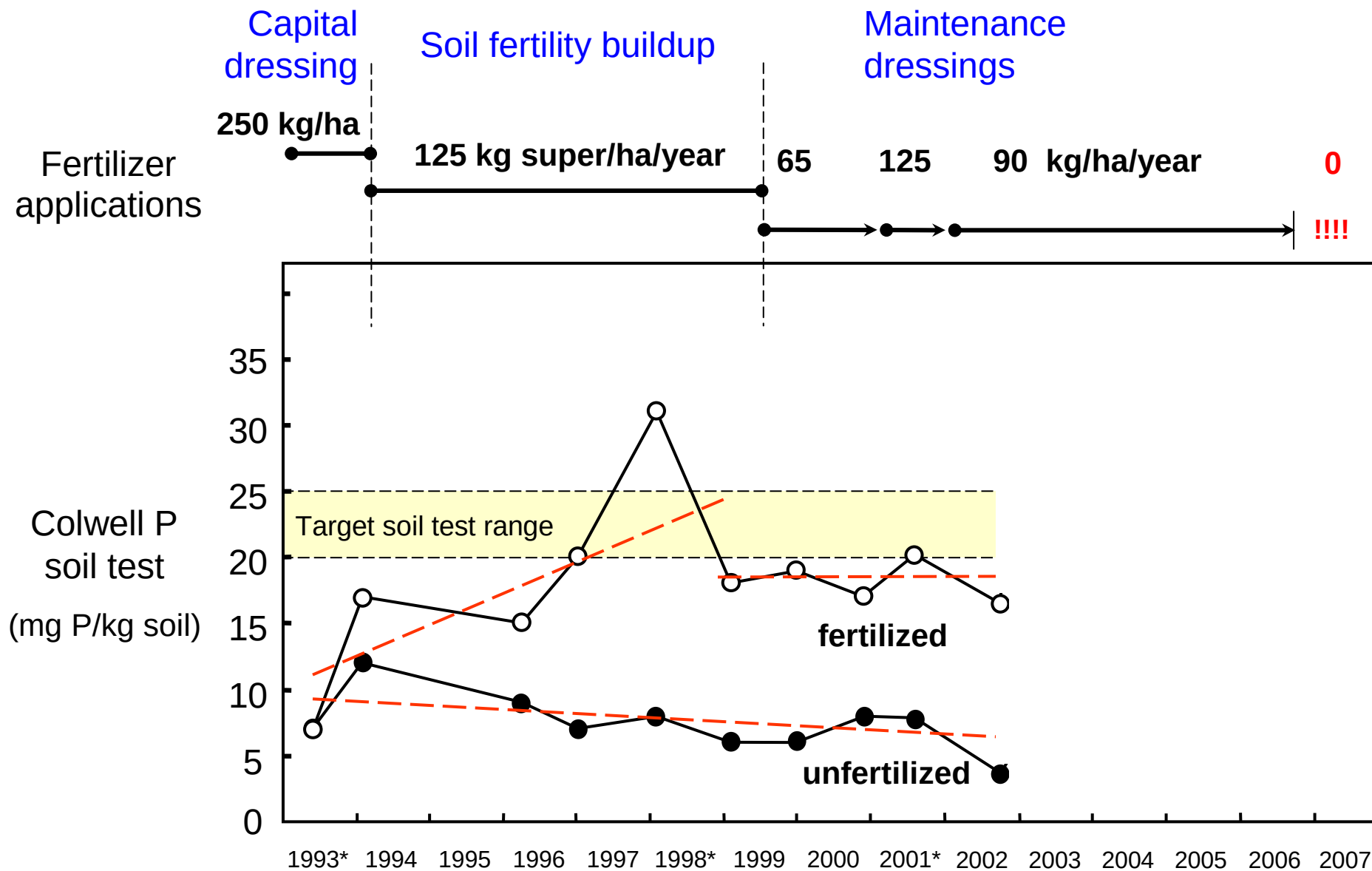
Australian Government
Rural Industries Research and
Development Corporation



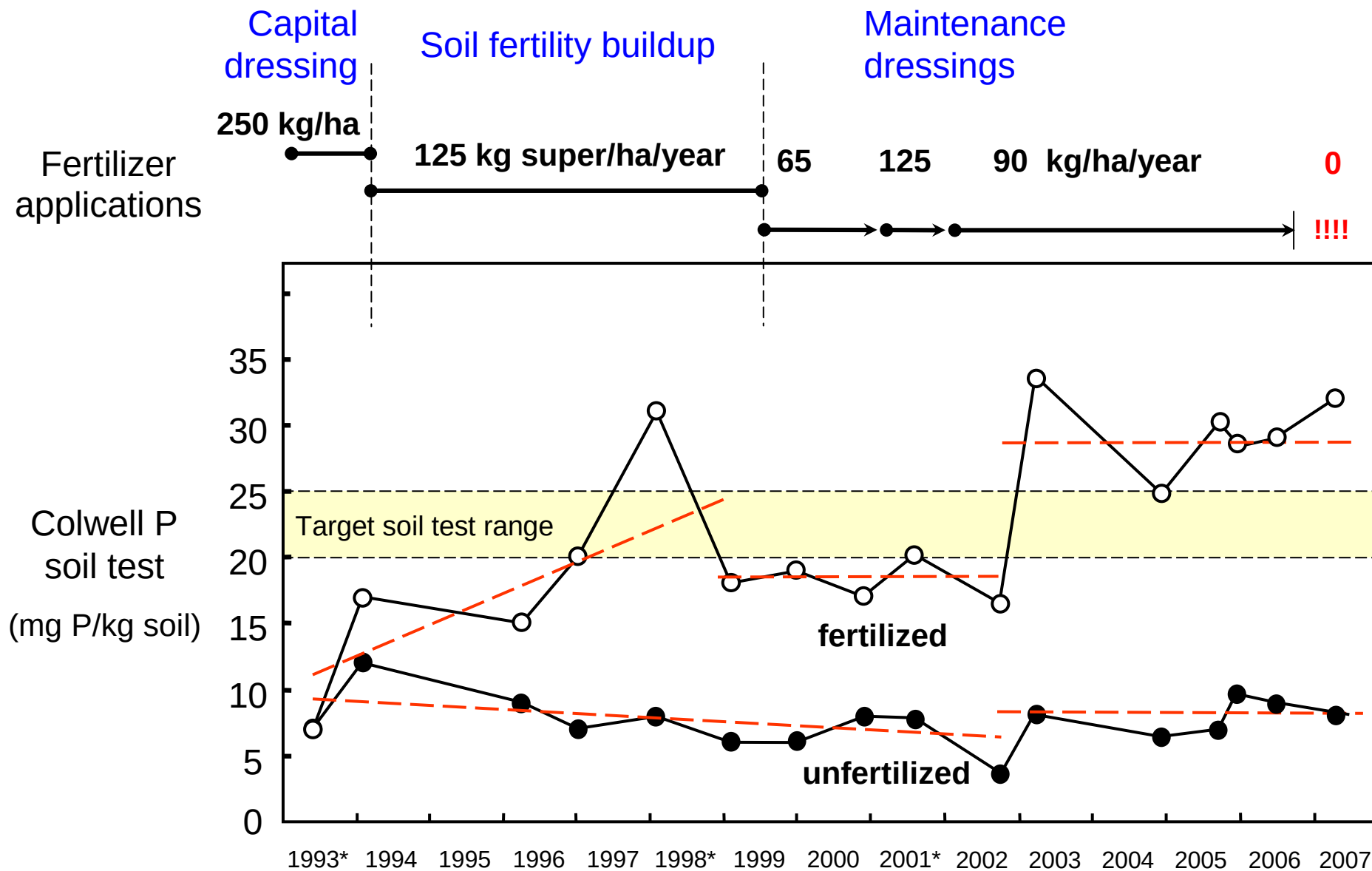
"Five Easy Steps" booklet and tool available for download from:
www.mla.com.au/nutrients



Drought and its impact on P management



* Mo-super applied in these years



* Mo-super applied in these years

How much fertiliser after a drought ?

- Drought means some P will remain unused in the soil
 - use a soil test to judge the amount of P that needs to be applied
- If stocking rate is **substantially** down, less P will be required
 - consider the stock numbers being carried and the soil P target required
..... adjust fertiliser applications according