

**HUMBLEBURN OCCS,
CRAGHEAD,
COUNTY DURHAM**

SURVEY OF RESTORED LAND

OCTOBER 1997

**Resource Planning Team
Northern Region
FRCA, Leeds**

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HUMBLEBURN OCCS

REPORT ON SUBSOIL DEVELOPMENT DURING FIRST YEAR OF AFTERCARE

1. Introduction and Aims of Report

- 1.1 This report was produced by the Resource Planning Team of the Farming and Rural Conservation Agency (FRCA) with the intention of investigating the effect on subsoil development, if any, of restoring subsoils following opencasting in one single layer (block tipping) as opposed to two layers of equal depth (loose tipping), and the effect of arable cropping during the aftercare period as opposed to ley grass. This report follows on from a baseline survey and report (Humbleburn OCCS, Reference 69/96), the field work for which was carried out in July 1996, which was produced by ADAS Statutory (now FRCA) at the beginning of the aftercare period. Humbleburn OCCS was operated by Ivor Hutchinson with RPS Clouston acting on his behalf as the soils and restoration consultants.
- 1.2 A subsequent survey of the subsoils was carried out in October 1997 when four soil pits were dug by hand to between 70 cm and 80 cm depth. Full profile descriptions of each pit were made (see Appendix I) and samples taken for bulk density measurements.

2. Site Description and History

- 2.1 Humbleburn OCCS lies 3½ km south-east of Stanley, on the north side of the B6532 (Grid Reference NZ 220 504). The land is typically level to gently sloping (0-3°).
- 2.2 Climate

Table 1

Factor	Units	Values
Grid reference	N/A	NZ220 504
Altitude	m, AOD	145
Accumulated Temperature	day°C (Jan-June)	1203
Average Annual Rainfall	mm	707
Field Capacity Days	days	179
Moisture Deficit, Wheat	mm	84
Moisture Deficit, Potatoes	mm	67

The combination of rainfall and temperature at this site means that there is an overall climatic limitation of Grade 2.

2.3 Pre-working ALC and Soil Physical Characteristics

A pre-working ALC and soil resource survey was carried out by ADAS in 1990 on behalf of Ivor Hutchinson. The area of interest was all classified as Subgrade 3b, to which it was limited by soil wetness and gradient restrictions. One main soil type was identified which consisted of a sandy loam topsoil with a strongly developed fine to medium subangular blocky structure (median thickness 25 cm) overlying a variable thickness (10 - 25 cm) of sandy clay loam upper subsoil with a moderately developed subangular blocky structure. The lower subsoil consisted of medium clay loam, sandy clay loam, heavy clay loam or, occasionally clay. The lower subsoil typically had a medium to coarse angular or prismatic structure.

2.4 Soils Handling and Working Methods

Most of the soils on the site were stripped and put into storage in 1993 although a residual area was stripped in April/May 1994. Approximately half of the site was restored between August and October 1995 with the remainder being completed between April and June 1996. Fields 4a, 5b and 6 had subsoils replaced in two equal layers of 450 mm depth while Fields 4b and 5a had subsoils replaced in one single layer. Field 8 was used only for soil storage (see Subsoil Restoration Map at the end of this report). More detailed information on the methods and machinery used during soil replacement is given in the baseline report (Humbleburn OCCS, Reference 69/96).

3. Aftercare Programme

The aftercare programme for the restored soils is as follows:-

3.1 Field 4

1996/98	Grass ley to be established.
1998	Underdrainage

Field 5

1996/97	Oilseed rape
1997/98	Winter barley
1998	Underdrainage after harvest

3.3 Fields 6 and 8

1996-97	Oilseed rape
1998	Underdrainage after harvest
1997/98	Winter cereal

4. Survey Methodology

Soil pits were dug by hand in Fields 4b, 5a, 6 and 8 to a depth of between 70 cm and 80 cm. Full profile descriptions were made using the standard terms in the Soil Survey Field handbook and samples were taken from each subsoil horizon to allow bulk density measurements to be made. The pits were dug in the same approximate locations as in 1996, although Pit 2 (an undisturbed profile) was not described in 1997. As a result of the soil pits being dug in slightly different locations, some difference in profile characteristics such as texture, depth of horizons, stoniness etc. was expected. In addition, the soil textures in 1997 were assessed by hand only whereas in 1996 they were determined by laboratory analysis. Previous experience has shown that hand texture results may overestimate the clay content of soils with a high bulk density when compared with the results obtained by laboratory analysis. This is the most probable explanation for the restored subsoils being recorded as clay or heavy clay loam in 1997 compared to sandy clay loam, medium clay loam or heavy clay loam in 1996.

5. Survey Results

5.1.1 Pit 1, Field 5a

In 1996 the subsoil examined in Field 5a had a massive structure and no roots were observed. In 1996 common fine fibrous roots were observed to 42 cm depth and few fine fibrous roots between 42 cm and 80 cm depth. A very weakly developed structure was evident in 1997 (coarse angular blocky in the upper subsoil and very coarse prismatic in the lower subsoil).

5.1.2 Pit 3, Field 4b

The profile examined in this field in 1996 had a subsoil with a massive structure and no roots. In 1997 roots were evident to 52 cm depth and a very weakly developed coarse angular blocky structure was observed.

5.1.3 Pit 4, Field 6

The subsoil examined in 1996 had a massive structure and few fine fibrous roots. That examined in 1997 also had a massive structure although common fine fibrous roots were observed to 46 cm depth, with few between 46 cm and 70 cm depth.

5.1.4 Pit 5, Field 8

This area was only used for soil storage. In 1996 a massively structured subsoil with few fine fibrous roots was observed. In 1997 an upper subsoil with a moderately developed coarse prismatic structure and common very fine fibrous roots, and a lower subsoil with a very weakly developed coarse angular blocky to massive structure and few very fine fibrous roots were observed.

5.1.5 No evidence of any earthworm activity nor anaerobic conditions was found in any of the pits dug in 1996. This was also the case in 1997 except in the pit dug in an area used for soil storage only (Pit No. 5); where some worm channels were observed in the upper subsoil.

6. Summary and Conclusions

6.1 All but one of the pits examined in 1997 showed very weakly developed structures (typically coarse angular blocky or very coarse prismatic) developing in the subsoils, compared to massive structures in the subsoils examined in 1996. Equally, fibrous roots were observed to greater depths in three out of the four pits whilst in the fourth pit fibrous roots were observed to be more frequent in the upper subsoil in 1997 compared to 1996.

6.2 There appears to be no significant difference in the development of subsoil structure in those soils restored in one single layer compared to those restored in two layers of equal depth. Equally, the bulk density measurements obtained show no significant differences between the two methods of subsoil replacement, and root development does not appear to be slower in the subsoils replaced in one layer compared with those replaced in two.

6.3 Although there appears to be no significant difference between subsoil replacement in one layer rather than two at present (i.e. at the end of the first year of aftercare) in terms of subsoil structural development, rooting and presence of macrofauna, this site was not underdrained at the time of the 1997 survey and the aftercare treatments have another four years to run. Consequently, differences may yet become apparent towards the end of the aftercare period.

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Resource Planning Team
Northern Region

FRCA, Leeds

APPENDIX 1. SOIL PROFILE DESCRIPTIONS

Pit No. 1 Field 5A

Location: Grid Reference NZ 2215 5060

Land Use: Oilseed rape stubble

Slope and Aspect: 3° S

Weather: Cool and overcast

Date: 7/10/97

<u>Depth (cm)</u>	<u>Horizon Description</u>
0 - 21	Very dark greyish brown (10YR3/2) medium clay loam containing 2-3% subsoil inclusions; no mottles; very slightly stony, containing 2 - 3% sandstones; moist; strongly developed medium and coarse subangular blocky structure; friable; moderately porous; many fine fibrous roots; no apparent macrofauna; non-calcareous; abrupt wavy boundary.
21 - 42	Greyish brown (10YR5/2) clay; many distinct light brownish grey (10YR6/2) and brownish yellow (10YR6/6) mottles; slightly stony, containing approximately 8% very small to medium sandstones; moist; very weakly developed coarse angular blocky structure; extremely firm; very slightly porous (<0.5% pores >0.5mm); common fine fibrous roots, concentrated on ped faces; no apparent macrofauna; non-calcareous; gradual wavy boundary.
42 - 80	Greyish brown (10YR5/2) clay; many distinct light brownish grey (10YR6/2) and brownish yellow (10YR6/6) mottles; slightly stony containing approximately 8% very small to medium sandstones; slightly moist; very weakly developed very coarse prismatic structure; extremely firm; very slightly porous (<0.5% pores >0.5mm); few fine fibrous roots; no apparent macrofauna; non -calcareous.

Pit No. 3 Field 4b

Location: Grid Reference NZ 2240 5070

Land Use: Ley grassland

Slope and Aspect: 3° W

Weather: Cool and overcast

Date: 7/10/97

<u>Depth (cm)</u>	<u>Horizon Description</u>
0.22	Very dark greyish brown (10YR3/2) medium clay loam; no mottles; slightly stony, containing approximately 6 - 7% very small to medium sandstones; slightly moist; strongly developed medium subangular blocky structure; slightly hard; moderately porous; many fine fibrous roots; no apparent macrofauna; non-calcareous; sharp wavy boundary.
22 - 77	Dark greyish brown (10YR4/2) and brown (10YR5/3) heavy clay loam; common brownish yellow (10YR6/6 and 10YR6/8) mottles; slightly stony, containing approximately 12% very small to large sandstones; slightly moist; very weakly developed coarse angular blocky structure; extremely firm; very slightly porous (<0.5% pores >0.5 mm); few fine fibrous roots to 52 cm depth, none below; no apparent macrofauna; non-calcareous.

Pit No. 4 Field 6

Location: Grid Reference NZ 2190 5066

Land Use: Oilseed rape stubble

Slope and Aspect: 1° S

Weather: Cool and overcast

Date: 7/10/97

<u>Depth (cm)</u>	<u>Horizon Description</u>
0 - 23	Very dark greyish brown (10YR3/2) medium clay loam containing approximately 2% inclusions of subsoil and overburden; very slightly stony, containing approximately 3% total sandstones; moist; moderately developed coarse subangular blocky structure; friable; moderately porous; many fine fibrous roots; no apparent macrofauna; non-calcareous; abrupt smooth boundary.
23 - 46	Light brownish grey (10YR6/2) clay; many distinct brownish yellow (10YR6/8) and light grey (10YR7/1) mottles; slightly stony, with approximately 10% very small to large sandstones; moist; massive; extremely firm; very slightly porous (<0.5% pores >0.5 mm); common fine fibrous roots; no apparent macrofauna; non-calcareous; gradual wavy boundary.
46 - 70	Light brownish grey (10YR6/2) clay; many distinct brownish yellow (10YR6/8) and light grey (10YR7/1) mottles; slightly stony, with approximately 10% very small to large sandstones; slightly moist; massive; extremely firm; very slightly porous (<0.5% pores >0.5mm); very fine fibrous roots; no apparent macrofauna; non-calcareous.

Pit No. 5 Field 8

Location: Grid Reference NZ 2225 5034
Land Use: Oilseed rape stubble
Slope and Aspect: 2° E
Weather: Cool and overcast
Date: 7/10/97

<u>Depth (cm)</u>	<u>Horizon Description</u>
0 - 15	Very dark greyish brown (10YR3/2) medium clay loam, with 1 - 2% inclusions of subsoil; no mottles; very slightly stony, with approximately 3 - 4% sandstones; moist; moderately developed medium and coarse subangular blocky structure; friable; moderately porous; many fine and very fine fibrous roots; no apparent macrofauna; non-calcareous; sharp wavy boundary.
15 - 36	Grey/light grey (10YR6/1) sandy clay loam; many reddish yellow (7.5YR6/8) mottles; slightly stony containing approximately 10% sandstones; moist; moderately developed coarse prismatic structure; extremely firm; slightly porous (<0.5% pores >0.5mm); common very fine fibrous roots; common earthworm channels; non-calcareous; abrupt smooth boundary.
36 - 70	Grey (10YR5/1) clay; many strong brown (7.5YR4/6) and yellowish brown (7.5YR5/8) mottles; slightly stony containing around 10% sandstones; moist; very weakly developed coarse angular blocky to massive structure; extremely firm; very slightly porous (<0.5 pores >0.5 mm); few very fine fibrous roots; no apparent macrofauna; non-calcareous.