



Soil Stabilisation Decommissioning

Haul Road Whole Life Cycle

























All regenerative systems start by measuring and understanding the existing soil conditions.

Soil knowledge leads to the correct remedial activity, resulting in a fully functional soil.

The measurements taken will cover aspects of the Physical, Chemical and Biological functionality of the soil and interpreting these aspects to find out the limiting factor to soil functionality. These principles are used in the following Decommission strategy.

The more we know about the subsoil before we start the better, therefore we should test the soil and then try and balance it back post treatments.

Understanding the effect of the stabilisation process on soils through the Pulverisation, Binder addition and Compaction is essential for compiling the Decommissioning Strategy DECOMSTRAT.

The Decomstrat will require a full suite of tests to be carried out prior and post soil stabilisation. Allowing for correct reinstatement.























Soil testing preconstruction work

- TerraMap scanned and Gold soil tested, soil scanner detects 4 isotopes which informs the sampler where to collect soil samples for wet chemical testing.
- Scan and test results uploaded onto digital, interactive mapping platform Omnia, generate reports digitally or physical printouts.
- This will show the state and functionality of the soil, so there is a target to aim for when soil is reinstated.

Construction of Haul Roads

- Roadways are put in by normal practice after soil has been baseline assessed.
- Test the roadway again, once stabilised by hydrated lime and cement.
- Compare it to the original soil, allowing regenerative reinstatement plans to be made before roadway removal is considered.

Regenerative reinstatement plan

- Will cover physical, chemical and biological aspects of the soil, how to balance these to maximise soil functionality post-reinstatement and bring them as close (or better in some cases) to the original.
- Parameters include pH, organic matter, bulk density, microbial populations and diversity. Actions include chemical amendments, growing plants to stabilise soil and additions of native microbial consortiums.
- A clear, ordered programme of work will be issued, including a timeline, before reinstatement. Will include nutrients, seed rates, plant species and biological inoculants to be applied. This will allow for successful development of plants and microbial communities over time (minimum of 6 weeks post application).

Soil inspections postreinstatement

- Carry out physical inspection of the soil profile and visual soil assessment.
- This is to ensure the regenerative reinstatement plan is working and the soils natural functionality has been either restored or further enhanced.























Soil Tests: using the TerraMap Gold test

Tests are required to be carried out at each stage of the Decommissioning Process.

Testing of the Natural Untreated Soil
Testing of the Binder Treated Soil
Testing of the Regenerated Soil

TerraMap Gold Analysis

An examination of the chemical, biological and physical aspects of the soil.

Extensive understanding of how and why the soil performs.

Presented on digital maps and paper reports.

The 42 parameters TerraMap Gold test includes amongst others:

- Active (water) pH
- Buffer pH
- Soil texture
- Organic matter
- Organic carbon





















TerraMap Scanning

TerraMap is the best soil mapping service with the most detailed soil analysis, all results are uploaded onto the best digital precision farming platform. No comparable service is available elsewhere on the UK market.

Onsite TerraMap Scanning





























TerraMap Scan Data

The Ca:**Mag** ratio is very different in topsoil and subsoil: topsoil more free draining than subsoil due to a chemical imbalance in Calcium and Magnesium in the subsoil.

Whole Field Analysis of Ca: Mag



Haul Road Strip Analysis of Ca: Mag























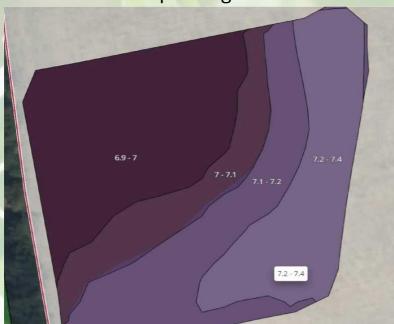


Soil pH

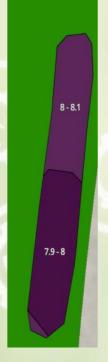
The Stabilisation has increased the pH because of the Ca in the cement.

Remedial Action required

Natural State pH range 7.2 – 7.4



Cement Treated State pH elevated 7.9 – 8.1













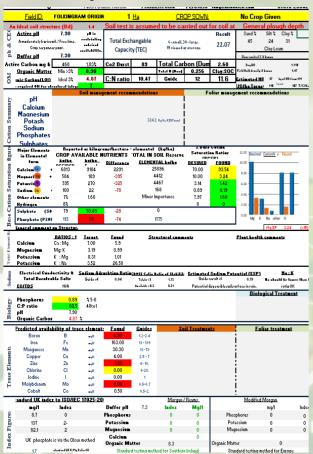






Gold Soil Reports - Gold Soil Analysis

Gold Soil Analysis - Natural State Untreated



Gold Soil Analysis - Cement Stabilised

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Trace Elements Biology Sodium T	Magacism Potascism Potascism Potascism Elscevical Camp Intel Ourslev EXPERS CP Patie Phasphores CP Patie Urquaic Carbon Boro Magasee Copper Zinc Chorine Lodin Molydeann Cobolt andard Wind mg/I 15.3 15.0 15.7	Co: Mg Mg K Mg K K: Mg K: Mg Inctivity & state NNA 1366 423 Sirving 423 Bettivity of tra B Fa Mm Co Co Cl I Mo Co Zx to ISO/IEC Index 2 2 2 2 1	7.00 4.15 0.24 2.71 Section Adv. \$5.8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-8 4.0501 \$ \$2.5-	36.4 1.29 0.77 3.18 arkhina Ratio 0.14 110 286.00 32.50 3.20 3.10 0.00 0.50 Buffer pH Phosphorus Potassium Magaessium	Guides 12-2.4 18-70 18-70 18-70 18-70 18-70 19-70 10-5-0.7 0.5-2.	List Statistics List List Signature Morgan Index 0	J. Ectimated Guider Dill Treatmen J. Ecame. Mg/I 0 0 0	Sadium Pate erult 6 ta Phosp Poto	Modified	gical Tre gical Tre liar treat	I be leave than ratio OK catment
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Gold Soil Analysis - Decommissioned

-	Jolu 3	OIL F			_				OHE		
	Field ID;	FOLKING	IAM GRAS	1	<u>Ha</u>	<u>C</u>	ROP SOWN:		No Crop	Given	
A	n Ideal soil struc		1.4	Soil	test is assun	ned to be carri	ed out for so		Gene	eral plough de	epth
CE	Active pH	8.60	pH is restricting					Result	Sand %	Silt Cla	
8	FALSE FALSE		autricat	Total Exch	•	6 = small, 0 15 viewed a					8
h		7.70	availability.	Capacit	y (TEC)	io viewed a	s average			Clay Loam	
	tive Carbon mg 8		0.63%	Co2 Burst	6	Table Carter	(D)	2.29	Stane cantent/	ifkraun	1.077
AC	ove Carbon mg o Organic Matte		7.80	LOZ BURST	ь	Total Carbon Total N (Dun)	0,181	Clav:SOC	Dry BD Field Bulk descrity if		1.077
MO			4.58	C:N ratio	12.65	Guide	12	12.2	Estimated Ni		NR from OM
0	rganic Carbon(LOI) a required OM for s		9	improve soil struct			IZ.	12.2	I/C/ha Targe		101 T/C/Hs
	Trequires our ren s			ement recon			Fol	iar manage	ement recor		
2	' pH										
i i	Calcium										
8	Magnesium										
Cation Summary	Potash				547.9	KqfkaK20Faund					
ţį	Sodium										
ü	Phosphates										
_	Sulphates						6 DASE	Cation			
20	Major Elements in Elemental			ams/hectare - NUTRIENTS:			Saturation	on Ratios	1200 Desired	Cation% v Fou	nd
figures	in Elemental	LUIN4	KUITIA	Difference		TAL kgiha	DESIRED	FOUND	1000		
9	Calcium (a)	12166	16739	4573		3194	70.00	96.32			
Ę.	Magnesi@ -	• 1043	180	-863	5	333	10.00	173	8.00		
Saturation	Potassic	970	457	-514		303	2.86	1.35	6.00	_	-
Sat	Sodium 🔞	178	82	-96		278	0.89	0.41	4.00 -		
	Other elements	7%	0.20		Minor In	nportance	8.25	0.20			
- É	Hydrogen	8%	4054.40	4000		423	8	0	2.00 -		
Base Cation	Sulphate (S0:		1951.13	1869					0.00		
3as	Phosphate (P205		118	1	Ī	511			Mg K	Na other H	
	General comment									Ma SP 11	
-0										ring or L	73 (<15)
Ratio	Calaina	RATIOS:1	Target	Found	Str	uctural comme	ents		Plant health	ring or L	/3 [KID]
ment Rati	Calcium	RATIOS:1 Ca: Mg	7.00	10.9	Str	uctural comme	ents		Plant health	ring or L	73 [610]
al Element Rati	Magnesium	.RATIOS:1 Ca:Mg Mg:K	7.00 3.49	10.9 1.01	Str	uctural comme	ents		Plant health	ring or L	73 [KID]
Total Element Rati		RATIOS:1 Ca: Mg	7.00	10.9	Str	uctural comme	ents		Plant health	ring or L	r3 (clb)
Total Element	Magnesium Potassium	.RATIOS:1 Ca:Mg Mg:K K:Mg K:Na	7.00 3.49 0.29 3.22	10.9 1.01 0.99 19.04				Sodium Pot		ring or L	
Total Element	Magnesium Potassium Potassium Electrical Cone Total Desolve	RATIOS:1 Ca:Mg Mg:K K:Mg K:Na ductivity & able Salts	7.00 3.49 0.29 3.22	10.9 1.01 0.99	ROSS Catio F	Ratio of Stabili 149	Estimated Guide I	esult <6	ential (ESP) 0.41	comments Na Na should be	:K lower than
Sodium Total Element Rati	Magnesium Potassium Potassium Electrical Cond	RATIOS:1 Ca:Mg Mg:K K:Mg K:Na ductivity &	7.00 3.49 0.29 3.22 Sodium Ads	10.9 1.01 0.99 19.04 corbtion Ratio	ROSS Catio F	Ratio of Stabilit	Estimated Guide I		ential (ESP) 0.41 urface in rain.	Comments Na Na should be ratio	:K lower than
Sodium Total Element	Magnesium Potassium Potassium Electrical Cone Total Desolve ECXTDS	RATIOS:1 Ca:Mg Mg:K K:Mg K:Na ductivity & able Salts	7.00 3.49 0.29 3.22 Sodium Ads Guide <4	10.9 1.01 0.99 19.04 corbtion Ratio	ROSS Catio F	Ratio of Stabili 149	Estimated Guide I	esult <6	ential (ESP) 0.41 urface in rain.	comments Na Na should be	:K lower than
Sodium Total Element	Magnesium Potassium Potassium Electrical Cone Total Desolve ECXTDS	RATIOS:1 Ca: Mg Mg: K K: Mg K: Na ductivity & able Salts N/A	7.00 3.49 0.29 3.22 Sodium Ads Guide <4	10.9 1.01 0.99 19.04 corbtion Ratio	ROSS Catio F	Ratio of Stabili 149	Estimated Guide I	esult <6	ential (ESP) 0.41 urface in rain.	Comments Na Na should be ratio	:K lower than
Sodium Total Element	Magnesium Potassium Potassium Electrical Conc Total Desolva ECZTDS Phosphorus C:P ratio pH	RATIOS:1 Ca: Mg Mg: K K: Mg K: Na ductivity & able Salts N/A 3.13 66.8 8.60	7.00 3.49 0.29 3.22 Sodium Ads Guide <4 % 5-8 40to1	10.9 1.01 0.99 19.04 corbtion Ratio	ROSS Catio F	Ratio of Stabili 149	Estimated Guide I	esult <6	ential (ESP) 0.41 urface in rain.	Comments Na Na should be ratio	:K lower than
Total Element	Magnesium Potassium Potassium Electrical Conc Total Desolva EC/IDS Phosphorus C:P ratio pH Organic Carbo	RATIOS:1 Ca: Mg Mg: K K: Mg K: Na ductivity & able Salts N/A 3.13 66.8 8.60 4.58	7.00 3.49 0.29 3.22 Sodium Ads Guide <4 % 5-8 40to1	10.9 1.01 0.99 19.04 sorbtion Batio	ROSS Catio F Totals < 3 Available < 0.5	Ratio of Stabilit 149 0.33	Estimated Guide Potential d	esult <6 ispersible soil s	ential (ESP) 0.41 urface in rain. Biolog	comments Na Na should be ratic	:K lower than OK ment
Sodium Total Element	Magnesium Potassium Potassium Electrical Conc Total Desolve EC/TDS Phosphorus C:P ratio pH Organic Carbo redicted availa	BATIOS:1 Ca: Mg Mg: K K: Mg K: Na ductivity & able Salts N/A 3.13 66.8 8.60 0 4.58	7.00 3.49 0.29 3.22 Sodium Ads Guide <4 % 5-8 40to1	10.9 1.01 0.39 19.04 sorbtion Ratio	ROSS Catio F Totals < 3 Available < 0.5	Ratio of Stabilit 149 0.33	Estimated Guide I	esult <6 ispersible soil s	ential (ESP) 0.41 urface in rain. Biolog	Comments Na Na should be ratio	.:K lower than OCK ment
Biology Sodium Total Element	Magnesium Potassium Electrical Conc Total Desolvi EC/IDS Phosphorus C:P ratio pH Organic Carbo redicted availa Boron	RATIOS:1 Ca: Mg Mg: K K: Mg K: Na ductivity & able Salts N/A 3.13 66.8 8.60 0 4.58	7.00 3.49 0.29 3.22 Sodium Ads Guide <4 % 5-8 40to1 % ce elemen	10.9 1.01 0.99 19.04 sorbtion Batio	ROSS Catio F Totals < 3 Available < 0.5 Guides 12-2.4	Ratio of Stabilit 149 0.33	Estimated Guide Potential d	esult <6 ispersible soil s	ential (ESP) 0.41 urface in rain. Biolog	comments Na Na should be ratic	.:K lower than OCK ment
Biology Sodium Total Element	Magnesium Potassium Electrical Con- Total Desolvi ECITIS Phosphorus C:P ratio pH Organic Carbo redicted availa Boron	RATIOS:1 Ca: Mg Mg, K K: Mg K: Na ductivity & able Salts N/A 3.13 66.8 8.60 4.58 billity of tra B Fe	7.00 3.49 0.29 3.22 Sodium Ads Guide <4 %5-8 40to1 % ce elemen	10.9 101 0.99 19.04 sorbtion Ratio 0.12	ROSS Catio F Totals < 3 Available < 0.5 Guides 12-2.4 18-189	Ratio of Stabilit 149 0.33	Estimated Guide Potential d	esult <6 ispersible soil s	ential (ESP) 0.41 urface in rain. Biolog	comments Na Na should be ratic	:K lower than OK ment
Biology Sodium Total Element	Magnesium Polassium Electrical Con- Total Desolv: ECYTDS Phosphorus C:P ratio pH Organic Carbo redicted availa Boron Iron Manganese	BATIOS:1 Ca: Mg Mg K K: Mg K: Na ductivity & able Salts N/A 313 66.8 8.60 4.58 BE Fe Mn	7.00 3.49 0.29 3.22 Sodium Ads Guide <4 %5-8 40to1 % Ce elemen ngil ngil	10.9 101 0.99 19.04 sorbtion Batio y 0.12 Found 1.70 219 90 41.40	ROSS Catio F Totals (3 Available (0.5 Guides 12-2,4 83-189 18-70	Ratio of Stabilit 149 0.33	Estimated Guide Potential d	esult <6 ispersible soil s	ential (ESP) 0.41 urface in rain. Biolog	comments Na Na should be ratic	:K lower than OK ment
Biology Sodium Total Element	Magnesium Potassium Potassium Electrical Conc Total Desolvi ECITDS Phosphorus C:P ratio pH Organic Carbo Iron Manganese Copper	BATIOS:1 Ca: Mg Mg K: Mg K: Mg K: Na ductivity & able Salts N/A 313 668 8.80 4.58 billity of tra B Fe Mn Cu	7.00 3.49 0.29 3.22 Sodium Ads Guide <4 % 5-8 40to1 % ce elemen ngil ngil ngil	10.9 101 0.39 19.04 sorbtion Ratio 0.12 Eound 1.70 219.00 41.40 3.60	ROSS Catio F Totals (3 Available (0.5 Guides 12-2.4 18-189 18-70 25-7	Ratio of Stabilit 149 0.33	Estimated Guide Potential d	esult <6 ispersible soil s	ential (ESP) 0.41 urface in rain. Biolog	comments Na Na should be ratic	.:K lower than OCK ment
Biology Sodium Total Element	Magnesium Polassium Electrical Con- Total Desolv: ECYTDS Phosphorus C:P ratio pH Organic Carbo redicted availa Boron Iron Manganese	BATIOS:1 Ca: Mg Mg K K: Mg K: Na ductivity & able Salts N/A 313 66.8 8.60 4.58 BE Fe Mn	7.00 3.49 0.23 3.22 Sodium Ads Guide <4 % 5-8 40to1 % ce elemen ngil ngil ngil ngil ngil ngil ngil	10.9 101 0.99 19.04 sorbtion Batio y 0.12 Found 1.70 219 90 41.40	ROSS Catio F Totals (3 Available (0.5 Guides 12-2,4 83-189 18-70	Ratio of Stabilit 149 0.33	Estimated Guide Potential d	esult <6 ispersible soil s	ential (ESP) 0.41 urface in rain. Biolog	comments Na Na should be ratic	.:K lower than OCK ment
Sodium Total Element	Magnesium Polassium Polassium Electrical Control Desolvi ECHTDS Phosphorus C:Pratio pH Organic Carbo redicted availa Boron Iron Manganese Copper Zinc	FATIOS:1 Ca: Mg Mg: K: Mg Mg: K: Ma ductivity & Ashle Salts N/A 313 66.8 8.800 3 4.58 Before Mn Cu Zn	7.00 3.49 0.29 3.22 Sodium Ads Guide <4 % 5-8 40to1 % ce elemen ngil ngil ngil	10.9 1001 0.39 19.04 scription Ratio 0.12 1.70 279.00 41.40 3.60 9.20	ROSS Catio F Totals < 3 Available < 0.5 Guides 1.2-2.4 18-189 18-70 2.5-7 4-10.	Ratio of Stabilit 149 0.33	Estimated Guide Potential d	esult <6 ispersible soil s	ential (ESP) 0.41 urface in rain. Biolog	comments Na Na should be ratic	.:K lower than OCK ment
Biology Sodium Total Element	Magnesium Potassium Potassium Potassium Electrical Conc Total Desolv: ECITIS Phosphorus Crip ratio pH Organic Carbo redicted availa Boro Iron Manganese Copper Zinc Chlorine lodine Molybdenum	RATIOS:J Ca: Mg Mg K K: Mg K: Mg K: Mg K: Ng B: Mg K: Ng K: Ng K: Ng A: Ng B:	7.00 3.49 0.29 3.22 Sodium Ads Guide <4 %5-8 40to1 % ce elemen ngil ngil ngil ngil ngil ngil ngil ngi	10.9 10.9 10.9 10.9 19.04 sorbtion Ratio 0.12 Eound 170 273.00 41.40 3.60 9.20 9.20 0.00 1.40	Foods Catio F Totals (3 Available (0.5) Fuides 1.2-2.4 18-189 18-70 2.5-7 4-10. 9-20. 10.5-0.7	Ratio of Stabilit 149 0.33	Estimated Guide Potential d	esult <6 ispersible soil s	ential (ESP) 0.41 urface in rain. Biolog	comments Na Na should be ratic	:K lower than OK ment
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Organic Matter and pH

The cement stabilisation has oxidised the organic matter seen by a reduction from 8.3 to 7.2 and an increase in Active Carbon %, the big rise in **pH** will increase bacterial content and Co2 release.

The 3rd result here shows the soil 5 weeks post treatment showing that the pH is dropping back to the original **pH** 7.9, and the organic matter has also increased showing that we are moving in the right direction. (5 weeks

post treatment is not long for remedial action to work)

	Field ID:	FOLKINGHAM	ORIGINAL	Field ID:	FOLKINGHAM	TREATED		Field ID:	FOLKINGHAM	GRASS
	An Ideal soil structur	re (Bd)	1.4	A Restricted soil struc	ture (Bd)	1.56		An Ideal soil structur	re (Bd)	1.4
& CEC	Active pH A moderately basic so Crop response		pH is restricting nutrient availability.	Active pH FALSE		pH is restricting nutrient availability.	& CEC	Active pH FALSE FALSE	8.60	pH is restricting nutrient availability.
hd	Buffer pH	7.30		집 Buffer pH	8.40		h	Buffer pH	7.70	
Active	e Carbon mg & %	468	1.03%	Active Carbon mg & %	382	1.18%	Activ	e Carbon mg & %	271	0.63%
_	Organic Matter	Min >3%	8.30	■ Organic Matter	Min >3%	7.20	V	Organic Matter	Min >3%	7.80
MC	Organic Carbon(LOI)	Ideal 3%	4.87	Organic Carbon(LOI)	Ideal 3%	4.23	O	Organic Carbon(LOI)	Ideal 3%	4.58

This soil test was taken 5 weeks after the remedial action and we can see a good direction in travel.

The pH is dropping the organic matter is rising, the C:N ratio is stabilizing. Sulphur is still elevated but this will drop as the pH drops.

Other nutrients are good which will encourage good plant growth and rooting throughout the profile.























Testing the soil biology: PLFA analysis

Phospholipid Fatty Acid analysis. PLFAs are an essential structural component of all microbial cellular membranes. PLFA analysis is a technique widely used for estimation of the total biomass and to observe broad changes in the community composition of the living microbiota of soil and aqueous environments. Soil biological testing gives a representation of living soil microbial biomass, allowing us to identify the presence or absence of various functional groups of interest through known PLFA biomarker

PLFA test measures microbial activity in the soil, ground stabilisation has a very negative effect on soil biology:

ults		Unit	Result	low	rather low	average	rather high	high
	Biological							
	Microbial biomass	mg PLFA/kg	25					
	Total bacteria	mg PLFA/kg	22					
	Gram positive	mg PLFA/kg	10					
	Actinomycetes	mg PLFA/kg	2,9					
	Gram negative	mg PLFA/kg	13					
	Total fungi	mg PLFA/kg	2,6				1	
	Arbuscular Mycorrhiza	mg PLFA/kg	1,4				1	
	Other fungi	mg PLFA/kg	1,2				1	
	Protozoa	mg PLFA/kg	0,16					
	Shannon Wiener Index		1.28					
	Fungal/bacterial ratio		0,8				1	
	Gram(+)/Gram(-) ratio		0,8					
	Physical							
	Acidity (pH)		7,0					
	C-organic	%	2,68					
	Organic matter	%	4,5					
	SOC/SOM ratio	%	0,60 49					1
	Clay (<2 pm)	%	49					
anic mat	tter Figure: Quality of the organic matter							
	Dynamic Average	Stable						
	Oysesso Average	Statie						
	Organic carbon held in micro-organisms		mg C/kg					
	Microbial biomass		529					

	Unit	Result	low	rather low	average	rather high	high
Biological							
Microbial biomass	mg PLFA/kg	< 0,6					
Total bacteria	mg PLFA/kg	< 0,6					
Protozoa	mg PLFA/kg	<0,03					
Shannon Wiener Index		< 1,60					
Fungal/bacterial ratio		<1,2					
Gram(+)/Gram(-) ratio		<1,0					
Physical							
		10.5		_	_		-
	%	2.02					
	%	5.2					
SOC/SOM ratio		0,39					
Clay (<2 pm)	%	45					
	Microbial biomass Total bacteria Gram positiva Actinomycetes Gram negative Total fungi Arbuscular Mycorrhiza Other fungi Protocoa Shannon Wiener Index Fungai/bacterial ratio Gram(+)/Gram(-) ratio Physical Actidity (pH) C-organic Organic matter SOC/SOM ratio	Microbial blomass mg PLFA/kg Total bacteria mg PLFA/kg Gram positive mg PLFA/kg Actinomycetes mg PLFA/kg Actinomycetes mg PLFA/kg Total fungi mg PLFA/kg Arbuscular Mycorrhiza mg PLFA/kg Other fungi mg PLFA/kg My PLFA/kg Actinomycetral ratio Gram(+)/Gram(-) ratio Physical Acidity (pH) C-organic % Corganic matter % SOC/SOM ratio	Microbial blomass mg PLFAkg < 0,6	Microbial blomass mg PLFA/kg < 0,6	Microbial biomass mg PLFA/kg < 0,6	Microbial biomass mg PLFA/kg < 0.6	Microbial biomass mg PLFAkg < 0,6

Here we can see the reduction in biological activity following soil treatment.

If no biological remedial work is undertaken, soil functionality will be compromised.























Microbial Activity

The cement stabilisation has caused a major decrease in microbial activity and change in C:N ratios due to the death of the microbes. The Cement Stabilisation has effectively killed all biology in the soil.

Natural State subsoil prior to Stabilisation

Co2 Burst	35	Total Carbon	3.58	
		Total N (Dum)	0.13	SOC/Clay
C:N ratio	27.54	Guide	12	11.5

Cement Stabilised subsoil

Co2 Burst	4	Total Carbon	Total Carbon (Dum)		
		Total N (Dum)	0.12	SOC/Clay	
C:N ratio	21.67	Guide	12	11.2	











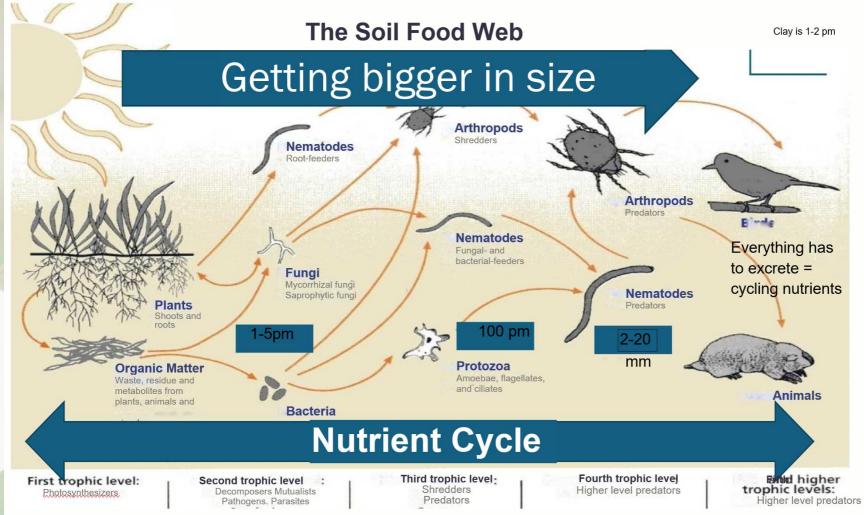


































Treatment Plan - DECOMSTRAT

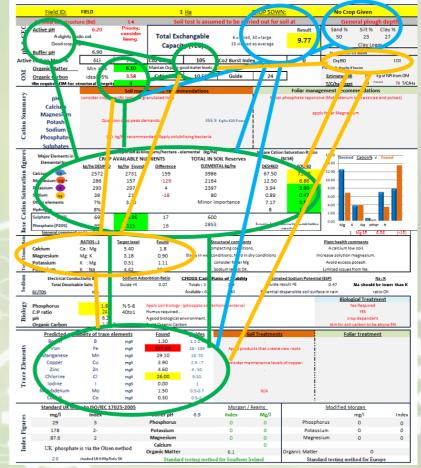
Effects of Cement Stabilisation on Subsoil:

Raises pH
Reduces Organic Matter
Reduces Microbial Activity
De-structures the Soil

Actions Required:

Reduce pH to buffer level
Increase Organic Matter in the soil
Introduce Microbiology
Re-structure the soil

All actions in the DECONSTRAT are determined by the TerraMap GOLD Test Analysis























Stabilisation of Haul Road Track with 3% CEMI























Pulverisation using Stabilisation Mixer to re-structure the stabilised



Samples taken for Gold Testing























Re-Balancing pH and Nutrients

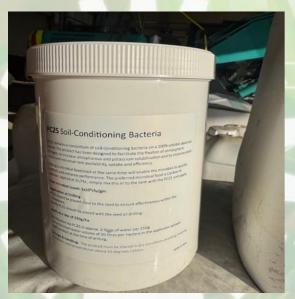
Ammonium Sulphate and Elemental Boron and Sulphur are applied to stabilise the pH levels in the subsoil.

Soil Conditioning Bacteria and Huma-Grow are applied to redress the nutrient loss during the stabilisation

Nutrients can leach through the soil profile and enhance the soil fertility

Good topsoil management is the key to successful decommissioning of stabilised works.

All the nutrients and structure will allow successful crop growth to take place within the topsoil.































Cover Crop Seeding

Early seeding trials in dishes showed very promising results in the Cement Stabilised soil with early establishment of seed growth.



Untreated subsoil



Cement Stabilised subsoil





















Regenerative Process

Seeding was carried out on the pulverised soil to introduce organic matter and in turn reintroduce microbial activity

Seed mix contained Linseed, Buckwheat, Phacelia, Radish, Mustard, Hairy Vetch and Clover.

























Six week established growth in the pH balanced pulverised subsoil. Fully established root systems and increased organic matter in the pulverised subsoil.























JJ Mac Ltd

In summary:

The soil is measured to ascertain its physical, chemical and biological status, all reinstatement works are designed to return this soil back to its native state.

These treatments include:

Chemical intervention - pH and humic acids,
Physical - Pulverisation
Biological - Plant roots and biological inoculants.
Organical - Wild Flower Planting

All targeted via Terra map digital mapping system, Gold Standard Analysis and PLFA Analysis.



Haul Road Decommissioned and topsoil fully reinstated after six weeks

















