This Advice Note gives guidance on the environmental design of landform and alignment for new roads.

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New Roads
Landform and Alignment

Summary: This Advice Note gives guidance on the environmental design of landform and alignment for new roads.
VOLUME 10
ENVIRONMENTAL DESIGN

Section 1 The Good Roads Guide - New Roads

Part 1  HA 55/92  Landform and Alignment
Part 2  HA 56/92  Planting, Vegetation and Soils
Part 3  HA 57/92  Integration with Rural Landscapes
Part 4  HA 58/92  The Road Corridor
Part 5  HA 59/92  Nature Conservation
Part 6  HA 60/92  Heritage
Part 7  HA 61/92  Contract and Maintenance Implementation

Section 2 The Good Roads Guide - Motorway Widening

Part 1  HA 62/92  Environmental Design Widening Options and Techniques

Section 3 The Good Roads Guide - Improving Existing Roads

Part 1  HA 63/92  Environmental Design Improvement Techniques

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December 1992
VOLUME 10  ENVIRONMENTAL DESIGN
SECTION 1  THE GOOD ROADS GUIDE - NEW ROADS

PART 1

HA 55/92

THE GOOD ROADS GUIDE
NEW ROADS
LANDFORM AND ALIGNMENT

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GENERAL PREFACE TO THE GOOD ROADS GUIDE
SERIES OF ADVICE NOTES

Structure of the Guide

0.1 The Good Roads Guide is the name given to the series of documents contained in Sections 1, 2 and 3 of Volume 10 of the Design Manual for Roads and Bridges. The Guide is written in nine Parts each of which is published as an Advice Note. The Guide is written to be read as a whole. The Parts of the Good Roads Guide are as follows:-

Section 1 NEW ROADS
Part 1 HA 55/92 Landform and Alignment
Part 2 HA 56/92 Planting, Vegetation and Soils
Part 3 HA 57/92 Integration with Rural Landscapes
Part 4 HA 58/92 The Road Corridor
Part 5 HA 59/92 Nature Conservation
Part 6 HA 60/92 Heritage
Part 7 HA 61/92 Contract and Maintenance Implementation

Section 2 MOTORWAY WIDENING
Part 1 HA 62/92 Environmental Design Widening Options and Techniques

Section 3 IMPROVING EXISTS ROADS
Part 1 HA 63/92 Environmental Design Improvement Techniques

How to use the Good Roads Guide

0.2 Many of the design ideas put forward in Section 1 - New Roads are also relevant to the other Sections and cross references have been provided.

0.3 The first Chapter of each Part of the Guide reviews the issues and topics covered. The subsequent chapters deal with a particular topic. Within each chapter, the key issues are first listed and then discussed with illustrations drawn from roads throughout the UK.

0.4 The Good Roads Guide is not a step-by-step guide on how to build a road or a substitute for professional advice. It is intended to be used by the designer to help in the identification of areas and issues where careful consideration of environmental factors is required. The division of the Guide into Parts and the Parts into topics has been done to aid this process.

0.5 Environmental design of roads is a matter of respecting the special character of each individual location. The illustrations included show solutions devised to meet the requirements of specific sites. The use of standard solutions, irrespective of the location, is not appropriate.

Implementation

0.6 The principles set out in this Advice Note should be taken into account in the preparation of all schemes for the construction and improvement of trunk roads, including motorways.

0.7 Where conflicts exist between environmental design, costs, engineering feasibility and safety requirements, and competing options are available, the Design Organisation will need to advise the Overseeing Department accordingly.

Application in Wales

0.8 Requirements in Wales are primarily covered by the publications "Roads in Upland Areas: Design Guide" (published by the Welsh Office 1990) and "Roads in Lowland Areas: Design Guide" and "Rock Profiling and Vegetation Re-establishment" (both due for publication by the Welsh Office in 1993). This Advice Note supplements these Design Guides.

Application in Scotland

0.9 The Scottish Office Roads Directorate endorses the practice given in the Good Roads Guide. More specific guidance is provided by the Roads Directorate's Landscape Officer.

0.10 The Scottish Office discussion document published in February 1992 "Roads, Bridges and Traffic in the Countryside" addresses related issues.
Application in Northern Ireland

0.11 The principles set out in this Advice Note are endorsed as good practice by the Department of the Environment (NI). The guidance will be taken into account in preparing schemes for the construction or improvement of all roads in Northern Ireland.
CHAPTER 1  LANDFORM AND ALIGNMENT: INTRODUCTION

1.1 SCOPE

- This Part gives guidance on the environmental design of landform and alignment for new roads.

1.2 MAIN ISSUES

- The objective of route selection should be to choose a route which has both the minimum effect on landform and requires the fewest large earthworks.
- Integration with the existing landform can best be achieved by grading out cuttings and embankments to slopes which reflect the surrounding topography.
- Grading out earthworks may affect adjacent sites of conservation or heritage interest. In such cases a balance needs to be struck. A major consideration is that non-renewable resources, such as ancient woodland, should be avoided wherever possible.
- The design of earthworks and their integration with the surrounding landform should aim to achieve the best possible use of excavated materials within the scheme, thus minimising the need for off-site tipping or borrow pits. If off-site works are necessary, they should be subject to the same good design principles as those used on site, achieved by liaison with the appropriate planning authority.
- Earthworks can only be integrated successfully if the new landform and its soil structure allow effective planting or return to an adjacent land use. Restoration to agriculture can be particularly effective in integrating the new road with the landscape. Effort spent in creating a landform which cannot provide the right conditions for plant growth is wasted.

1.3 EFFECTS OF ROAD DEVELOPMENT ON LANDFORM

Good alignment and design can help overcome many of the following effects:
- intrusion of the road into undisturbed, high-quality landscapes
- large earthworks which intrude into views from nearby property and public places
- intrusive embankments crossing valleys and low-lying land
- cuttings which create notches on the skyline or scars on hillsides and sidelong ground
- unsympathetic junctions between new and existing landscapes
- landtake required for large earthworks affecting heritage and nature conservation sites
- changes to drainage regimes.

1.4 DESIGN OBJECTIVES

- To choose the route least damaging to the landscape; this will be the one that respects existing landform best and avoids disruption of major topographical features.
- To find an alignment which uses the existing landform to good effect and which minimises the scale of earthworks.
- To design profiles which reflect existing natural slopes.
- To retain the least highway land, by the return of land to its former use where this does not conflict with the need to provide mitigation by planting.
- To use existing landform to minimise noise and visual intrusion: for example, placing a road in a cutting or behind rising ground to protect settlement.
- To develop new landforms, including mounds and false cuttings, to screen the road from settlement.
- To achieve a balance between horizontal and vertical alignment which minimises earthworks but provides the best integration with natural landform and the best screening for settlement.

1.5 MITIGATION

- The best mitigation is the selection of the least-damaging route. Mitigation should not be approached as a means of improving an inherently poor route.
- Full use should be made of the Overseeing Department’s statutory powers for mitigation. Particular use should be made of the compulsory acquisition of land for mitigation and the use of land under license for grading out earthworks. Areas required for the latter should be included in the draft Compulsory Purchase Order for the scheme but can be returned to the owner after the works have been completed.
- Consideration should always be given to varying standards to accommodate environmental constraints.
- Design must respond both to the broad scale of the topography and to small-scale landform. Earthworks should respond even to minor changes in the geological characteristics along the route.
- Detailed earthworks’ design can make all the difference to a scheme. For example, careful consideration needs to be given to side slopes and, in particular, the junctions between earthworks and the verge or adjacent landform. The relationship between the junctions of earthworks with interchanges, overbridges or balancing ponds is also very important.

1.6 STATUTORY BODIES

- Within this Part, reference to the Department of Transport, English Nature, English Heritage and the National Rivers Authority should also be read as referring to the appropriate statutory authority or adviser for Wales, Scotland and Northern Ireland.
CHAPTER 2  GRADING OUT CUTTINGS AND EMBANKMENTS

2.1 PRINCIPLE

- Grading out of earthworks needs to be considered in relation to the amount of surplus or deficient material. For example, grading out of embankments may be a useful way of disposing of surplus material. In grading out cuttings, care must be taken not to open up views of the road from surrounding countryside.

2.2 KEY ISSUES

- Grading out provides integration with the surrounding landscape.
- Land can be returned to agriculture, reducing maintenance liabilities and maintaining landscape character.
- Vegetation is easier to establish on slopes shallower than 1:2.
- Compaction can be avoided more easily on slopes shallower than 1:2.
- Fences and hedges can follow the landscape pattern on graded-out land.
- Graded-out embankments dispose of surplus material.
- Return to agriculture requires minimum gradients of 1:4 for pasture and 1:10 for arable. The high standards of soil handling and reinstatement needed are described in Pt 2, Ch 13. Agricultural advice on restoration is needed at the design stage.
- Land required for grading out is included in the draft Compulsory Purchase Order and handed back after the scheme has been completed.

2.3 GRADING OUT CUTTINGS

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<th>Good practice</th>
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Minor cuttings  Prominent minor cuttings can be avoided completely

A287, East Sussex  Not only is the landform conspicuous and harsh, but it is a maintenance liability. The unattractive drain and skylining of the fence make matters worse.
2.3 GRADING OUT CUTTINGS CONTINUED

Good practice: M40, Pans Hill Grading out the embankment below the hill and return to agriculture has reduced its impact on the landscape.

2.4 GRADING OUT EMBANKMENTS

Common practice Minimum gradient

Improvement Prominent embankments can be graded out and returned to agriculture.

Good practice: A6, Derbyshire The bank has been graded out and returned to pasture. Both the verge and wall are in keeping with local character.

2.5 MAJOR CUTTINGS AND EMBANKMENTS

It is often inappropriate to grade out major cuttings and embankments, either because the scale of the earthworks required makes it impractical or because the grading out would extend into areas of heritage, landscape or nature conservation interest, or would affect property. In these cases, attention to the details of the tops of cuttings, toes of embankments, variations in gradient and finished surfaces, as set out in Ch 16, can make all the difference to a scheme.

A27, Brighton Bypass The slopes of cuttings and embankments have been graded to those of the prevailing landform.
3.1 PRINCIPLE

Where lateral views of a section of road are intrusive, a cutting is one of the best means of hiding it. Cuttings, however, may themselves be intrusive, particularly where they create a skyline notch, or are on sidelong ground.

3.2 KEY ISSUES

- Sinking a road in a cutting to hide it from view may create a surplus of spoil which has to be disposed of.
- Avoiding a notch is often best achieved by a curved alignment through the higher ground.
- The careful siting of a bridge can often help reduce the impact of a cutting on the skyline.

3.3 HIDING THE ROAD

Good practice: M40, Warmington Valley The cutting hides the road and much of the traffic

Typical good practice

3.4 PROMINENT MAJOR CUTTING FACES

A229, Kent Cuttings which take the edge off one side of a hill can be very prominent and should be avoided by better alignment wherever possible

3.5 MINOR CUTTING FACES

Good practice: A6, Derbyshire On a smaller scale, especially in upland areas, rock cuttings can match existing features and are in character with the area
CHAPTER 3 SITING AND ALIGNMENT OF CUTTINGS

3.6 AVOIDING A NOTCH

A303, Wiltshire Poorly-sited and aligned cuttings can create a notch on the skyline visible from a wide area.

Good practice: M40, Chilterns The well-sited cutting on a curving alignment is concealed from wide views as it climbs the Chilterns escarpment.

Good practice: A6, Lincoln The cutting is aligned in a curve and the elegant, award-winning bridge restores the broken skyline.

3.7 ALIGNMENT

Bad practice A road at right angles to the contours creates a widely-visible cutting.

Better practice A curved alignment reduces views of the cutting from the countryside and for the driver.

Best practice This takes a curved alignment through a re-entrant or other suitable landform.
4.1 PRINCIPLE
- False cutting is a means of screening the road from properties in the surrounding landscape. It is particularly appropriate in gently-undulating ground where a natural cutting cannot be achieved. It has the added benefit of reducing the impact of noise.
- The best effect is obtained where the backslope is returned to the adjacent land use, maintaining the character of existing views.

4.2 KEY ISSUES
- Restoration of the backslope to agriculture requires the standards set out in Pt 2, Ch 13.
- Cuttings need to be 4.5 m deep to screen all vehicles, but a depth of 2 m will hide cars.
- False cuttings have been widely used to maintain in historic landscapes, but attention to detail is needed to ensure that the full character of the vista is retained.
- Particular attention needs to be paid to the way in which each end of a false cutting is graded into its adjacent landform.
- False cutting may require additional fill.

4.3 EFFECTIVE FALSE CUTTING

4.4 ATTENTION TO DETAIL

M20, Chilston Park, Kent  Most of the benefits of a false cutting have been lost here through poor attention to detailing

4.5 MAINTAINING AN IMPORTANT VISTA

A50, Sudbury, Derbyshire  False cutting has been used to maintain views of the folly from Sudbury Hall. Cars are hidden but heavy goods can still be seen. A higher bank would have cut out most views of the folly and would have spoiled the view
CHAPTER 5 FOLLOWING THE CONTOURS

5.1 PRINCIPLE

- Following the contours is, in general, good practice. It integrates a road with the landscape, reduces earthworks and minimises disturbance to adjacent land use.

5.2 KEY ISSUE

- The design of each scheme should take into consideration the full range of vertical and horizontal alignment standards available.

5.3 RESPONSE TO LANDFORM

Poor practice: M1, Bedfordshire The straight alignment cuts across the gently-undulating midlands landscape

To be avoided A better alignment would avoid cutting through these two closely-spaced ridges with prominent, steep-sided cuttings and the prominent cutting for the side road

5.4 FOLLOWING THE CONTOURS ACROSS UNDULATING LOWLAND

Good alignment This follows the lower ground and rises up at the shallowest gradients

Bad alignment The road would produce a sequence of cuttings and embankments resulting in large areas of highway land

5.5 GOOD RESPONSE TO LANDFORM

Good practice: A386, Devon In this example the road follows the landform successfully. It could have been improved by consistent use of a dark surface and by grading out the land by the bridge
CHAPTER 6  RESPONDING TO RIDGES

6.1 PRINCIPLE
- Road alignments need to respond to ridges and make best use of them to fit the landscape.

6.2 KEY ISSUES
- Following the foot of a major ridge often allows the road to lie on ground hidden from settlement on the ridge.
- Intervening ridges can be used to protect nearby settlement from noise and visual intrusion.
- Even minor ridges offer opportunities for sensitive alignment. A rise of only 4 or 5 metres can be used to protect a nearby settlement.
- Although roads on the skyline should generally be avoided, following the top of a major ridge can have environmental benefits by avoiding valley settlement.

6.3 FOLLOWING THE FOOT OF A MAJOR RIDGE

M25/A22 junction, Surrey  The road follows the foot of the dip slope of the North Downs and the major junction is absorbed by the sale of the ridge

Good practice

6.4 INTERVENING RIDGES

Intervening ridges can be used to protect nearby settlement from noise and visual intrusion

6.5 OPPORTUNITIES PROVIDED BY MINOR RIDGES

M4, Gwent  Even minor ridges are useful. A road is usually less visible when it follows their edge: it never appears on the skyline

6.6 FOLLOWING THE CREST OF A MAJOR RIDGE

M4, Ridgeway, Wiltshire  The valley sides and valley bottoms have intricate landform, vegetation and settlement patterns so that a road off the ridge would have a major impact

While this principle needs to be treated with caution, it can be an appropriate solution where the skyline is avoided. In addition, there is an opportunity to place roads which follow higher ground or ridges in cuttings, further concealing them from view: see Ch 3.
CHAPTER 7  ROADS ON SIDELONG GROUND

7.1 PRINCIPLE
- Roads rising up or following valley sides on sidelong ground can be very intrusive. They can give rise to prominent earthworks if not properly sited and designed.

7.2 KEY ISSUES
- Split carriageways are often effective for sidelong ground.
- Alignment along a valley side can offer the best concealment from ridges and the often intricate landscape of valley bottoms.
- Alignment should avoid major earthworks resulting from cutting through subsidiary ridges and valleys.
- Sidelong ground can present geotechnical problems which may preclude the ideal landscape solution.

7.3 SEPARATE CARRIAGEWAYS

7.4 GOOD ALIGNMENT

A30, Okehampton Bypass  Well-placed alignment on the valley side means that the route is concealed from Dartmoor on the higher ground and avoids the intricate landscape of the valley bottom.

7.5 AVOIDING MAJOR EARTHWORKS

Good practice: M6, Lune Gorge, Cumbria  Split carriageways have been combined with grading out and the return to pasture of cuttings and embankments.

Concealing the road completely  This can be done in suitable terrain by creating separate cuttings for each carriageway.

Major earthworks are avoided by following the contours high up the valley side.
CHAPTER 8 FOLLOWING A VALLEY BOTTOM

8.1 PRINCIPLE

- Following a valley bottom can conceal a road from long views. However, it can have a major impact on river and vegetation patterns along the valley bottom and can be prominent in views from the valley sides unless adequately aligned and designed.

8.2 KEY ISSUES

- Good practice should avoid crossing and recrossing watercourses, roads, railways and other linear features of valley bottoms.
- Roads placed to one side of the valley at the junction between the valley bottom landscape and the valley sides’ landscape can often provide the most effective solutions.

8.3 ALIGNMENT

Bad practice

Good practice

8.4 HIDING THE ROAD

M25, Surrey Avoiding severance of the meander would have improved this alignment

M40, Warmington, Warwickshire A false cutting has successfully concealed the motorway in the Warmington valley
CHAPTER 9 CROSSING VALLEYS

9.1 PRINCIPLE
- Roads can be carried across valleys on embankments or viaducts. Each has environmental advantages and disadvantages which need to be considered as early as possible in the design process.

9.2 KEY ISSUES
- Choosing the appropriate crossing point is essential.
- Narrow, steep-sided valleys are best suited to viaduct crossings and wide, shallow valleys to embankments. The intermediate cases, however, often present difficult problems. The issues can best be summarised as follows:

  **Viaducts:**
  - retain views down the valley
  - can be design contributions to the landscape, and minimise visual intrusion
  - minimise landtake and thus impact on property, heritage and nature conservation
  - are expensive
  - offer fewer opportunities for planting

  **Embankments:**
  - block views down the valley
  - can have a large landtake
  - can be integrated with the adjacent landform
  - can incorporate false cutting for screening
  - offer more scope for screen planting.

9.3 VIADUCTS AND NARROW, STEEP-SIDED VALLEYS
Viaducts can be essential in minimising landtake and severance on sites of nature conservation interest: see Pt 5, Ch 4. They can maintain views down valleys minimising disruption of landscape character.

**Viaducts** are best suited to a narrow, deep crossing point.

A30, Okehampton Bypass The viaduct allows the character of the valley to be retained

A69, Cumbria The viaduct is high enough to allow the vegetation underneath to become fully integrated with its surroundings.

A69, Cumbria The viaduct across this valley near Keswick has allowed property and industrial archaeological features to be retained. The impact of an embankment would have been severe.
9.4 EMBANKMENTS AND WIDE, SHALLOW VALLEYS

M6 over the Ribble, Lancashire  The embankment is on a long sag curve which prevents it from dominating the valley or obstructing views across it. A viaduct would have been more obtrusive.

9.5 VIADUCT OR EMBANKMENT?

The embankment is visually dominant, blocks the view down the valley and does not fit the landscape well, but...

A viaduct would not be a significant improvement.

Improvement An embankment can be integrated with the landscape by good use of earthworks and planting integrated into landscape.
10.1 PRINCIPLE

- Flat landscapes vary greatly in character. An understanding of appropriate scale and landscape context is essential for good alignment and design. Conventional screening earthworks can be inappropriate and serve only to draw attention to the road.

10.2 KEY ISSUES

- The road should be kept as near existing levels as possible
- Alignments using existing topographical, drainage and vegetation features are often the best.
- Earthworks should avoid emphasising the line of the road.
- Flat landscapes such as the Fens are often of high agricultural value, so disturbance of soils may have to be kept to a minimum.

10.3 USING EXISTING FEATURES

- Woodland, banks or other large features prevent traffic from appearing against the skyline

A17, Lincolnshire Here the road follows the embankment of a disused railway line across the Fens

10.4 RESPONSE TO LANDSCAPE TYPES

Modern rectilinear patterns

Landslapes like the Fens have straight roads and field boundaries and rectangular plantations. Flood prevention banks often form long, low features in the landscape. Roads can follow such linear features or be linear features themselves without changing landscape character

Ancient patterns

Landslapes like Romney Marsh are very different from modern rectilinear ones. A high density of nature conservation and heritage features which need to be avoided is one of their characteristics, and straight roads are alien to them. However, they often have more features to form foci for mitigation measures than other landscapes
10.5 LOCATION OF EARTHWORKS

Good design principles

A140, Norfolk A prominent bund adjacent to the road becomes a dominant feature in flat landscapes

10.6 GRADING OUT

Embankments with rough grass emphasise the line of the road, particularly in arable areas

On lower-grade agricultural land it may be feasible to grade out the road embankment and avoid ditches with sharp profiles.
CHAPTER 11 USING MAN-MADE FEATURES

11.1 PRINCIPLE
- Alignment with man-made features can help to absorb a road into its setting and minimise the impact of a new road on the countryside.

11.2 KEY ISSUES
- Disused railways with mature vegetation have been successfully used for new roads in several parts of the country.
- Existing transport and service corridors can be used.
- Modifying existing structures such as railway bridges, which are often of significant aesthetic and heritage merit, can be successful.

11.3 REDUNDANT RAILWAY LINES

A22, East Grinstead, East Sussex Here the road has been routed within a disused railway cutting, concealing it from view and avoiding the disturbance caused by construction of a new route.

11.4 EXISTING RAILWAY LINES

M1, Hertfordshire By aligning the motorway with the line of the railway, disturbance to the landscape has been minimised.

11.5 PYLONS

M3, Hampshire Siting a road alongside pylons can be an effective way of minimising intrusion into the landscape.

11.6 EXISTING STRUCTURES

A17, Sutton Bridge, Lincolnshire Across the River Nene was originally a nineteenth-century railway bridge which has been enlarged and modified structurally to take traffic from an upgraded road. The scheme has retained this significant landscape feature and avoided the construction of a new road bridge.

A361, South Molton, Devon In this award winning scheme the original railway viaduct has been modified to carry a new trunk road, while maintaining its distinctive character.
**12.1 PRINCIPLE**
- Grade-separated junctions and at-grade roundabouts can be very intrusive unless well-sited and designed with earthworks at an appropriate scale.

**12.2 KEY ISSUES**
- Major grade-separated junctions should be sited on low-lying ground screened by landform wherever possible. Siting and earthworks need to take into account the impact of gantries, signs and lighting, as well as the road and its traffic.
- All earthworks for grade-separated junctions need to be constructed in line with good practice for slopes and with their potential for planting and seeding in mind.
- Particular care should be taken with earth-shaping between the carriageway levels. Whenever possible existing vegetation should be retained within the junction.
- The landtake required for grade-separated junctions provides an opportunity for substantial planting and the establishment of species-rich grassland and wetland balancing areas.

Note: This section should be read together with Chs 2, 6, 13; Pt 2; and Pt 5, Ch 2.

**12.3 WELL-SITED JUNCTIONS**

M25, Junction 6, Surrey *The junction is well-sited at the foot of the North Downs and concealed from major public viewpoints*

**12.4 PROMINENT JUNCTIONS**

M1, Junction 23A, Leicestershire *The junction is too prominent in this flat, open, river valley. There is little natural landform around which improved screening could be based*

**12.5 LANDSCAPE TREATMENT OF MULTI-LEVEL JUNCTIONS**

The M40/M42 Umberslade Junction *The site for this junction was chosen because it had the minimum impact on the surrounding landform and woodland. Mature trees have been retained with instant effect. The extensive areas of grassland are suitable for habitat creation. Well-designed mounding and planting separate the carriageways effectively*
CHAPTER 13  ROUNDABOUTS

13.1 PRINCIPLE
- Roundabouts can be very intrusive unless well sited and designed with earthworks and planting of an appropriate type.

13.2 KEY ISSUES
- Roundabout earthworks generally need to be low, simple and rounded.
- Well-designed roundabouts can signal the change from a rural to an urban environment.

**Guildford** Varied grading has created a satisfactory landform

The angular earthworks give a very unsatisfactory appearance, although planting will soften the effect in time

**In rural areas** the planting of trees and a simple, domed profile will often be an appropriate design

**Mounding** should not be arbitrary and should be integrated with planting on the roundabout and adjacent to it

Change from rural to urban environments can be signalled by appropriate roundabout
14.1 PRINCIPLE

- While every effort should be made to ensure a balance of cut and fill, surpluses or deficiencies of material can arise. The contractor is obliged to obtain planning permission to dispose of or win new material off site and it is essential that there is full co-operation with the planning authority which should provide clear guidance.

14.2 KEY ISSUES

- The earliest possible recognition of the need for disposal or borrow pits is essential in order to produce a satisfactory design.
- Sometimes the full extent of the requirement can only be determined by detailed design or during the course of the contract as materials are excavated or worked.
- The planning authority should have the opportunity to provide information for tenderers on potential sites and listing the conditions which would apply for their design and afteruse.
- Wherever possible, surpluses or shortfalls should be dealt with in the design of earthworks on site, for example by grading out embankments or cuttings.
- Where off-site works are required it is usually better to tip or borrow close to the site to avoid the impact of moving materials on local roads.
- The environmental impact of borrow and disposal sites should be assessed and the best sites used in the scheme design.
- Return to previous land use is often an appropriate objective. This is usually agricultural use. Alternatively flooded borrow pits can sometimes be turned into features of landscape and nature conservation interest.

14.3 DISPOSAL OF SURPLUS MATERIAL

Good practice: Surpluses can be integrated with the road earthworks in many cases

14.4 BORROW PITS

M40, Warwickshire Surplus material has been graded out to the least of the overbridge and returned to agricultural use, disguising the bridge embankment

M40, Oxfordshire This borrow pit was excavated late in the construction programme, without the opportunity for some of the archaeological features within it to be avoided or excavated. The sides are so steep that they may slump and are unlikely to develop into features of wildlife interest

Successful designs have terraced, gentle slopes for colonisation by aquatic vegetation, wide enough to provide both a shelter and a screen for animals: see Pt 5, Ch 4 and the example shown below.

Good practice: M27, Hampshire Borrow pits have formed the basis of a new public open space in a heavily-developed area
15.1 PRINCIPLE

- Bored tunnels can be used to avoid major impact on settlement or sites of high amenity, nature conservation or heritage interest. Cut-and-cover tunnels minimise impact where a road passes through a densely built-up area.

15.2 KEY ISSUES

- Tunnels are very expensive and a thorough appraisal of the costs and environmental benefits is needed before a decision is made.
- Siting of the tunnel portals, their landscape treatment and the alignment of the approach road are the major environmental design issues.
- Control buildings and ventilation shafts may be required. Their design and siting is of crucial importance.

15.3 CUT AND COVER TUNNELS

Amenity benefits

M25, Bell Common Tunnel, Essex This cut-and-cover tunnel allowed the reinstatement of a cricket pitch and woodland at the edge of Epping Forest

A1(M), Hatfield Tunnel, Hertfordshire Cut-and-cover tunnels can provide commercial development and minimise severance in urban areas

15.4 BORED TUNNELS

A55, Penmaenmawr, North Wales This tunnel portal allows the maximum amount of vegetation to soften its appearance

A55, Conwy, North Wales A tunnel has been placed under the River Conwy to avoid intrusion on the historic town and its setting
CHAPTER 16  CUTTINGS: VARYING GRADIENTS

16.1 PRINCIPLE
- Cuttings have usually been constructed to a uniform gradient of 1:2. They are often in harsh contrast with natural gradients which are more varied and irregular. Good design can provide better integration with natural landforms.

16.2 KEY ISSUES
- Different rock types give rise to different natural slopes, and cuttings should reflect these, blending into natural gradients wherever possible.
- In areas of woodland and rough pasture, an irregular surface finish will provide better integration with the adjacent areas.
- Junctions between new artificial gradients and natural ones need careful attention as described in Chs 2, 3, and 12. In particular there are benefits in rounding off the tops of cuttings to a gentle profile, creating a gradual transition to the natural landform.

16.3 INTEGRATING WITH NATURAL LANDFORMS
The photograph below, with a typical section shown to its right, shows how natural gradients respond to changes in parent material. Uniform engineered gradients would be in stark contrast and a subtler response is needed.

Natural conditions  The hard ragstone rock on the upper part of this escarpment has a different gradient and a different landform character to the more gently-sloping clay below it. The irregular outcrops characteristic of ragstone have significant nature conservation interest.

Design solutions for rough pasture  The cuttings have been designed to take account of varying gradients, leaving scattered rock outcrops exposed, and an irregular finish to the rough pastures. Monitoring of construction by a landscape clerk of works is an essential part of the implementation of such a scheme.

16.4 SMALL-SCALE VARIATIONS IN SLOPES

Natural, small-scale landforms like these can be imitated by a combination of detailed specification and on-site supervision, together with monitoring by resident engineers and clerks of works.
17.1 PRINCIPLE

- Terracing can be used to break up the sides of deep cuttings, overcoming their dominance. Sometimes it is also required for structural stability. However, regular terracing often emphasises the dominance of the slope, so good design must create variety.
- Terracing provides the opportunity to establish vegetation.

17.2 KEY ISSUES

- Terracing needs to work with the natural bedding planes of the parent rock.
- Design of terracing needs to be considered in conjunction with exposure of rock outcrops (see Ch 18) and the establishment of vegetation on steep slopes (see Pt 2, Ch 11).
- Planting on terraces can be difficult and often looks unnatural. Creation of the right landform for natural regeneration is often more appropriate.

17.3 THE NEED FOR TERRACING

This steep chalk cutting could have been better terraced without a major increase in landtake.

17.4 REGULAR TERRACES

- In both of these cases the benching is too regular and it will be a long time before their regularity is disguised by planting.

17.5 EFFECTIVE PRACTICE

- Adequate benching has allowed the establishment of vegetation, although it is rather too regular.
- Section showing the principles of good terracing.

A229, Kent

Dartford Tunnel approaches

A361, Devon
18.1 PRINCIPLE
- Rock outcrops can provide a sense of place, driver interest and nature conservation benefits. They are often preferable to attempts to establish vegetation on very steep slopes.

18.2 KEY ISSUES
- Modern blasting techniques can cut across bedding planes and leave an unnatural shear face. Specialist advice is needed to work with the natural bedding planes to ensure the best visual effect.
- A varied profile is needed for visual character and to allow vegetation to establish.
- Planting on rock outcrops is difficult to establish and maintain and it rarely looks natural. It is better to ensure the right conditions for natural regeneration from the start.
- A safe distance needs to be allowed between the outcrop and the carriageway.

18.3 USING THE CHARACTER OF THE ROCK

18.4 CUTTINGS AND VEGETATION

**Good practice: A6, Derbyshire** This limestone exposure where natural regeneration has become established and the characteristic form of the limestone is exposed, gives a very distinctive character to the road. Furthermore, the wall fits in with this outcrop.

**M6, Cumbria** On small cuttings where there are no major roadside constraints it is often possible to pull back and vary the nature of the rock outcrops to produce attractive roadside features.
18.5 A SENSE OF PLACE

M1, Charnwood Forest, Leicestershire This section of road is given immediate character and a sense of place where it passes through the only granite outcrop in lowland England.

18.6 SAFETY

1. Cutting base An adequate distance from the carriageway needs to be left and the fencing needs careful attention. 2. Scree safety Weathering produces scree which develops a characteristic vegetation of nature conservation interest. 3. Cutting top Unstable soil and vegetation at the top of the cutting must be cleared.

18.7 INTEGRATION WITH STRUCTURES

A470, Glamorgan A mixture of materials, unsightly efflorescence, different stone sizes and the absence of stone cladding on the abutment gives a poor result.

A470, Glamorgan Gabions have been used to retain unstable ground in a very good practice.

Good practice The bridge has been integrated with the sandstone outcrop by the use of stone walling and stone cladding of concrete infill.

Good practice: M6, Cumbria Concrete within the outcrop has been clad in local stone.
19.1 PRINCIPLE

- Individual designs are needed for roadside ditches and drains to meet different site conditions. Good design ensures that drainage is unobtrusive and, where large-capacity ditches are required, landscape and nature conservation benefits are considered.
- Design must take account of the need to protect watercourses from pollution. This can be achieved by using settlement chambers and balancing ponds, see Ch 20.

19.2 KEY ISSUES

- Wherever possible roadside drainage should be integrated with the drainage of adjacent land.
- Roadside drains need not be open and gravel-filled: less conspicuous design solutions are available.
- Roadside ditches can be used to integrate the road with the surrounding landscape. They can be developed for their wildlife interest, and can be used to buffer adjacent sites for nature conservation interest.
- Full advantage should be taken of the wide range of geotextiles available for unstable soil conditions.

19.3 INTEGRATING DRAINAGE

A clumsy and intrusive drainage scheme

19.4 ROADSIDE DRAINS

Prominent, gravel-filled drains, with their mowing and weed control problems, can be replaced by the type of detail shown below:

M6, Cumbria A concealed roadside drain

19.5 ROADSIDE DITCHES

A 453, Ashby-de-la-Zouch, Leicestershire

This ditch design combined with a coarse grass verge and lack of roadside hedging make

M6, Cumbria Where drainage down a cutting face is necessary to cope with flash flooding, a site specific design using local materials such as this is the best solution

Improvement Where erosion control is required, lining channels with geotextile is always preferable in landscape terms to

Improvement Although grading out the cutting requires extra landtake and restoration of the pasture, it provides a much better landform, integration of the road with the landscape and natural position for the channel at the base of the slope

Good practice: A435, Evesham Bypass The right cross section has allowed natural vegetation to establish, making an attractive edge to the road
20.1 PRINCIPLE

- Balancing ponds are opportunities to create features of landscape and wildlife interest using well-established design principles. Site-specific design proposals are needed, not the unconsidered application of standard details.

20.2 KEY ISSUES

- Good design needs sufficient landtake for flowing natural contours, with full contour drawings provided to the contractor.
- Security fencing and access points need to be integrated with the design.
- Shallow edges are necessary for vegetation establishment. Membranes and concrete liners need to be well-buried.
- A commitment to proper management and maintenance is essential.
- Wildlife will only become established if good water quality is maintained.
- Consideration should always be given to overdeepening dry balancing areas to ensure that they can provide a wetland habitat throughout the year: see Pt 5, Ch 2.

20.3 MAKING THE MOST OF OPPORTUNITIES

Good practice: M6, Lancashire  Shallow edges have created the right conditions for reed beds and wet grassland which are of nature conservation interest

20.4 CREATING A NATURAL LANDFORM
**20.5 USING THE RIGHT MATERIALS**

Poor detailing has produced an unsatisfactory result: steep sides which conflict with gentle field gradients, visually obtrusive concrete and a prominent security fence.

**Improvement** using better materials and detailing.

**20.6 LINERS AND EDGING**

- **Membrane liner**
- **Concrete liner**
- **Gabions** to establish shelves for planting are a useful solution to the problem of steep sides.

**20.7 FILTERING INCOMING WATER**

A successful pond needs good water quality. This section indicates the principles but a site-specific design is always needed.
21.1 PRINCIPLE

- Diverting or crossing watercourses is sometimes unavoidable, although it is undesirable on engineering, landscape and nature conservation grounds. Where such measures are required, good design can ensure a fit with the landscape and even provide overall benefits.

21.2 KEY ISSUES

- The National Rivers Authority, English Nature and other bodies have considerable experience of creating new wetlands and minimising damage to existing ones. Expert advice should be sought from the outset.
- In general, new or modified watercourses should be wide, with shallow margins and appropriate marginal planting. Design should work with the flow and substrate characteristics of the stream.
- A wide range of geotextiles and modular systems such as gabion mattresses are available to allow flexible and sympathetic design.
- Nature conservation opportunities include planting particular species or the creation of special features like nesting banks for kingfishers and should be taken up under appropriate guidance: see Pt 5, Ch 2.
- Watercourse crossings need to minimise impacts on the flow characteristics and vegetation and maximise opportunities for new habitat creation.

21.3 NEW CHANNELS

Poor practice: A516, Derbyshire A regular section with steep sides creates an unsatisfactory canalised appearance and does not provide the right conditions for the establishment of marginal vegetation
21.5 CULVERTS
Junctions between culverts and existing watercourses can become eyesores unless a site-specific design solution is chosen.

21.6 MINOR WATERCOURSES

21.7 CONSTRAINED SITES

21.8 CROSSING WATERCOURSES

21.9 EDGE DETAILS

**Good practice: M40, Cherwell Valley, Oxfordshire** The embankment is a dominant feature, but care has been taken to retain the character and form of the river on both sides of the road.

**Typical edge details** The objective should be to encourage vegetation along the water’s edge. Reed fringes, which are of wildlife benefit, can be established where waves will be less than 300mm high.
22.1 PRINCIPLE
Carriageways can be separated at different levels (split-level carriageways) or at the same level
(separated carriageways or roads with wide central reserves). Both have opportunities for integration with
landform and vegetation and the retention of features of landscape or heritage interest, although higher
maintenance costs may be expected.

22.2 KEY ISSUES
- On sidelong ground split carriageways can be of great benefit in breaking up lateral views. This issue is
dealt with in Ch 7.
- The need for earthworks may be avoided where two separate carriageways at different gradients are
made, instead of a continuous carriageway needing substantial cut-and-fill.
- Mature tree belts, rock outcrops and other landscape features can be retained between the carriageways
to break up views and provide driver benefit.
- In some cases, an existing single carriageway within its mature roadside landscape can be retained for
traffic in one direction, with a new separate carriageway being provided some distance away for traffic in
the opposite direction.

22.3 SPLIT-LEVEL CARRIAGEWAYS

Good practice: A591, Cumbria  The wooded bank between the carriageways screens
headlight glare and provides an attractive route

Good practice: M6, Lune Gorge A split-level carriageway reduces the dominance of the road

22.4 RESPONSE TO LANDFORM

Good practice: M6, Cumbria  The carriageways have been separated around the ridge: only
minor earthworks have been needed. The lines of the dry stone walls running across the road
draw the eye away from it

22.5 RETAINING EXISTING CARRIAGEWAYS AND VEGETATION

Good practice  The vegetation retained in the central reserve screens property from the
visual impact of four lanes of traffic
### 22.6 RETAINING SIGNIFICANT FEATURES

Good practice: A611, Nottinghamshire  The widely-separated carriageways retain a significant block of woodland and a Scheduled Ancient Monument between them

A27, West Sussex  Parkland holm oaks and walling have been retained here in a wide central reserve, providing a landmark on a flat, open landscape and a link with the parkland beyond

A380, Devon  An ancient boundary bank has been retained within the central reserve, retaining historic interest, breaking up the scale of the road and reducing headlight glare

### 22.7 WIDE CENTRAL RESERVES

Wide central reserves have a positive role in breaking up the scale of major highways - particularly where they are overlooked from above. They also provide the opportunity for planting to be carried out between the carriageways, the benefits of which should outweigh the higher maintenance costs.

A22, East Sussex  A wide, grassed central reserve

A wide central reserve has allowed hedge planting, which breaks up the scale of the road

Staggered planting to reduce headlight glare

M40, Warmington Valley  The central reserve has been widened to 20 m, helping to break up the scale of the road when viewed from the valley sides
## 23. ENQUIRIES

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