



# **GOOD PRACTICE GUIDE FOR HANDLING SOILS**

## **Sheet 15:**

### **Soil Replacement with Bulldozers and Dump Trucks**

**Issued by the Farming and Rural Conservation Agency, Cambridge**

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## MAFF FOREWORD

Standards of restoration of minerals and waste sites have steadily improved in recent years, with operators increasingly aware of their environmental responsibilities. The industry is putting forward more imaginative restoration concepts to a variety of afteruses, and is more aware than ever that it will be judged on the standard of that restoration, and the sustainability of the development.

Sustainable mineral development means balancing economic, environmental and social needs, whilst using resources wisely. The UK Strategy for Sustainable Development recognises the importance of safeguarding agricultural land to meet the needs of future generations, and minimising the loss of soils to new development\*.

Improved restoration standards have sometimes enabled planning permission to be given for best and most versatile agricultural land to be worked for minerals, on the basis that it can be restored in a way that safeguards its long-term agricultural potential\*\*. Inherent in these high standards of restoration is the requirement to handle soils in such a way that damage to their structure is minimised. It is the aim of this Guide to provide comprehensive advice on soil handling “Good Practice” to operators, soil moving contractors, consultants and planning authorities.

The Guide is in the form of 15 Sheets giving advice on soil stripping, the forming and taking down of soil storage mounds, and soil replacement operations using excavators, earth scrapers or bulldozers. There are also four Guidance Sheets on remedial works involving the removal of stones and damaging materials, and decompaction during the replacement operations.

This document should be cited as MAFF (2000), Good Practice Guide for Handling Soils (version 04/00). FRCA, Cambridge.

**Any views expressed in the guidance are those of the consultant and do not necessarily represent the view of the Ministry of Agriculture, Fisheries and Food.**

\*(DETR, A Better Quality of Life, May 1999, paragraphs 6.66 and 8.50)

\*\*MPG7 (November 1996, paragraph 3).

### Acknowledgements

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## **SHEET 15 SOIL REPLACEMENT WITH BULLDOZER & DUMP TRUCKS**

The purpose of this Guidance Sheet is to provide a model method for best practice where the soils are replaced using bulldozers and dump trucks. This Guidance Sheet comprises 6 pages of text, 3 figures and a user response form.

The model may need to be modified according to site conditions or requirements of the Planning Authority. Where this is the case, deviation from the model should be recorded with reasons. The guidance does not specify the type, size or model of equipment, but this should have been agreed as part of the planning conditions or as a reserved matter. The machines should be of a kind which will cause the minimum compaction whilst being operationally efficient (eg wide tracked), and must be well maintained at all times.

Persons involved in the handling of soils, overburden etc., and in the construction or removal of mounds or tips, must comply with the Health and Safety at Work Etc. Act 1974 and its relevant statutory provisions, and in particular those aspects which relate to the construction and removal of tips, mounds and similar structures. This requirement takes preference over any suggested practice in the Sheets.

The user of these guidelines is solely responsible for all liabilities that might arise. No liabilities are accepted for any losses of any kind arising from the use of this guidance.

This soil handling method uses a bulldozer to replace the soils and dump trucks transport it to the replacement area. If the soil is from store an excavator will be required to load the trucks.

The bulldozer soil handling method can significantly affect the agricultural quality of the restoration through severe soil deformation (compression and smearing). This is primarily caused through unavoidable repeated trafficking over the soils during the lifting and the building and excavating mounds, and on replacement; the effects of

which increases with increasing soil wetness. Consequently, for satisfactory restoration there is a need for effective decompaction treatment during the replacement operation (see Sheet 19). Decompaction treatment is an obligate requirement when soils are handled by bulldozers and dump trucks.

The early installation of under drainage is strongly recommended. Where required this should either be undertaken sequentially during the replacement of the soils or in the early aftercare period. Until drains are installed it is recommended that the restored land is sown and managed as grassland.

There are a number of key operational points to minimise the degree and extent of severe soil deformation and for the effective treatment of the compaction:

- (i) To minimise compaction and optimise decompaction:
  - the dump trucks must only operate on the 'basal'/non-soil layer, and their wheels must not in any circumstances run on to the soil layer(s).
  - the adoption of a bed/strip system minimises the need for the trucks to travel on the soil layers.
  - the machines are to only work when ground conditions enable their maximum operating efficiency.
  - the soils are to be stripped by the bulldozer in as thick layer as possible whilst maintaining their operational efficiency.
  - effective decompaction on soil replacement is a requisite of the bulldozer handling method (see Sheet 19).
  - the soil layers should have a moisture content of 5% or greater below their lower plastic limit\*. Moisture content should be assessed by oven

drying\* of samples taken from representative locations and mid/lower points of each soil horizon. [\*Or as required in the planning conditions.]

- (ii) To minimise the re-wetting of the soil and maximising decompaction effectiveness:
- the bed/strip system provides a basis to regulate the exposure of lower soil layers to periods of rain and a means of maintaining soil moisture contents. The soil profile within the active strip should be replaced to the topsoil layer before rainfall occurs and before replacement is suspended.
  - measures are required to protect the face of the soil layer from ponding of water and maintain the basal layer in a condition capable of supporting dump trucks.
  - the area to receive soil is to be protected from in-flow of water, ponding etc. Wet sites should be drained in advance.

### The Replacement Operation

- 15.1 The area to be restored is to be protected from in-flow of water, ponding etc. Wet sites must be drained in advance. Before the operation starts the basal layer should be to level and clean.
- 15.2 Prior to commencing operations a Meteorological Office forecast should be obtained which gives reasonable confidence of soil replacement proceeding without interruptions from rainfall events. If significant rainfall is forecast or occurs during operations, the replacement must be suspended, and where the soil profile has been started it should be replaced to topsoil level.

Replacement must not restart unless the weather is expected to be dry for at least a full day.

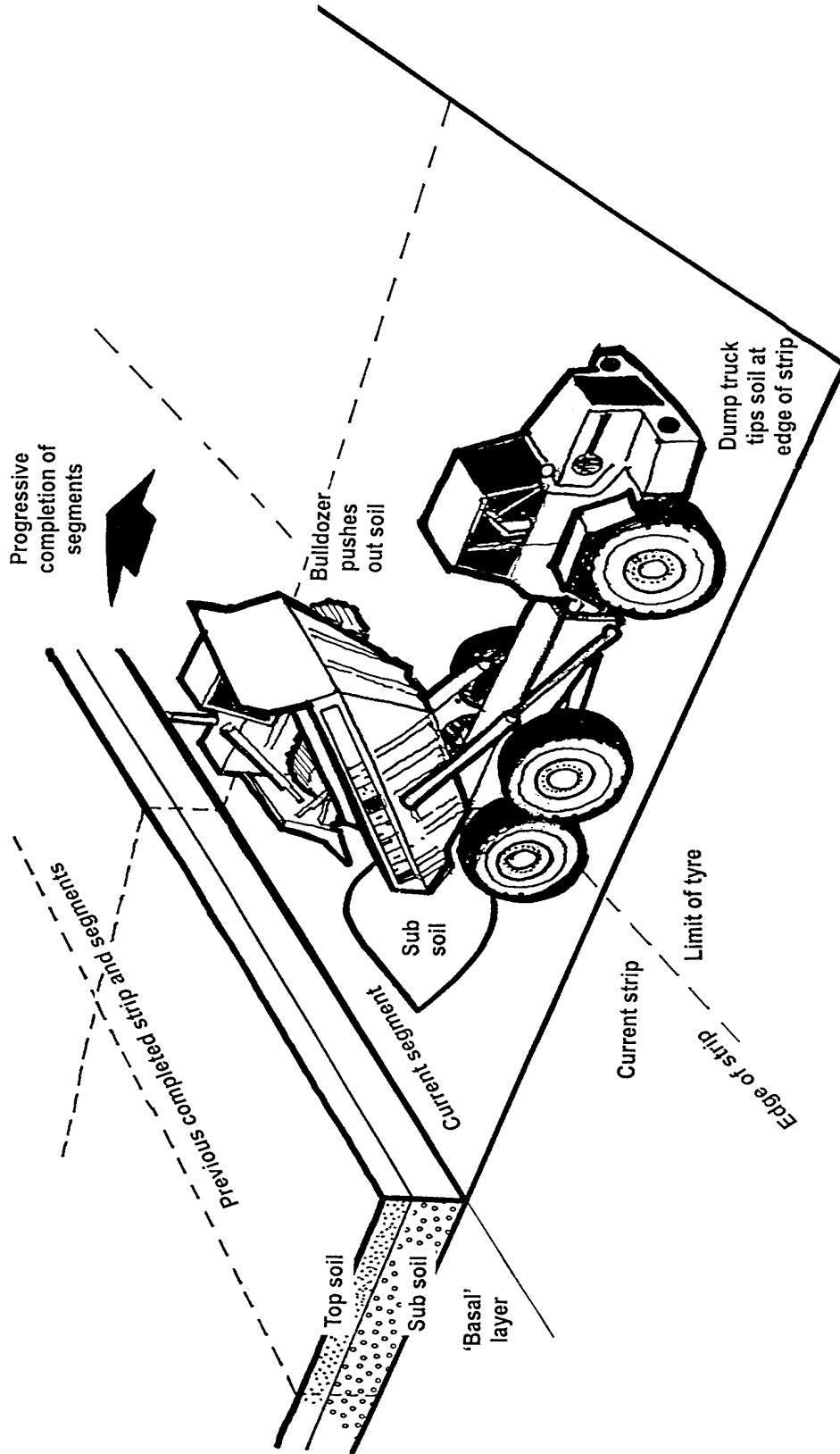
- 15.3 All machines must be in a safe and efficient working condition at all times. The machines are to only work when ground conditions enable their maximum operating efficiency. The operation should only be carried out when the basal layer supports the machinery without ruts or is capable of repair/maintenance. The operation is to be suspended before traction becomes a problem or the integrity of the basal layer and haul routes fails. All haul routes should be maintained.
- 15.4 The operation should follow a detailed replacement plan showing soil units to be replaced, haul routes and the phasing of vehicle movements. The soil units should be defined on the site with information to distinguish types and layers, and thickness. Detailed daily records should be kept of operations undertaken (including the removal of stones and damaging materials, and the results of any assessment of the need for additional decompaction and the effectiveness of decompaction work undertaken), and site and soil conditions.
- 15.5 The dump trucks are only to stand, work and travel on the basal/formation layer. Only the bulldozer is to operate on the soil layers to spread the soil.
- 15.6 The soil layers above the base/formation layer are to be replaced in sequential strips with the subsoil layer(s) to be replaced first, followed by the topsoil layer; each layer being replaced to the specified thickness. The next strip is not to be started until the current strip is completed. This is often referred to as the 'bed or strip system'. The system involves the progressive sequential laying of the materials in strips across the area to be restored (Figure 15.1).
- 15.7 Demarcate the initial strip width (15-20m) and axis, divide strip into 20m long segments. The haul routes should be clearly defined.

- 15.8 Reverse the dump truck to the edge of the current strip and tip the lowest layer (subsoil) soil at the edge of the strip. The bulldozer is used to spread the lower subsoil to full thickness, and in the thickest layers as possible from front to back of strip (Figure 15.2). This is undertaken progressively until the whole segment is complete, and then repeated in each segment until the strip is complete with the full depth of subsoil.
- 15.9 Level boards and soil pits should be used to verify soil thickness in each strip and overall levels. Allowance (ie. bulking factor) should be made for any 'heave' that may take place when the soil is decompacted.
- 15.10 The ripping strategy needs to be determined at the planning of operations and must take into account the thickness of soil layers, depth of recompaction and the effective depth of the ripping tool (Sheet 19), and the need for the removal of stones and other damaging materials (Sheet 17). These should be specified in the soil replacement plan. Decompaction and removal of materials should only take place when each specified soil layer is completed along the strip, and the work must be completed before the next layer of soil is placed.
- 15.11 On completion of the lowest layer (subsoil) across the whole strip, repeat the process sequentially spreading the next layers (subsoil/topsoil) (Figure 15.3). If the dump trucks have to rise on the already placed lower layers, this must be limited to the rear wheels only. The above decompaction operations must be arranged to treat the compacted strip margins.
- 15.12 On completion of the topsoil layer the above processes should be repeated for the next strips until the area to be restored is completed. Before the operation starts the basal layer should be to level and clean.
- 15.13 At the end of each day the current strip/segment must be completed if rain is forecast. If during a day it is evident that a full strip cannot be completed, then ensure the current segment is completed.

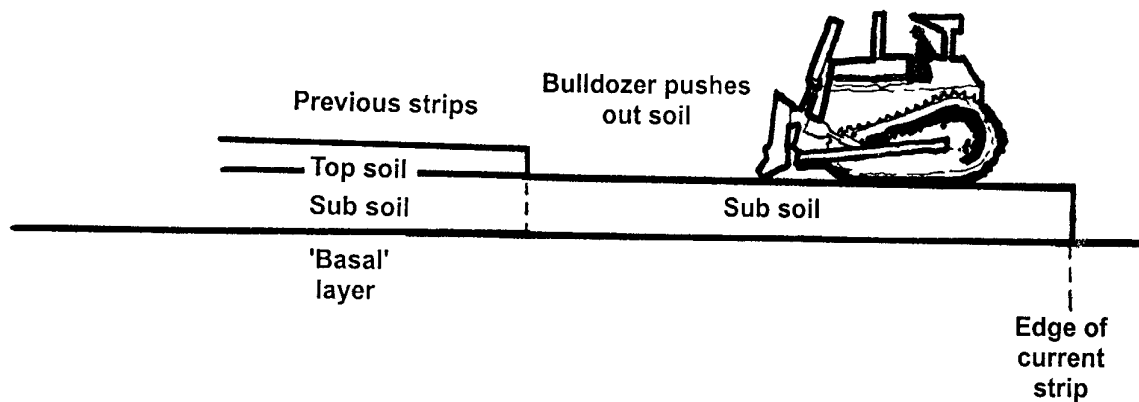
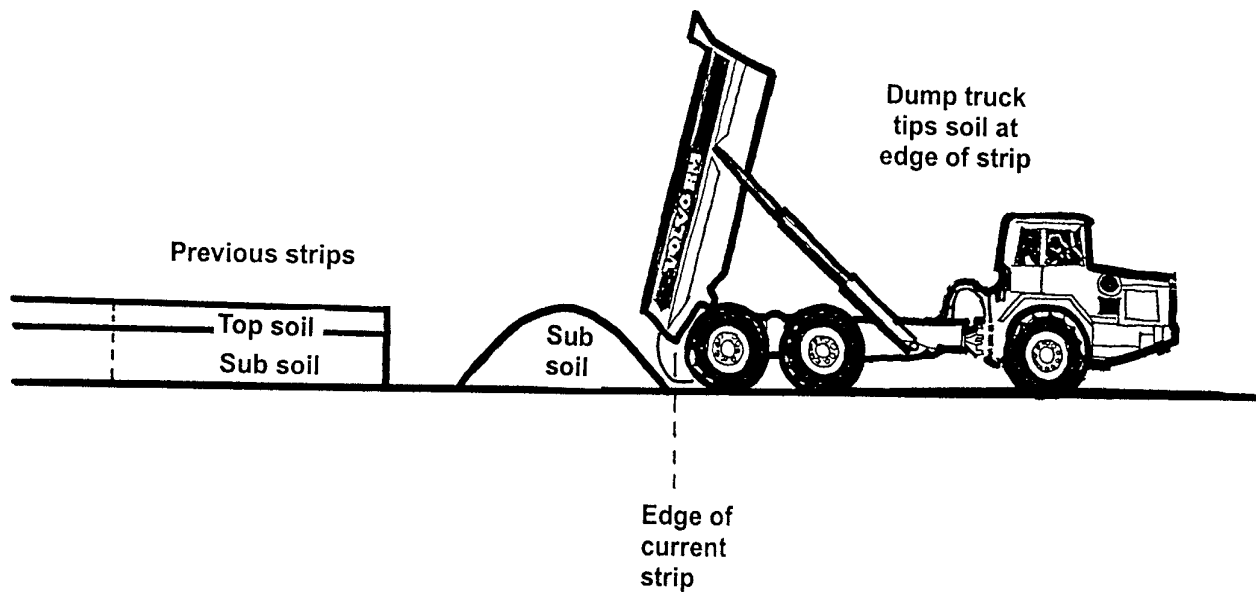
15.14 At the end of each day, or during the day if interrupted by rain, make provisions to protect the base of the restored strip from ponding/run-off by sumps and grips, and also clean and level the basal layer. At the start of each day ensure there is no ponding in the current strip or operating areas, and the basal layer is to level with no ruts.

#### Operational Variation

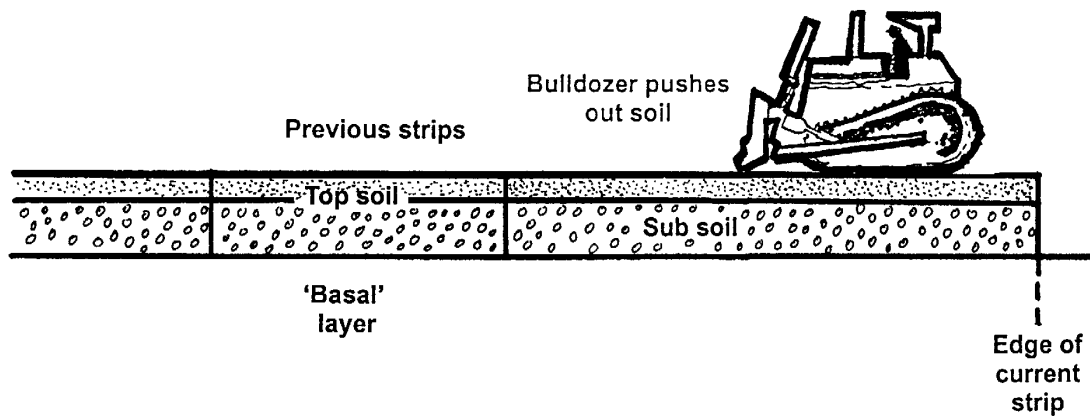
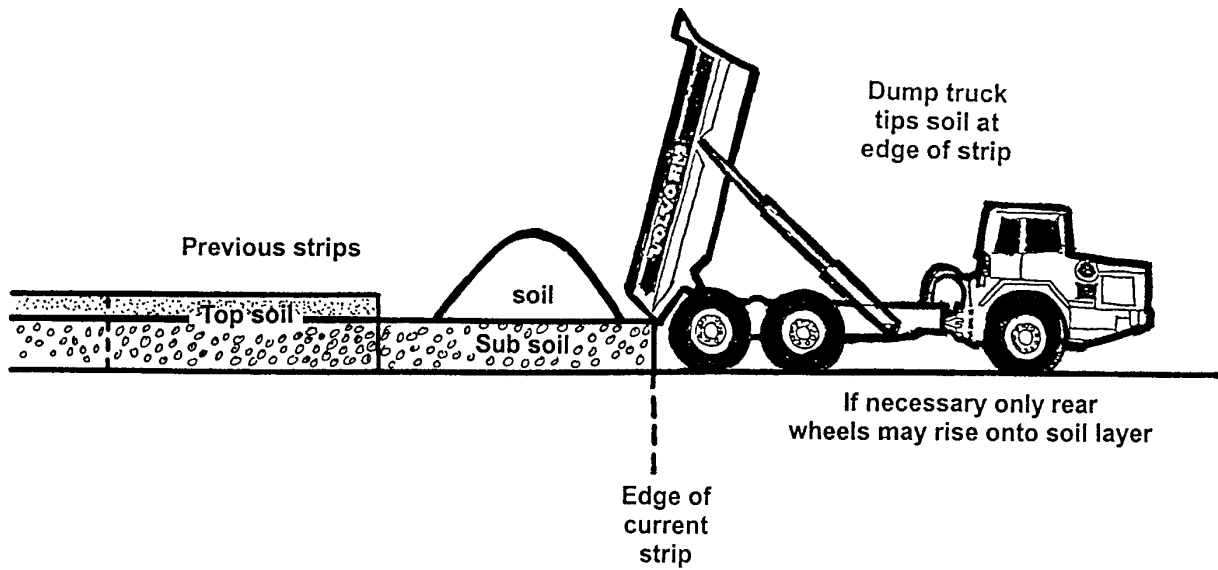
15.15 If the basal/formation layer is to be decompacted, before any soil material is placed, each strip is to be firstly decompacted before the subsoil layer is replaced. Decompaction is dealt with in Sheet 19, which covers strategies, equipment and methods of operation. The basal layer must only be decompacted in the strip required for soil replacement, and must be prepared on the day of soil placement. During this process it may be necessary to use Sheet 17 for the removal of stones or damaging materials from the basal layer.



**Figure 15.1 Soil replacement by bulldozers  
 and dump trucks:  
 Sub soil layer**



**Figure 15.2 Soil replacement by bulldozers  
 and dump trucks:  
 Sub soil layer**



**Figure 15.3 Soil replacement by bulldozers  
 and dump trucks:  
 Top soil layer**

**SHEET 15**

**Version: 04/00**

**FEEDBACK**

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