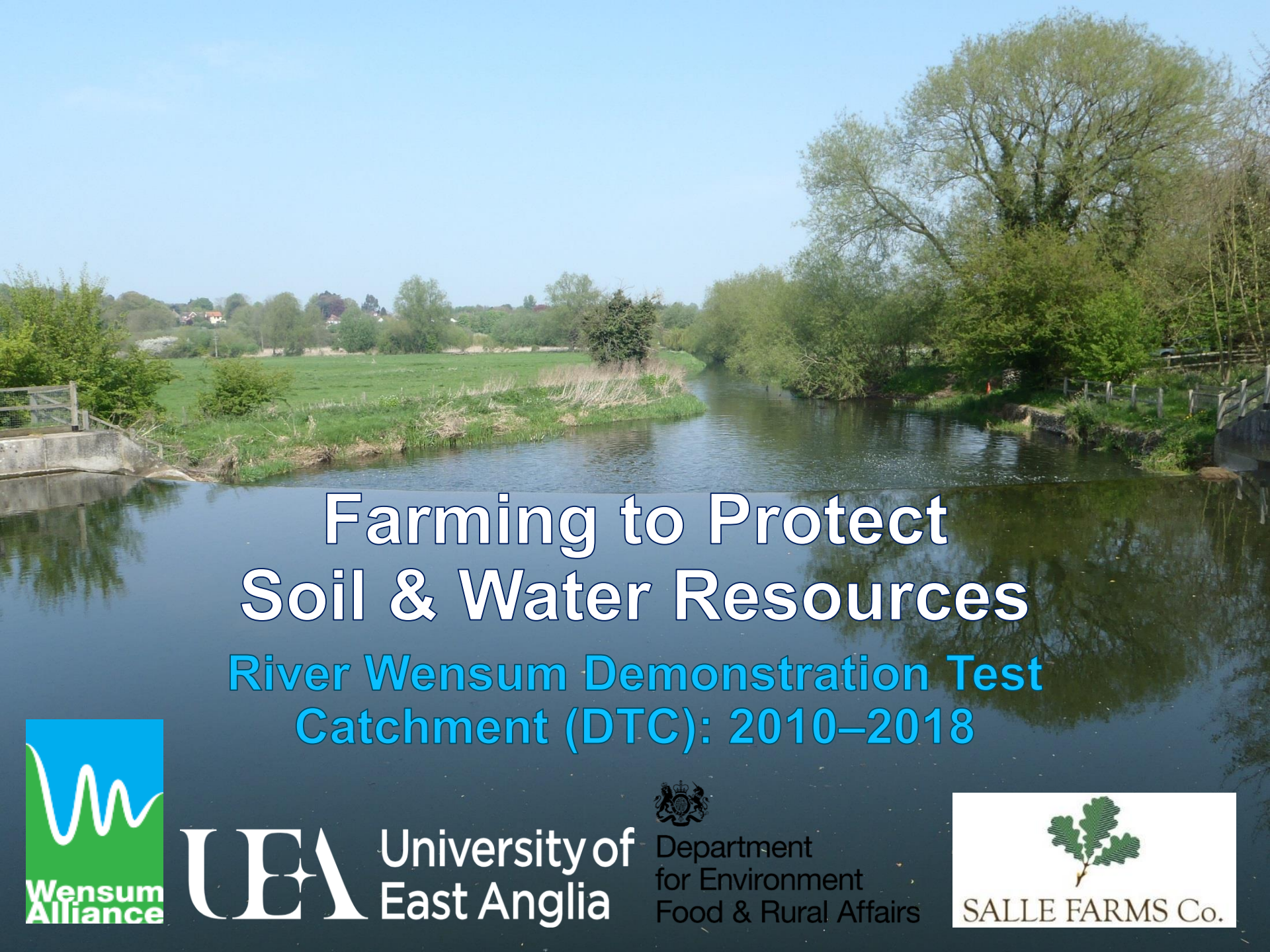


Farming to Protect Soil & Water Resources

River Wensum Demonstration Test Catchment (DTC): 2010–2018

Wensum Alliance

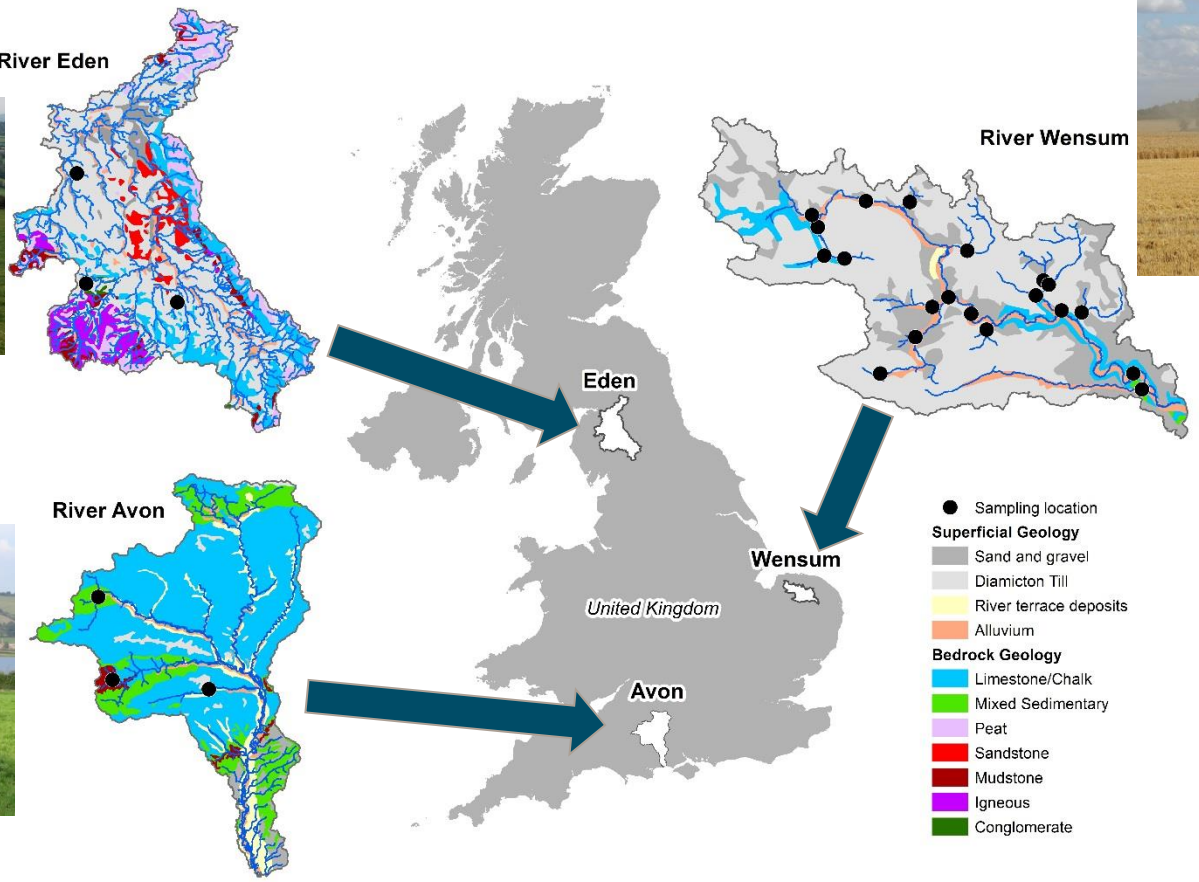
University of East Anglia

Department for Environment Food & Rural Affairs

SALLE FARMS Co.

Catchment Science Research

Demonstration Test Catchments (DTCs)



Investment
£12.3 m

Phase 1
2010 – 2014

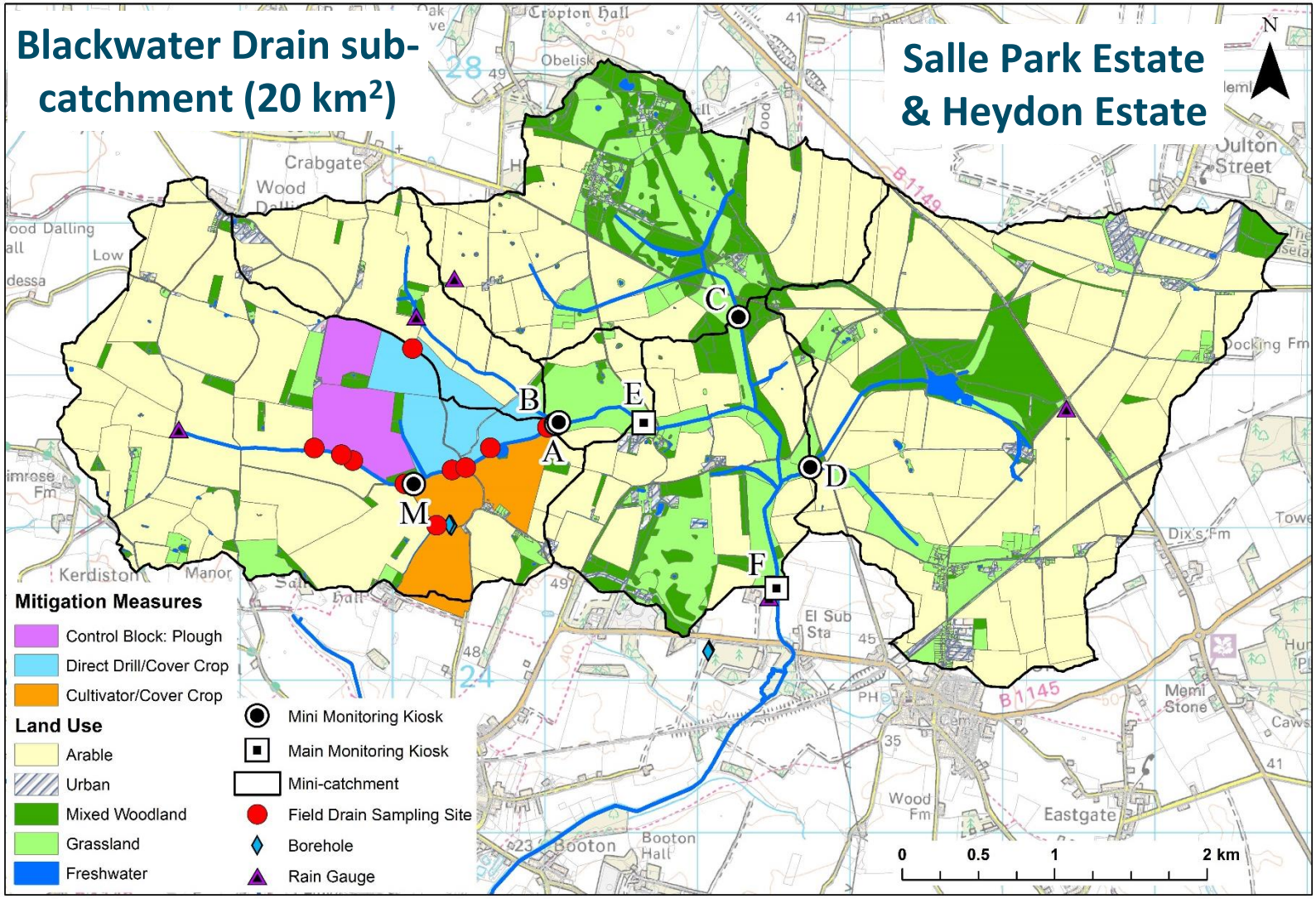
Phase 2
2014 – 2017

Phase 3
2017 – 2019

The DTC project aims to evaluate the extent to which on-farm mitigation measures can cost-effectively reduce the impacts of water pollution on river ecology while maintaining food production capacity.

Catchment Monitoring Programme

Wensum DTC study catchment



Catchment Monitoring Programme

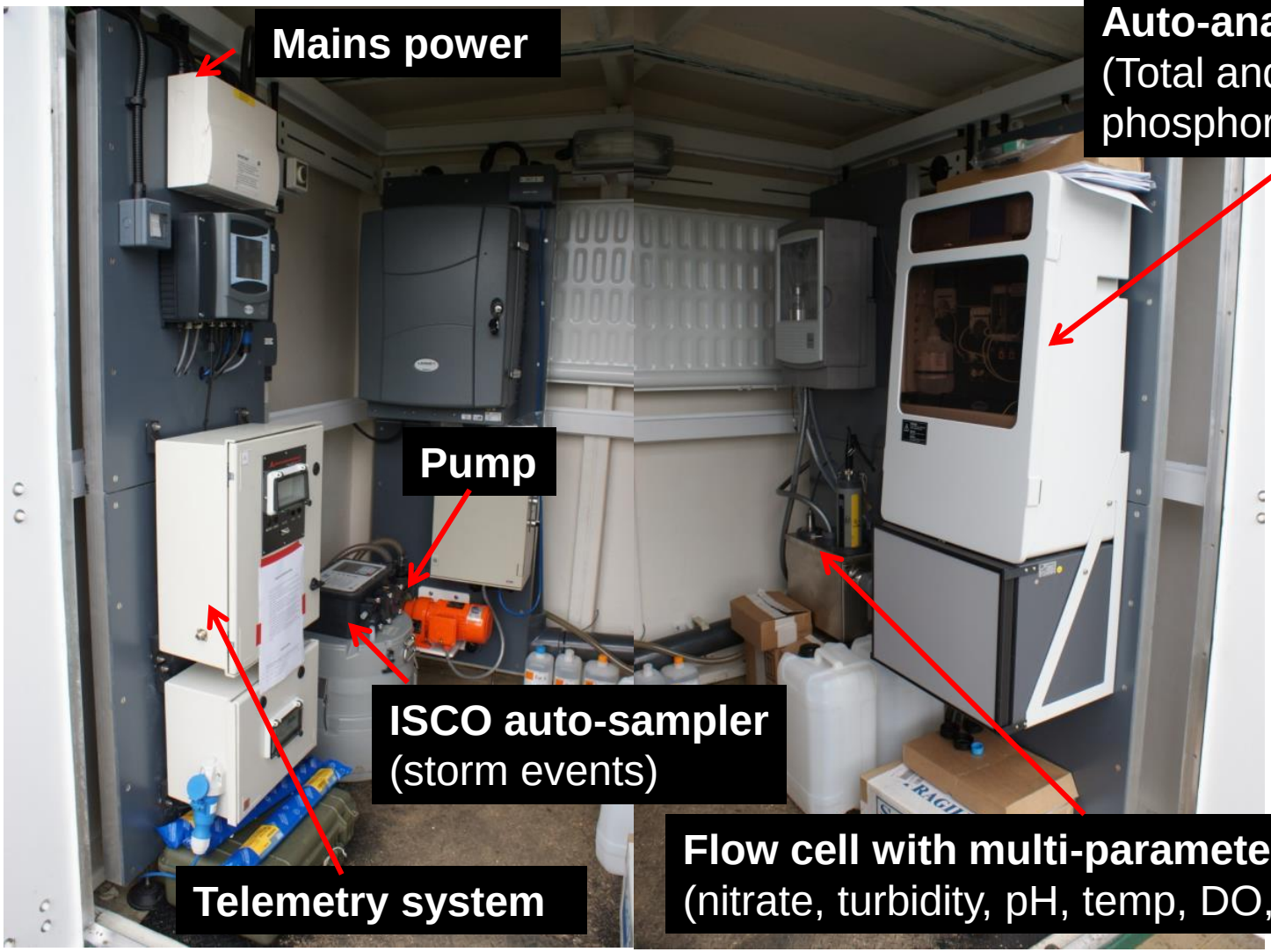
Riverine monitoring: bankside kiosks

METEOR COMMUNICATIONS
ESSENTIAL MONITORING SOLUTIONS

Catchment Monitoring Programme

Riverine monitoring: bankside kiosks

METEOR COMMUNICATIONS
ESSENTIAL MONITORING SOLUTIONS

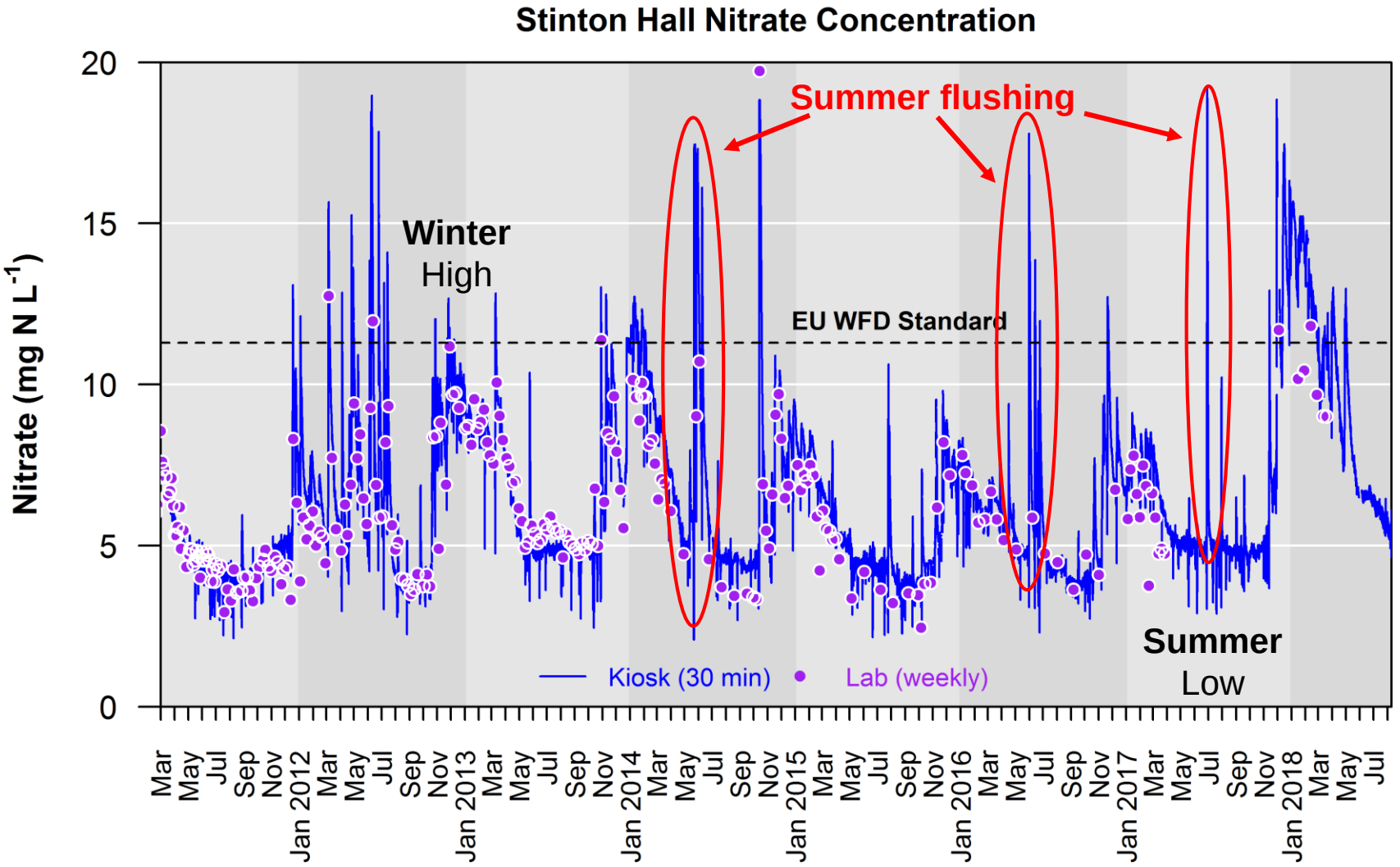


Cost per kiosk

£85k

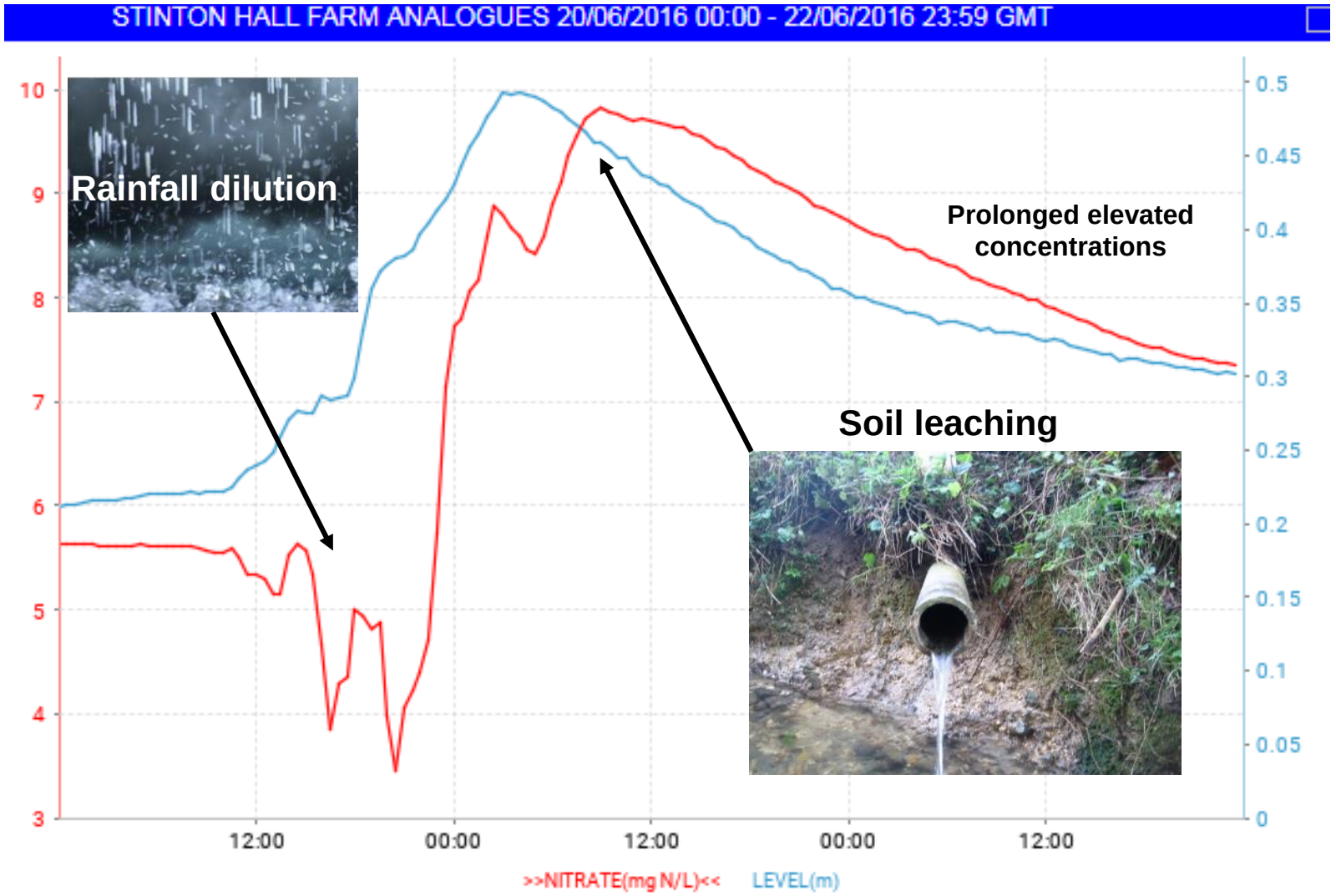
Catchment Monitoring Programme

Riverine monitoring: bankside kiosks



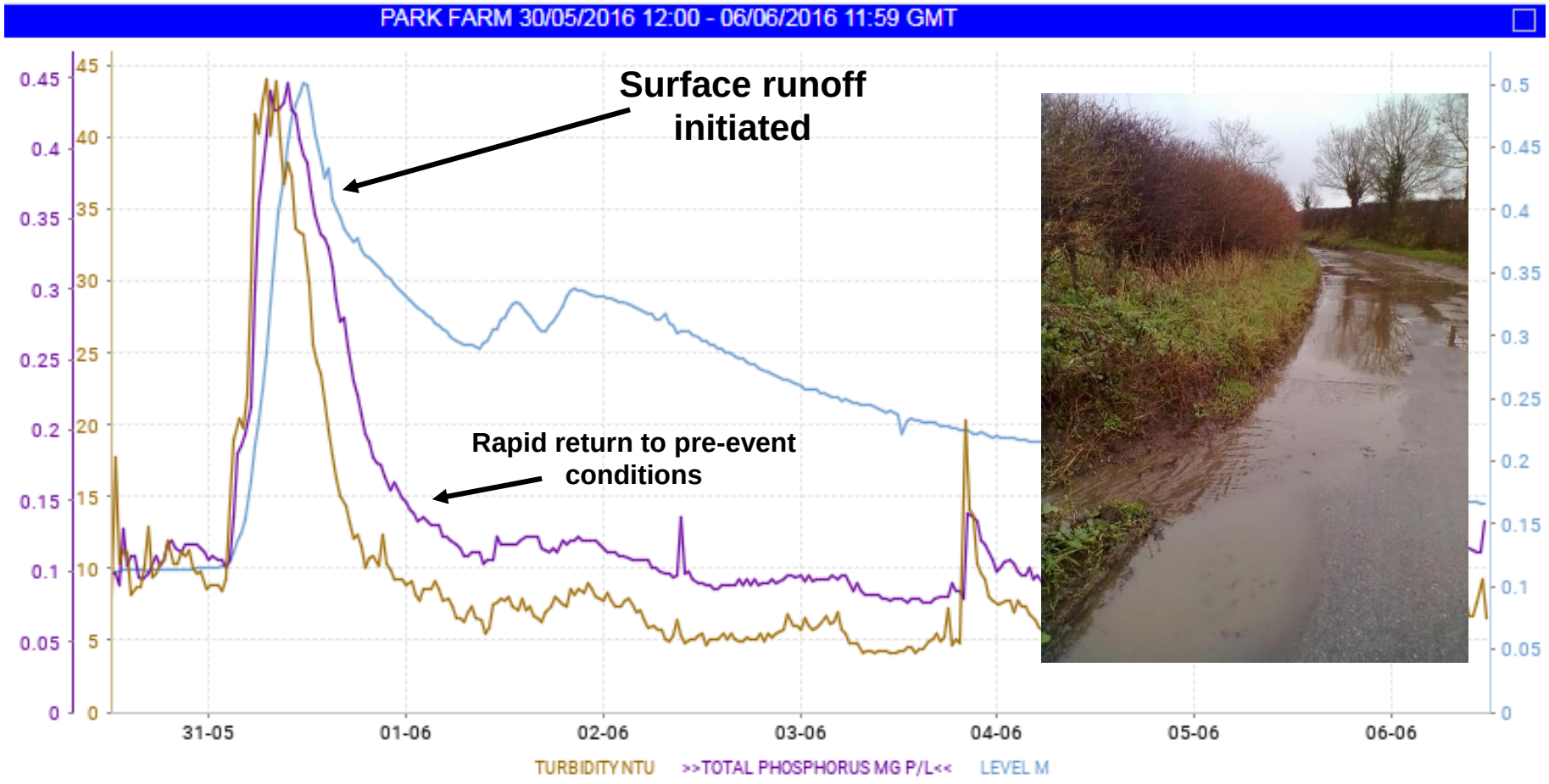
Catchment Monitoring Programme

Riverine monitoring: nitrogen



Catchment Monitoring Programme

Riverine monitoring: phosphorus and sediment



Salle Farms Company

SALLE FARMS Co.
Helping to lead modern farming technology

2500 ha arable

Property, Christmas trees and grain handling facility

Crush Foods

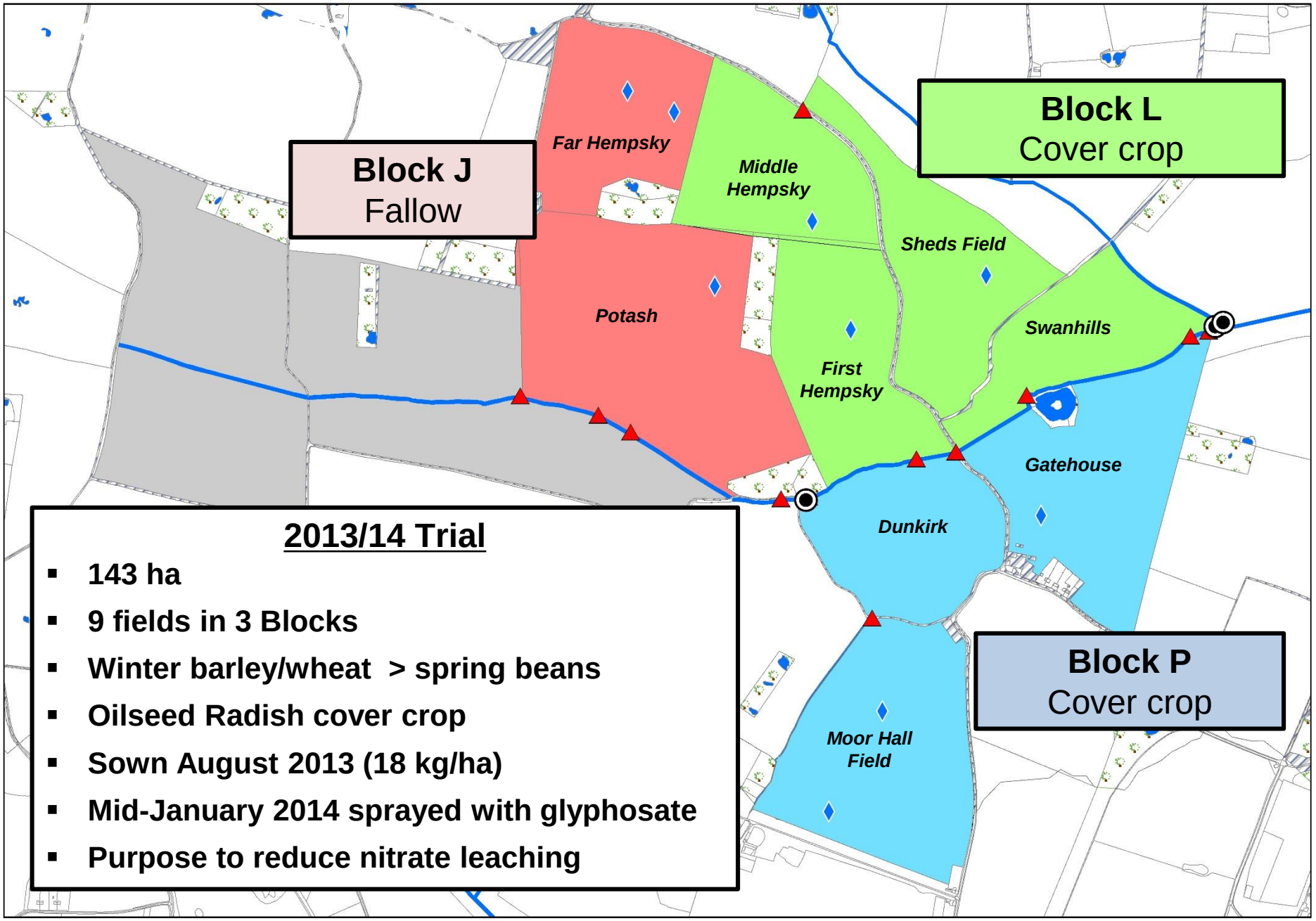
Poul Hovesen
Estate Manager

Seven year crop rotation begun in mid-1990s – cultivation system as of **2012**

	Crop 1	Crop 2	Crop 3	Crop 4	Crop 5	Crop 6	Crop 7
Organic Manure		Limex 70 + Turkey Manure				Limex 70	
First Preparation	Plough	Plough	Stubble Cutter	Plough	Plough	Plough	
Weed Control			Glyphosate				
Second Preparation	Press followed by NZA	Press followed by NZA	Discordon followed by NZA	NZA Springtine Cultivator	Press followed by NZA	NZA Springtine Cultivator	Discordon
Drilling	Rapid	Rapid	Rapid	Compactor / Precision Drill	Rapid	Rapid	Rapid
Planted Crop	**Winter Barley**	**Winter Oilseed Rape**	**Winter Wheat**	**Sugar Beet**	**Winter Wheat / Spring Barley**	**Spring Beans**	**Winter Wheat**

Nutrients | Sediment | Pesticides | Soil

Nutrients: Winter Cover Crops



2013/14 Trial

- 143 ha
- 9 fields in 3 Blocks
- Winter barley/wheat > spring beans
- Oilseed Radish cover crop
- Sown August 2013 (18 kg/ha)
- Mid-January 2014 sprayed with glyphosate
- Purpose to reduce nitrate leaching

Winter Cover Crops

Trial 1: November 2013

Block J

Block P

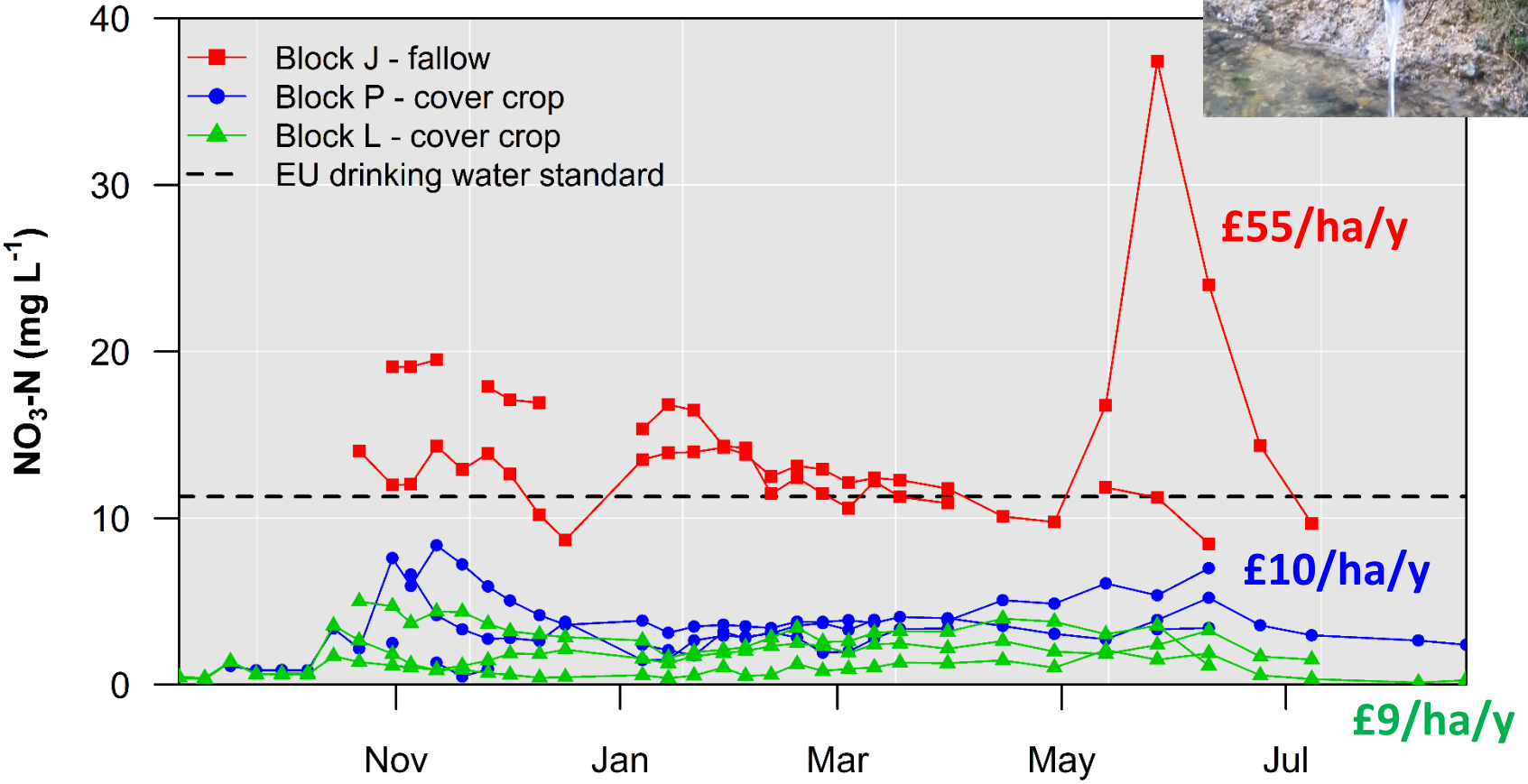
Block L

Winter Cover Crops

Field Drain Monitoring

P = **75%** reduction in N losses

L = **88%** reduction in N losses



Winter Cover Crops

Economics: Farm returns

First Cover Crop Trial in Winter 2013/2014

	Block J	Block P	Block L
	Fallow	**Cover crop**	**Cover crop**
Gross output beans: Yield (t/ha)	5.80	6.55	6.24
Output at £260/t (£/ha)	**1334**	**1435**	**1506**
Costs: Establishment (£/ha)	96	128	67
Applications (£/ha)	90	120	120
Variable costs (£/ha)	318	415	432
Harvesting (£/ha)	85	85	85
Total costs (£/ha)	**589**	**704**	**748**
Margin (£/ha)	**745**	**731**	**758**

Output **+ 8-12%** with a cover crop

Costs **+ £120–160/ha** with cover crop

Acknowledgement: Data supplied by Salle Farms Co.

Winter Cover Crops

Economics: Farm returns

Second Cover Crop Trial in Winter 2015/2016

	Block 1	Block 1	Block 2	Block 2
	Spring Beans		Sugar Beet	
	Fallow	Cover crop OS Radish	Fallow	Cover crop mixture
Gross output: Yield (t/ha)	5.9	4.7	64.3	85.6
Bean output @ £230/t (£/ha)	1,355	1,090		
Beet Output @ £25/t (£/ha)			1,606	2,141
Costs: Establishment (£/ha)	107	143	158	147
Applications (£/ha)	94	85	105	102
Variable costs (£/ha)	293	338	562	592
Harvesting (£/ha)	85	85	200	200
Total costs (£/ha)	580	650	1,025	1,041
Margin (£/ha)	775	440	581	1,100

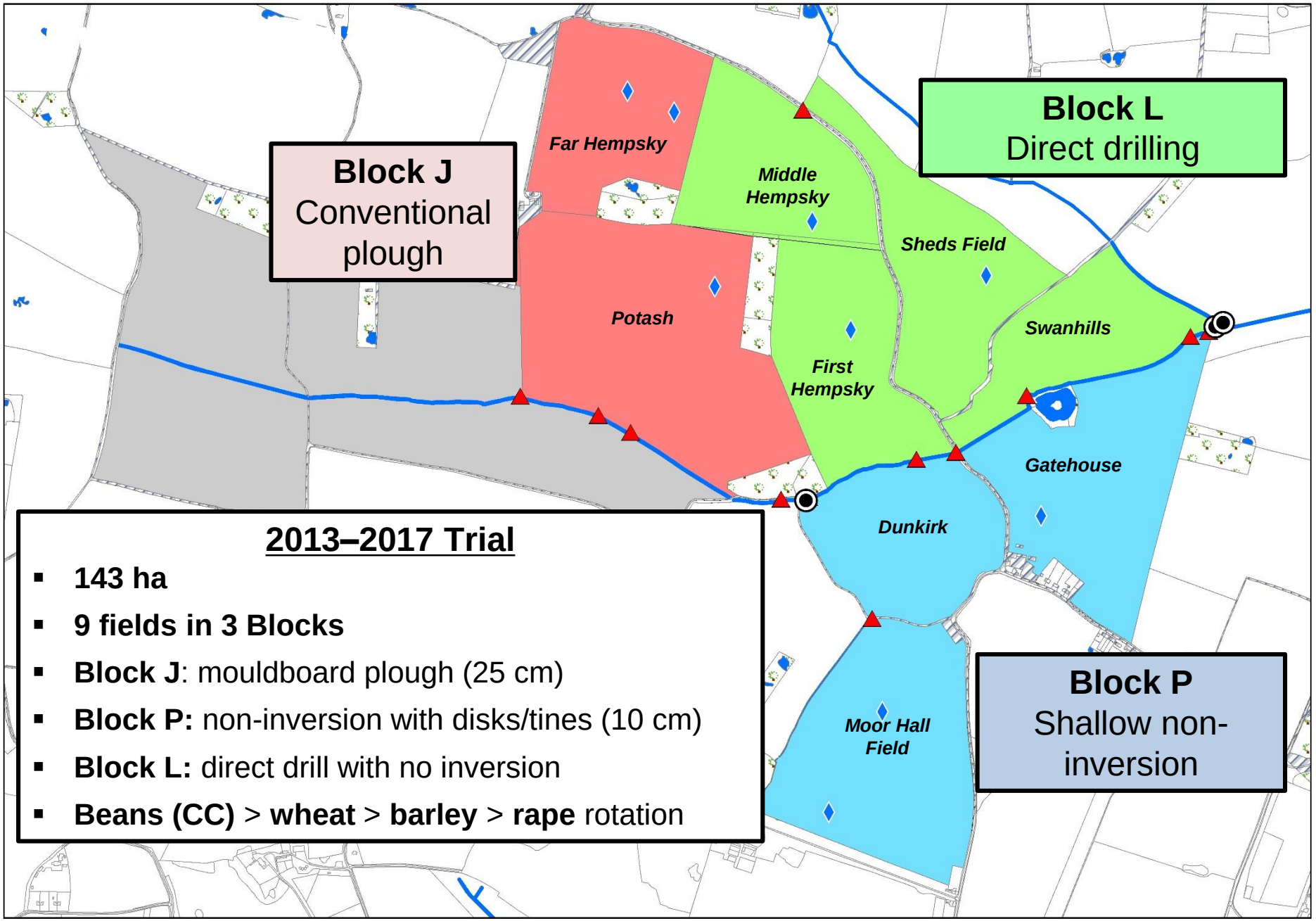
Sugar beet yield **+33%**

£16 higher

£519 higher

Acknowledgement: Data supplied by Salle Farms Co.

Soil Improvement: Reduced Tillage



2013–2017 Trial

- **143 ha**
- **9 fields in 3 Blocks**
- **Block J**: mouldboard plough (25 cm)
- **Block P:** non-inversion with disks/tines (10 cm)
- **Block L:** direct drill with no inversion
- **Beans (CC)** > **wheat** > **barley** > **rape** rotation

Reduced Tillage

Agricultural Equipment

Cultivation

Block J: mouldboard plough

Block P: TopDown + Carrier (non-inversion)

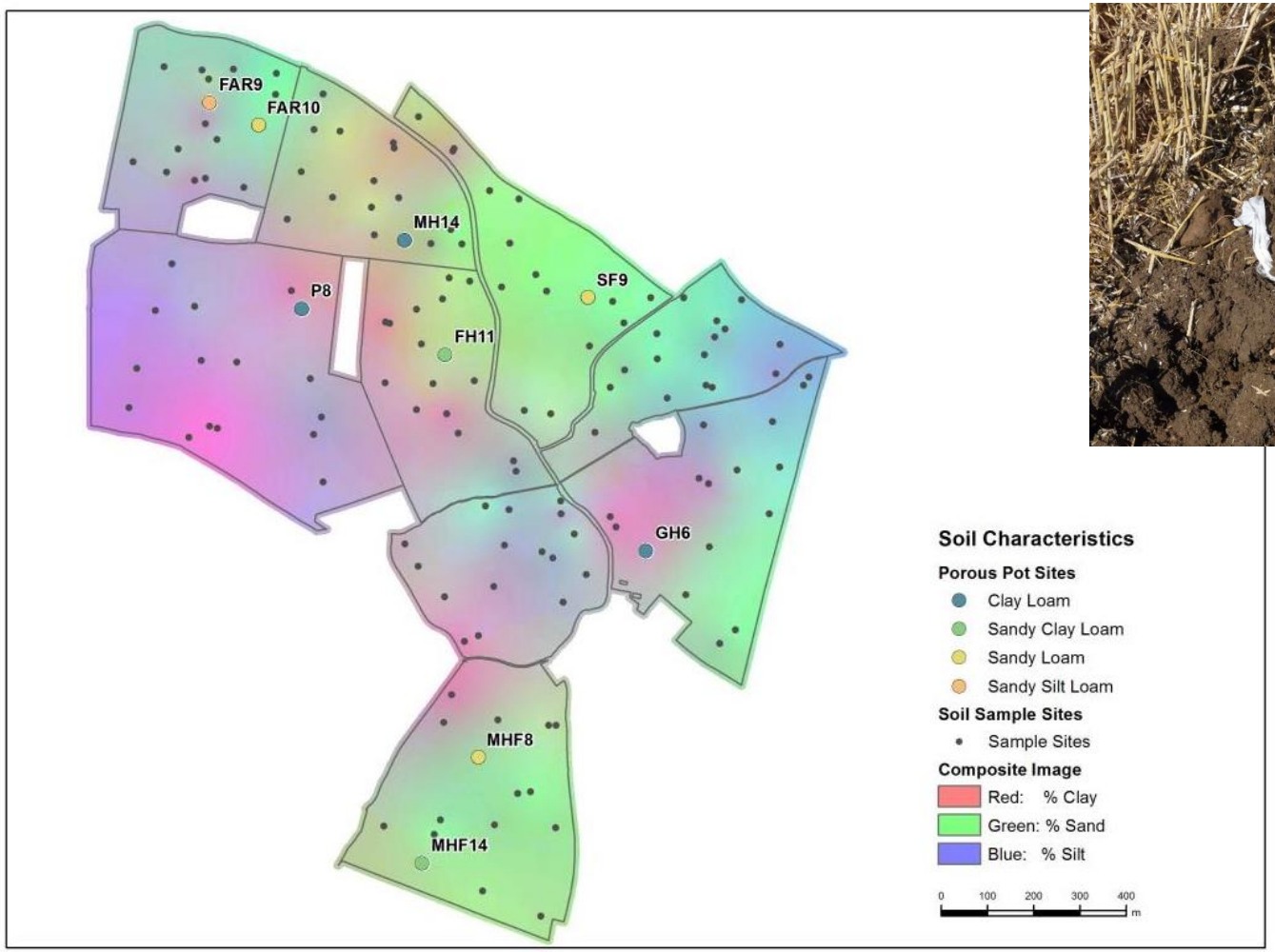
Sowing

Blocks J + P: Rapid drill

Block L: Seed Hawk direct drill

Reduced Tillage

Soil assessments

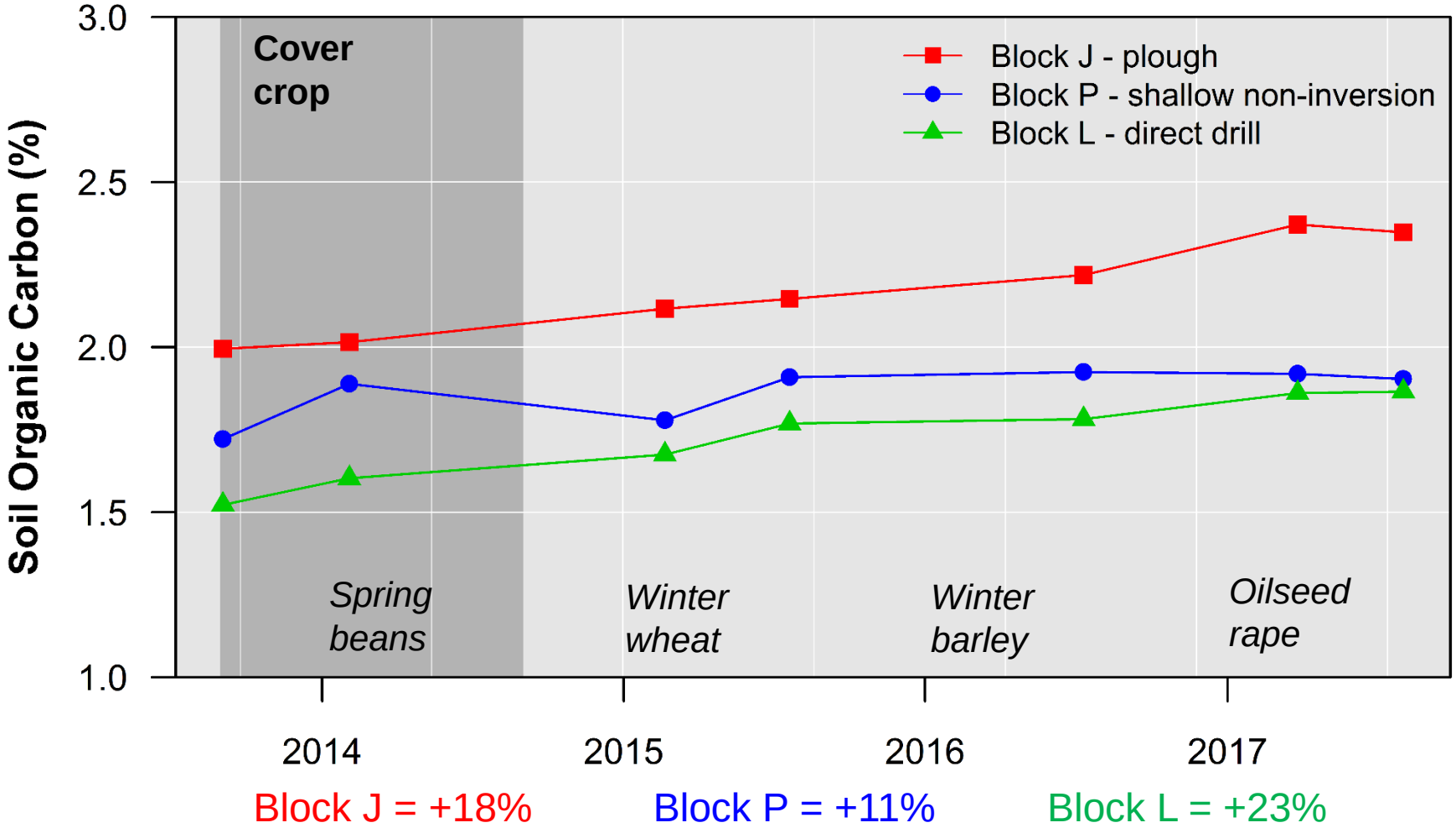


- Soil texture
- Soil structure
- Infiltration rate
- Bulk density
- SMN
- P, K, Mg indices
- OC content
- Soil biology

Aim: to assess the physical, chemical and biological condition of the soils

Reduced Tillage

Soil Chemistry: Organic Carbon



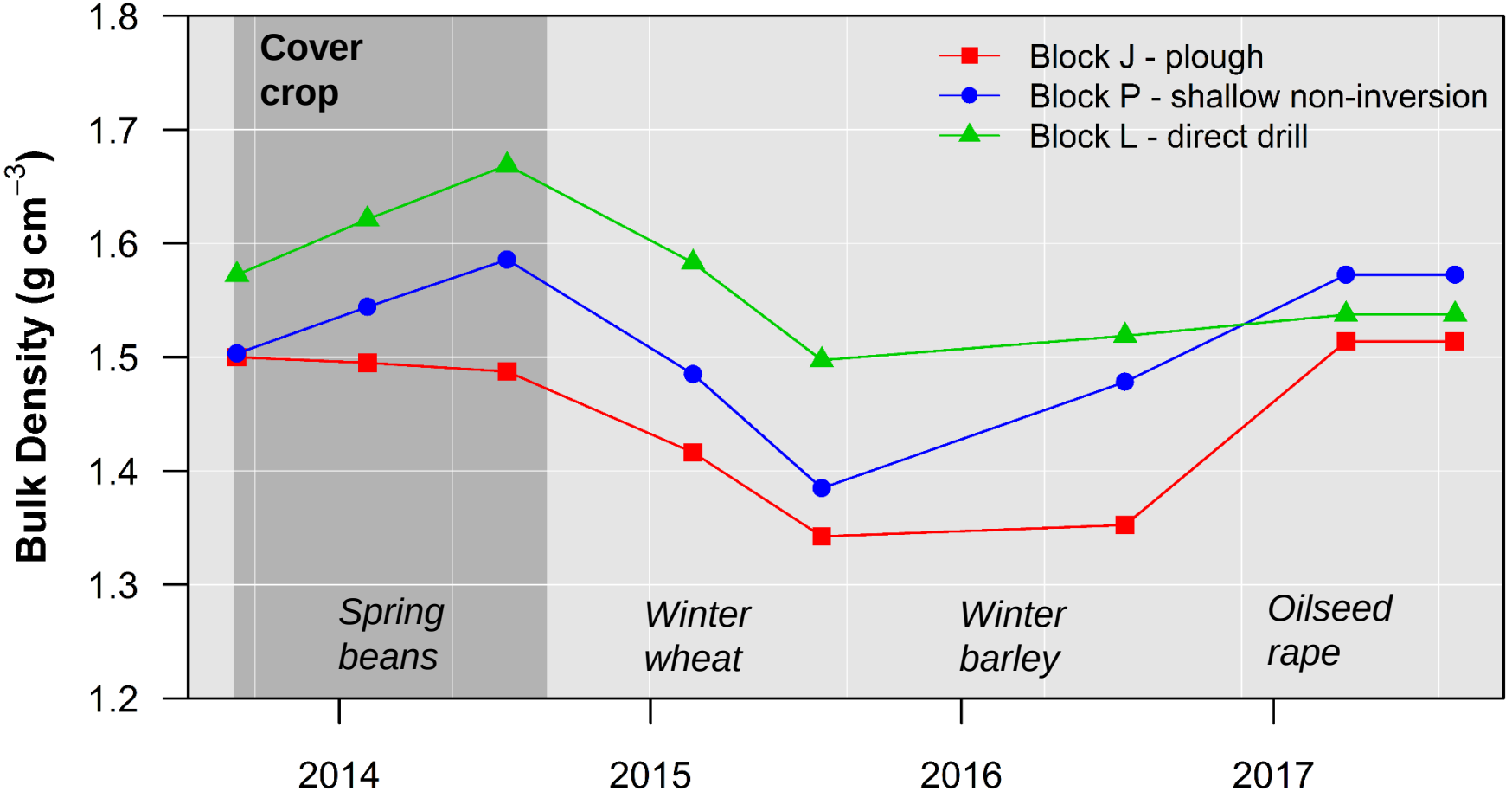
Block J = +18%

Block P = +11%

Block L = +23%

Reduced Tillage

Soil Structure: Bulk Density



Reduced Tillage

Economics: Farm Returns

		2013/14	2014/15	2015/16	2016/17
		Spring beans + CC	Winter wheat	Winter barley	Oilseed rape
Block J	Total cost (£/ha)	589	784	561	600
Plough	Output (£/ha)	1,334	1,694	1,086	1,734
	Margin (£/ha)	**745**	**910**	**525**	**1,134**
Block P	Total cost (£/ha)	748	782	581	553
Shallow non-inv.	Output (£/ha)	1,506	1,695	1,099	1,729
	Margin (£/ha)	**758**	**913**	**518**	**1,176**
Block L	Total cost (£/ha)	704	788	598	550
Direct drill	Output (£/ha)	1,435	1,620	1,086	1,613
	Margin (£/ha)	**731**	**832**	**488**	**1,063**

Block P: yield **0 – 4% higher** | costs **-8% – +4%** | Margins **0 – 4%** above Block J

Block L: **Lowest** fuel/labour costs **| highest** pesticide/fertiliser inputs **| Lower** yields
Margins **4 – 10%** below Block P

Reduced Tillage

Implications for the Farming System

Salle have now applied the shallow tillage system across their entire arable area.

	Crop 1	Crop 2	Crop 3	Crop 4	Crop 5	Crop 6	Crop 7
Organic Manure		Limex 70 + Turkey Manure		Turkey Manure		Limex 70	
Cover Crop Drilling				Opus / Bio-Drill 50mm Points		Opus / Bio-Drill 50mm Points	
Cover Crop Control				Glyphosate (Nov/Dec)		Glyphosate (Nov/Dec)	
First Preparation	Carrier Straw Harrow	Opus 50mm Points	Carrier CrossCutter		Opus 50mm Points / Plough		
Weed Control	Glyphosate						
Second Preparation	Opus 50mm Points		Opus 50mm Points	NZA Spring Tine Cultivator		NZA Spring Tine Cultivator	Opus 50mm Points
Drilling	Rapid	Opus / Bio-Drill 50mm Points	Rapid	Compactor / Precision Drill	Rapid	Rapid	Rapid
Planted Crop	**Winter Barley**	**Winter Oilseed Rape**	**Winter Wheat**	**Sugar Beet**	**Winter Wheat / Spring Barley**	**Spring Beans**	**Winter Wheat**

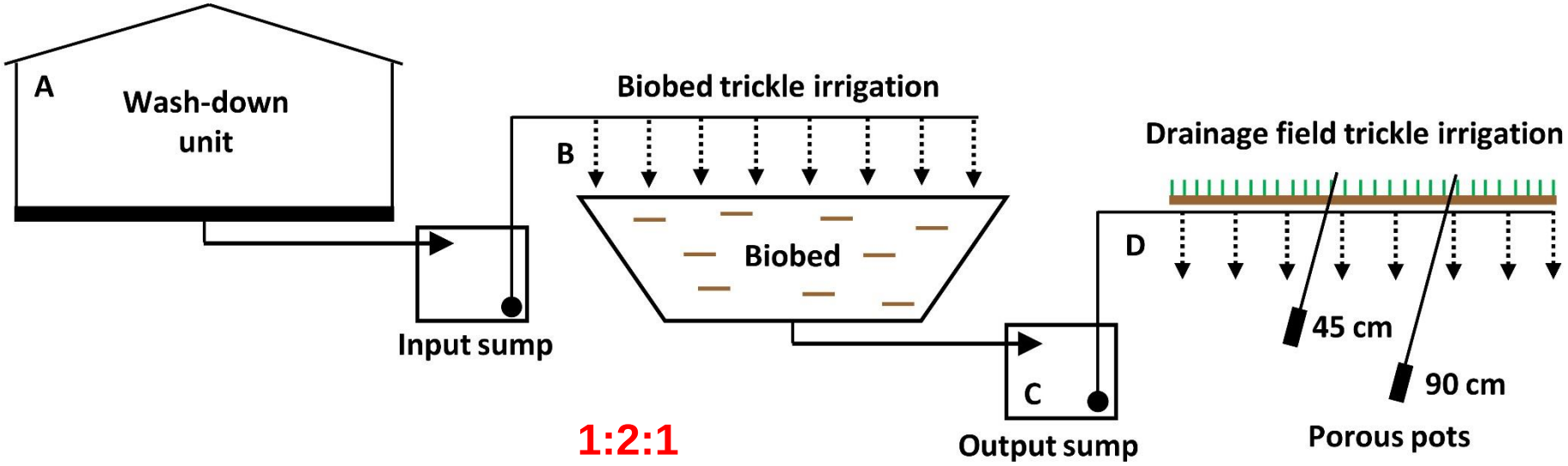
Average crop establishment costs across the seven year rotation have been calculated at **£44/ha** compared to **£62/ha** under the old system (a **29% reduction**).

Pesticides: Biobed

Manor Farm Biobed

Experimental Design

Stage 1 **Stage 2** **Stage 3**



1:2:1

Compost : straw : topsoil

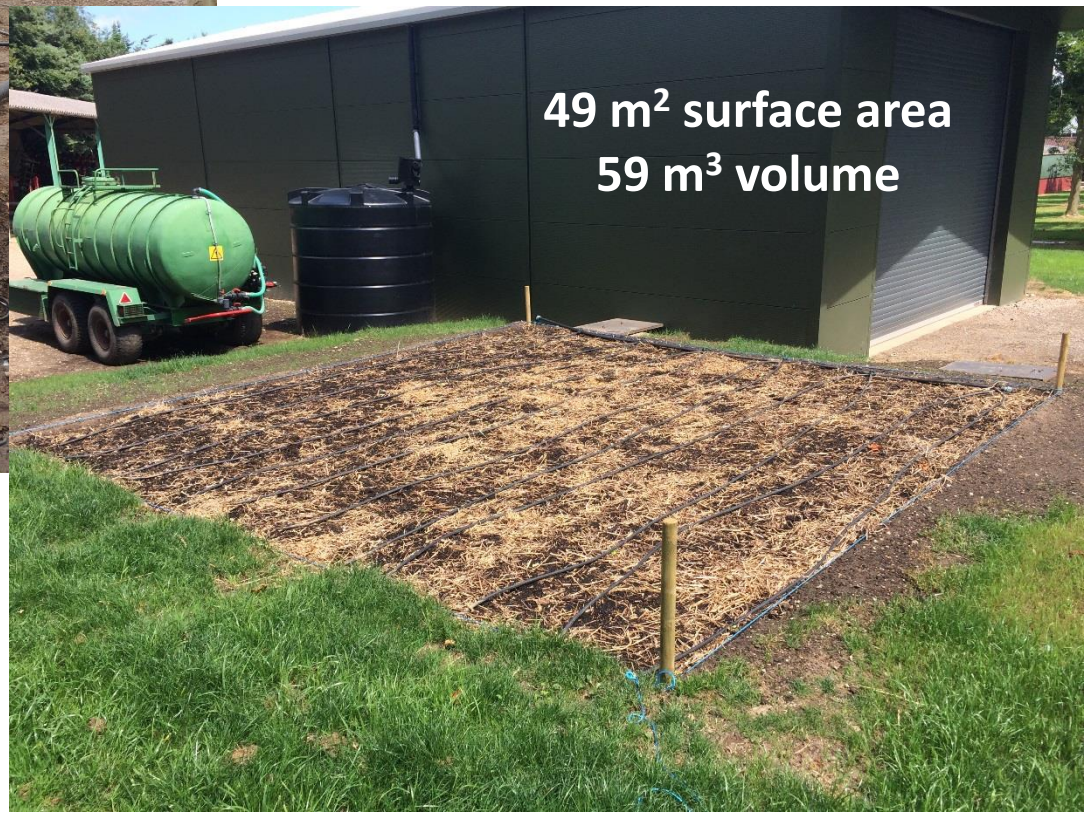
Constructed in 2013 with Catchment Sensitive Farming (CSF) funding

Manor Farm Biobed

Stage 1: wash-down facility

Manor Farm Biobed

Stage 2: biobed and sumps



Manor Farm Biobed

Stage 3: drainage field

Manor Farm Biobed

Pesticide removal efficiency: 2013 - 2015

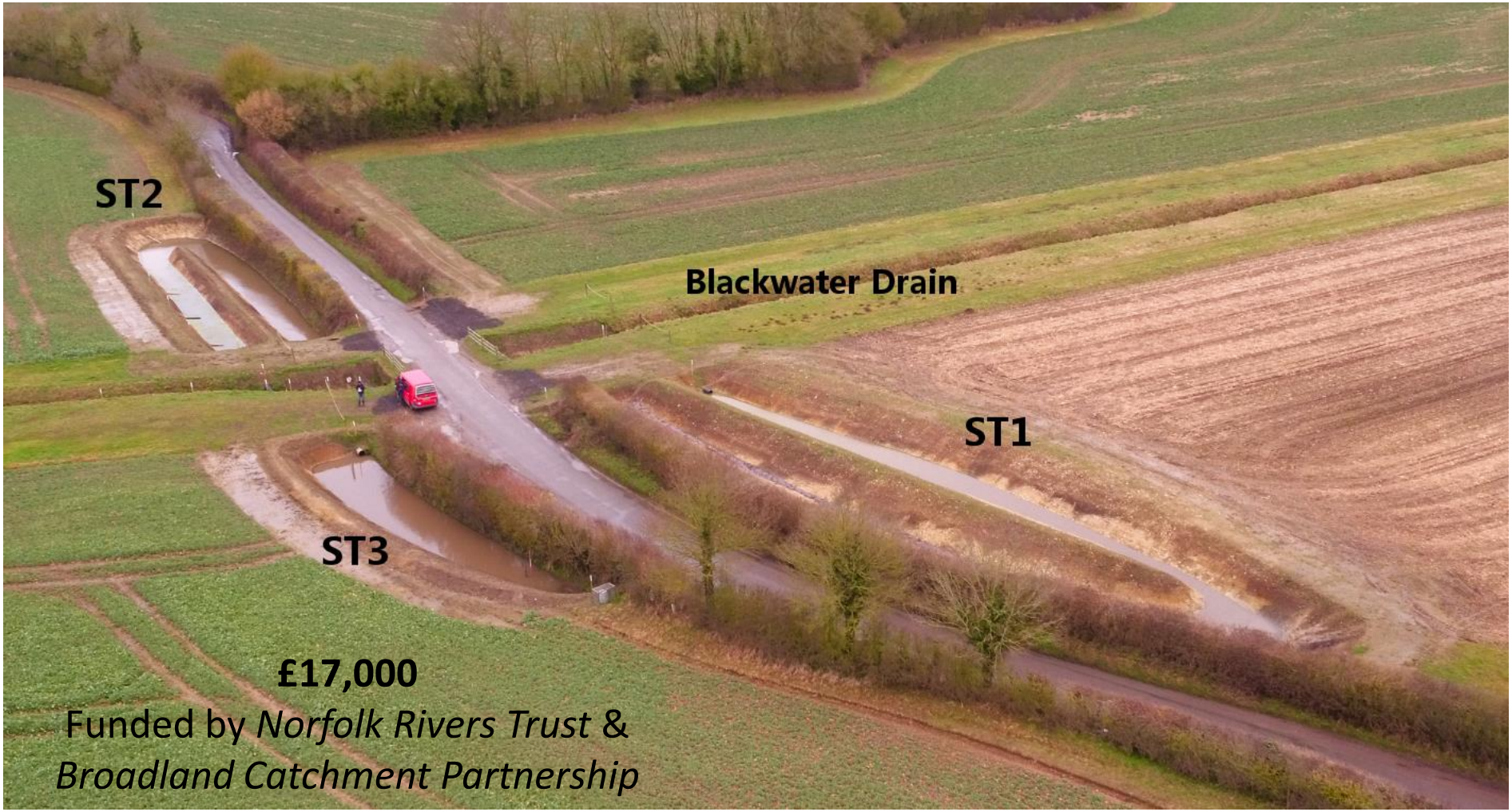
Pesticide	Biobed Sump Mean Concentration (µg L^{-1})			Porous Pot Mean Concentration (µg L^{-1})			
	Input	Output	Efficiency (%)	45 cm	Efficiency (%)	90 cm	Efficiency (%)
Propyzamide	2551.3	60.0	**97.6**	-	**-**	-	**-**
Chloridazon	2547.7	81.9	**96.8**	-	**-**	-	**-**
Triclopyr	958.5	32.8	**96.6**	1.2	**96.3**	2.5	**92.4**
Ethofumesate	26935.1	980.9	**96.4**	-	**-**	-	**-**
Chlorotoluron	150.4	6.9	**95.4**	-	**-**	-	**-**
Bromoxynil	167.3	11.3	**93.2**	1.1	**90.3**	1.6	**85.8**
2,4-D	2944.9	213.7	**92.7**	2.2	**99.0**	6.5	**97.0**
Mecoprop	803.7	112.7	**86.0**	3.0	**97.3**	6.6	**94.1**
MCPA	30.4	4.8	**84.2**	1.1	**77.1**	1.6	**66.7**
Fluroxypyr	1162.0	224.6	**80.7**	9.3	**95.9**	16.0	**92.9**
Dicamba	223.5	43.8	**80.4**	9.1	**79.2**	13.9	**68.3**
Carbetamide	15.3	3.0	**80.4**	-	**-**	-	**-**
Clopyralid	1025.5	238.1	**76.8**	5.5	**97.7**	16.2	**93.2**
Metsulfuron-methyl	32.9	8.1	**75.4**	-	**-**	-	**-**
Metazachlor	5561.0	1754.9	**68.4**	-	**-**	-	**-**

Sediment: Silt traps

Roadside Silt Traps

Installation

Constructed October 2016



£17,000

Funded by *Norfolk Rivers Trust* &
Broadland Catchment Partnership

Roadside Silt Traps

Sediment retention

Silt trap 3 (Nov 2016 – Nov 2017)

Sediment retained:	**7,253 kg**
Damage cost:	**£392**
TP retained:	**11.6 kg**
Damage cost:	**£148**
TN retained:	**29.7 kg**
Damage cost:	**£13**
Total mitigated damage cost:	**£553**
Trap cost:	**£3,600**
Payback time:	**~7 years**

Damage costs per tonne

TP: £12,790
N: £430
Sed: £54

River sediment load downstream

2011-2016 average: **15 t y^{-1}**
2016/17: **6.3 t y^{-1}**

Further info: wensumalliance.org.uk

Acknowledgements

Kevin Hiscock, Andrew Lovett, Richard Cooper, Gilla Sünnenberg, Steve Dugdale, Trudie Dockerty, Emilie Vrain

Poul Hovesen, James Beamish, Lister Noble