VOLUME 10 ENVIRONMENTAL DESIGN AND MANAGEMENT

SECTION 5 ENVIRONMENTAL BARRIERS

PART 1

HA 65/94

DESIGN FOR ENVIRONMENTAL BARRIERS

SUMMARY

This Advice Note provides guidance for the design of environmental barriers. It supersedes in part HA 14/76 (DMRB 5.2).

INSTRUCTIONS FOR USE

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THE DEPARTMENT FOR REGIONAL DEVELOPMENT*

Design Guide for Environmental Barriers

* A Government Department in Northern Ireland

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REGISTRATION OF AMENDMENTS

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HA 65/94

DESIGN GUIDE FOR ENVIRONMENTAL BARRIERS

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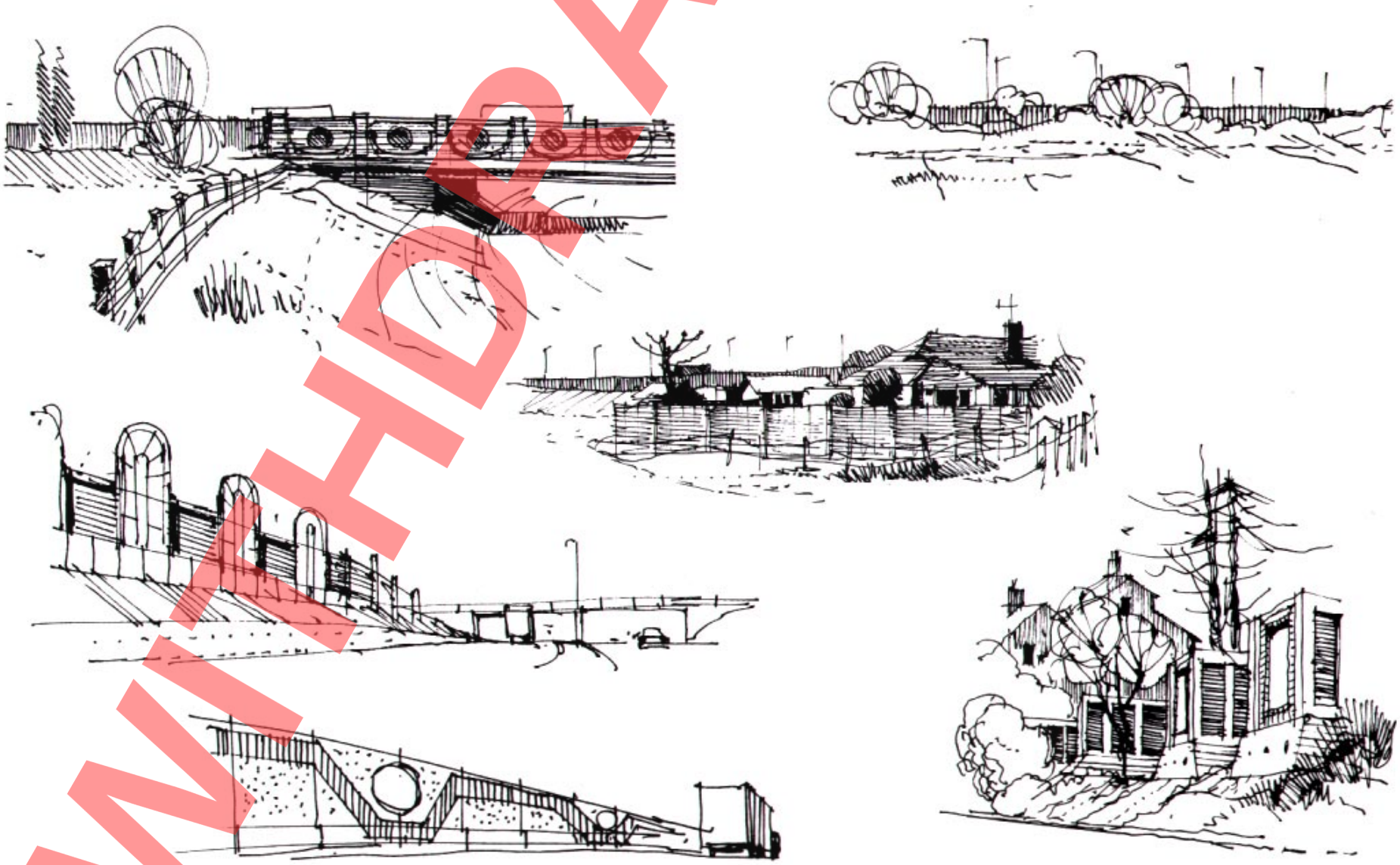

DESIGN GUIDE FOR ENVIRONMENTAL BARRIERS

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1. INTRODUCTION

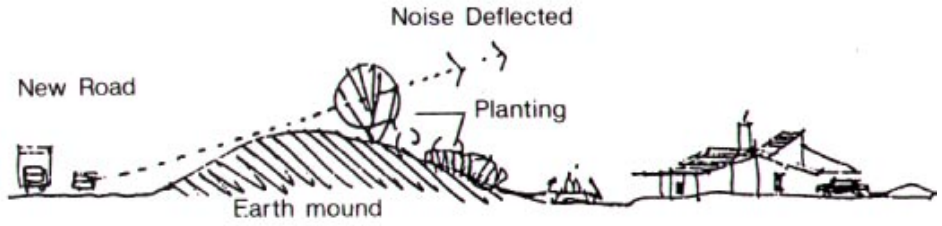
Background

1.1 The 1990 White Paper " This Common Inheritance" set down the Government policies for the environment. The White Paper noted the care taken to select lines and levels for roads that minimise the impact of the noise on local people, and highlights the role of earth mounds and noise barriers as a means deflecting noise away from people. The White Paper also recognised that these may incidentally improve the appearance of the road.

1.2 An environmental barrier combines the function of a visual screen and a noise barrier to protect residential, recreational and other vulnerable areas alongside a road. This document l gives advice on how the impact of the barrier itself on its surroundings can be minimised by the appropriate choice of the form and materials used, at the same time taking advantage of developments in the techniques of noise attenuation.

Scope

1.3 The procurement of environmental barriers will normally be carried out under contracts incorporating the Overseeing Organisation's Specification for Highway Works (MCHW 1). Products conforming to equivalent standards and specifications of, and tests undertaken in, other states of the European Economic Area will be acceptable in accordance with the terms of clauses 104 and 105 of MCHW 1. For contracts not incorporating this form of specification, advice should be sought on suitable clauses of mutual recognition which would have the same effect.



1.4 This document extends the advice given in HA 58/92 Chapter 8 (DMRB 10.1.4.8) and HA62/92 Chapter 7 (DMRB 10.2.1.7). It supersedes paragraph 3.2 of HA 14/76 (DMRB 5.2); a companion document HA 66/904 is in preparation which will update the technical requirements for environmental barriers, superseding the remainder of HA 14/76.

Implementation

1.5 This Advice Note should be used for all schemes currently in preparation provided that, in the opinion of the Overseeing Organisation, this would not result in significant additional expense or delay progress. Design organisations should confirm its application to particular schemes with the Overseeing Organisation.

Design Philosophy

1.6 A new road can have a profound effect on the quality of life for residents in its vicinity. In addition to the noise, dust and fumes caused by traffic, the road may restrict access to local facilities and obstruct views of the surroundings. Barriers can be incorporated into the scheme design to mitigate the immediate effects of traffic, but they may create an oppressive sense of enclosure unless they are sensitively designed. The aim should be to make then as unobtrusive in the landscape as possible, or to provide interest and visual quality whenever integration is not feasible. This approach will create opportunities for imaginative treatment of the protected side of the barrier in particular

1.7 This guide does not prescribe a standard range of barriers from which to make a selection, as this could lead to a restricted consideration factors which might be important to fitting barriers to their context. The design concepts for barriers may vary considerably in response to the different impacts that a road can have in urban, semi-urban and rural contexts. Instead a step by step approach is set out which should ensure that the constraints and opportunities in each situation are recognised.

1.8 The first part of this guide discusses the variety of forms which barriers can take and the factors which need to be considered in different situations. The case studies in chapters 10, 11 and 12 work through the design method for a number of typical situations in different contexts. More specific details of acoustic performance and engineering requirements for the range of structural materials considered in the guide will be given in HA 66/94 (DMRB 10.5.2).

1.6.

2. OVERVIEW OF DESIGN CRITERIA

Consideration of Options

2.1 The design of a new road involves achieving a balance between meeting the needs of traffic and minimising its intrusion on the local environment. Routes which pass close to residential property need to be assessed for the effects of traffic noise and visual intrusion.

2.2 Road traffic noise can be controlled in several ways:

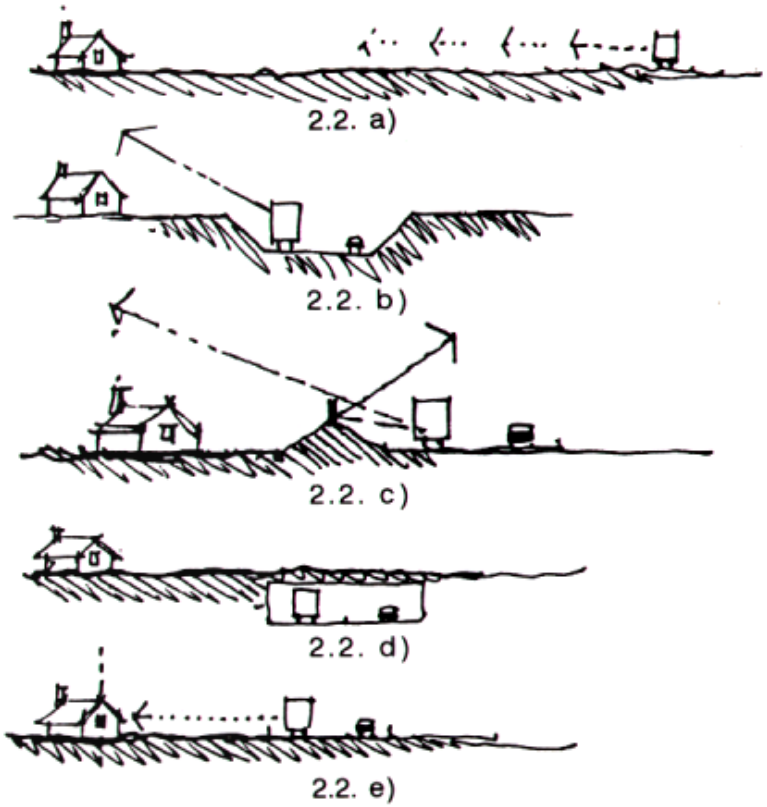
a) by distancing the road so far away that the noise received it minimal;

b) by placing the road in cutting;

c) by constructing a barrier (fence, wall or earth mound) which impedes the transmission of noise;

d) by containment at source eg: by constructing the road in a tunnel, or by using noise reducing road surfaces;

e) by insulation at reception point eg: by provision of secondary glazing.



2.3 Each of these methods has limitations:

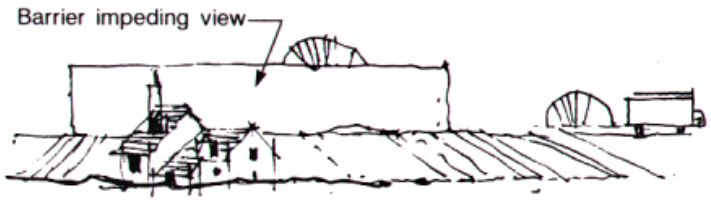
a) the alignment of the road is dictated by many factors which may make it impossible to achieve noise attenuation by distance alone;

b) engineering factors or vertical alignment may rule out cuttings in certain locations;

c) barriers can deprive occupants of views previously enjoyed;

d) tunnels are often too expensive to be a realistic option, and noise reducing road surfaces are at present relatively expansive to construct the maintain;

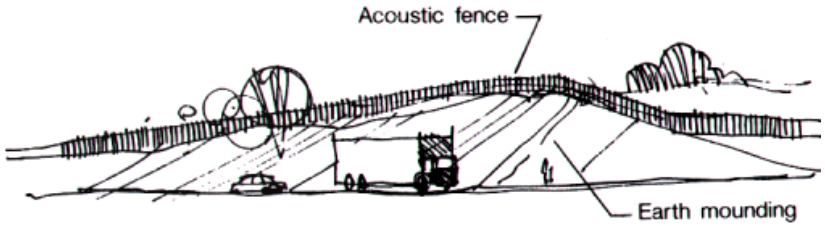
e) insulation does not screen occupants from adverse visual affects or from noise when they are outside the house.



2.3. c)

2.3. e)

2.4 An environmental barrier will often provide the most appropriate means of mitigating noise over a wide area. A barrier may take the form of an acoustic fence, or an earth mound and may be used in combination with other measures, such as lowering the vertical alignment, “false cuttings”, and secondary glazing of properties.



2.4.

Land Requirements

2.5 Measures to mitigate the adverse effects of noise and visual intrusion should be considered at an early stage. Alignment options should include sufficient land to allow the most appropriate form of mitigation to be used. As the character of the new road is often alien to its surroundings, it is desirable to create a buffer zone between the road and its environs. Space is a prime requirement in achieving this objective. If consideration of the need for an environmental barrier is delayed until after compulsory purchase orders have been published, the options are likely to be limited to unnecessarily intrusive and potentially more expensive solutions.

2.6 **As soon as potential interaction is identified, noise specialists, landscape architects and architects should be brought into the design team to advise on options for mitigation.**

Statutory Obligations

2.7 Under the respective legislation, occupiers of property within 300m of a new road are entitled to be offered appropriate insulation if the noise from traffic on it reaches a specified level at the property. The entitlement to insulation is governed by the Noise Insulation Regulations which refer to the method of noise prediction to be used. The respective legislation for each of the Overseeing Organisations is shown in Table 2.1

2.8 The occupier of a property may also claim monetary compensation for any loss in value of the property caused by the presence of the road. Compensation may be payable even where the noise at a property does not reach the qualifying level and whether or not it is situated within 300m of the road. Careful consideration of road alignment options and mitigation measures can avoid noise and visual intrusion on properties, with consequential savings in compensation costs.

2.9 Highway authorities are empowered to carry out “works for mitigating any adverse effect which the construction, existence or use of a highway has or will have on its surroundings”. They are also given the power to acquire land additional to that needed for construction of the road itself to permit landscaping or the creation of earth mounds. The interpretation of “works” in this context is fairly broad and includes amenity treatment such as grassing and planting of trees and shrubs on landscape areas. In this context both noise and visual intrusion are adverse effects which can properly be mitigated by the use of earth mounds, barriers and planting.

2.10 Properties affected by new roads may in extreme cases be acquired at the discretion of the highway authority where mitigation cannot prevent living conditions becoming intolerable either during construction or after the road is opened. In certain circumstances affected properties (within 100m of the centre line) may be acquired in advance of construction.

TABLE 2.1 RESPECTIVE LEGISLATION

ENGLAND and WALES	SCOTLAND	NORTHERN IRELAND
Land Compensation Act 1973	Land Compensation (Scotland) Act 1973	Land Acquisition and Compensation (Northern Ireland) Order 1973
Noise Insulation Regulations Calculation of Road Traffic Noise 1988 (CRTN)	Noise Insulation (Scotland) Regulations 1975 Memorandum on the Noise Insulation (Scotland) Regulations 1975	Regulations pending
Highways Act 1980: Section 246 (acquisition, see 2.10) Section 282 (mitigation, see 2.9)	The Roads (Scotland) Act 1984: Section 104 (acquisition, see 2.10) Section 106 (mitigation, see 2.9)	The Roads (Northern) Ireland) Order 1993: A 112 (acquisition, see 2.10) A 116 (mitigation, see 2.9)

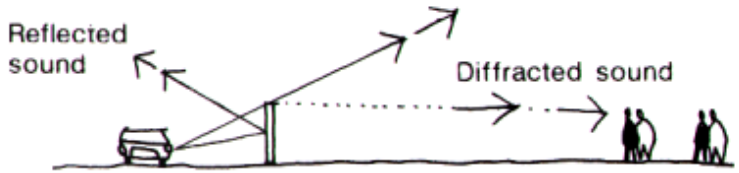
Reduced Visual Intrusion

2.11 A barrier placed in the line of sight between the traffic and the observer will reduce visual intrusion. A new road scheme changes the visual quality of the area through which it runs as perceived by the people who live in and visit the area. This is partly due to he size of the road and its structures but mainly because the road is man-made, and its alignment, materials, signs, lighting and traffic can be out of character with the rest of the landscape. Thus the amount of visual intrusion of a road is dependent of the quality and type of landscape through which it runs. A barrier will itself change the visual quality of the general scene, but will reduce the adverse effects of the more intrusive elements, particularly the movement of traffic. The challenge for the road engineer is to produce a barrier whose appearance harmonises with its surroundings, thereby minimising the visual intrusion caused by the barrier itself whilst maximising the reduction in visual intrusion arising from the road and its traffic.

2.12.a) Direct Transmission

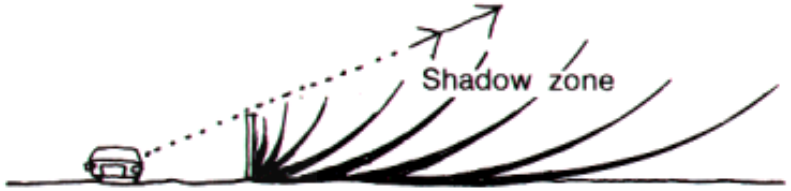
Noise Reduction

2.12 Noise reductions are achieved when a barrier is placed in the line of sight between the source of noise and the point of reception, thereby interrupting the direct transmission of sound. Sound pressure waves will be dispersed as they are reflected back towards the source, but, where they graze the top (or ends) of a barrier, they are diffracted. Barriers can be constructed of materials which absorb the energy of the sound pressure waves, to eliminate reflection.



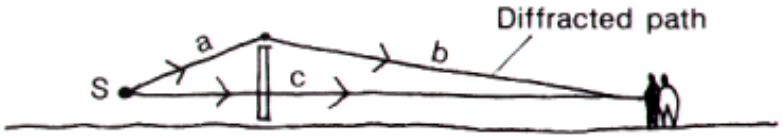
2.12.b) Diffraction and Reflection

2.13 The area behind the barrier which benefits from a noise reduction is known as the “shadow zone”. The degree of screening varies according to the angle through which the path of transmission is diffracted.



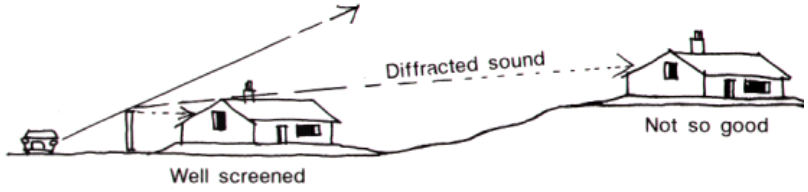
2.13.

2.14 The extent to which the noise is reduced can be calculated from the geometry of the diffracted path. The most important factor is the path difference = a + b - c. With a difference of 1m, the level of noise may be reduced by up to 15 dB(A) (see CRTN88, Chart 9).



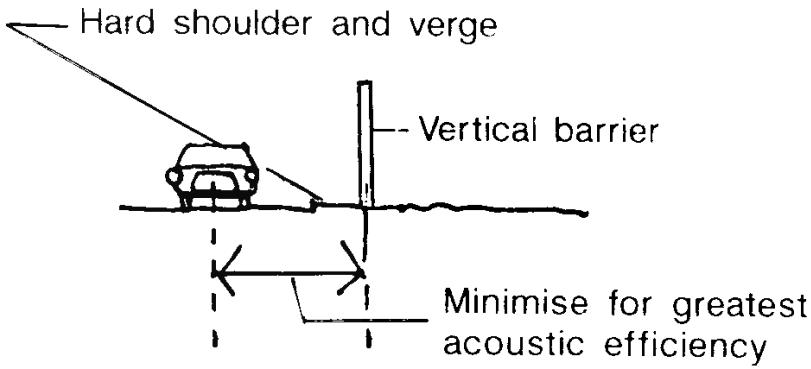
2.14.

2.15 Geometric considerations indicate that differences in level have a significant effect on noise reductions. Properties at some distance behind a barrier may also be less well screened than those nearby. In addition, weather conditions and the changes in interaction with the ground surface can increasingly negate the benefits of barriers at distances over 100 metres.



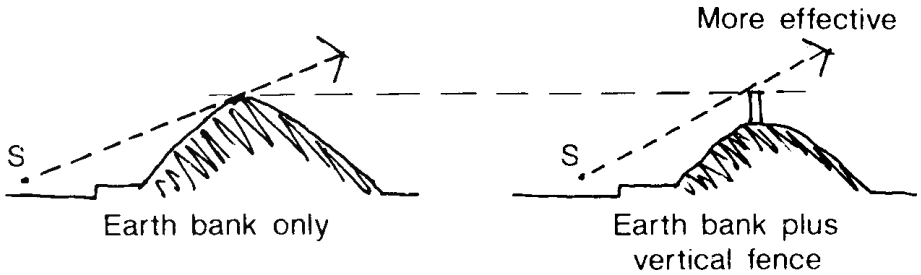
2.15.

2.16 Barriers are most effective if sited as close as possible either to the noise source or the receiver because this maximises the path difference. Barriers will in most cases be set back from the road edge by the need for verges, hard shoulders and other clearances; while this reduces their acoustic efficiency, it prevents them creating a visually oppressive “canyon” effect on either side of the road. Barriers cannot generally be sited adjacent to the receivers since this would requires the acquisition of land remote from the highway corridor.



2.16.

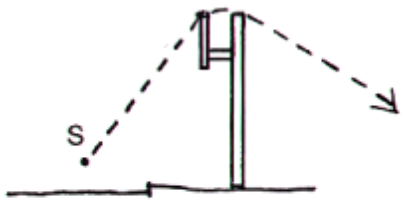
2.17 It has been shown that a sharp edge at the top of a barrier increases its efficiency, so that a vertical fence is more effective than an earth mound of the same height. By using a low barrier on top of an earth mound, a given level of noise reduction can be provided with less visual impact. Similarly, short barriers at the top of cuttings can improve their acoustic efficiency.



2.17.

2.18 Raising the height of a barrier increases the size of the shadow zone. The minimum effective height for a barrier is normally 2 metres although the use of lower barriers may be appropriate in conjunction with cuttings or earth mounding. Although barriers up to 10 metres in height have been used in other countries, structural constraints normally limit the maximum height of simple fence type barriers to about 5 metres; the cost of higher structures escalates rapidly and alternative or supplementary methods of noise control should be considered.

2.19 Recent research has shown that multiple-edged barriers can give improved performance, so that a short barrier could be used to achieve a particular target for attenuation. The technology is still being developed and further advice should be sought on the current status.



Multiple-edged barrier

2.19.

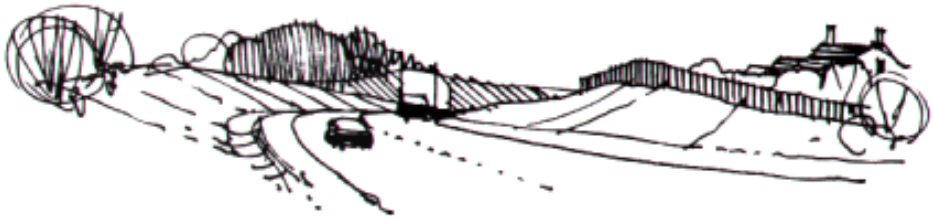
Approach to Barrier Design

2.20 The following principles should form the basis of the first considerations for barrier design:

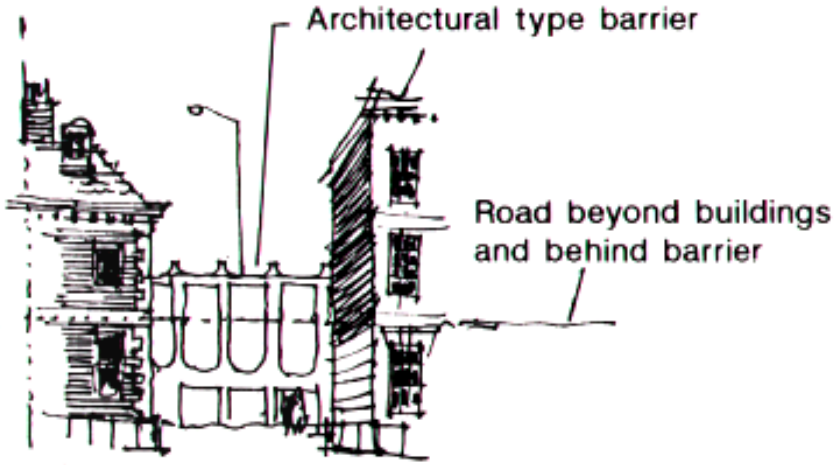
a) The need for barriers should be considered at the initial route planning stage. The choice of line or route, decisions about the profile of the road and its general layout should be made taking into account the effects on people living alongside the traffic corridor, incorporating solutions to mitigate adverse effects.

b) Barrier appearance should be considered initially from the viewpoint of those living alongside the road. Barriers should as far as possible reflect the character of the local neighbourhood, and should preserve or even enhance the quality of the environment for local residents.

c) As far as possible, barriers should be designed so that it is not apparent to the road user or to those who live alongside the road that there is actually a barrier there.

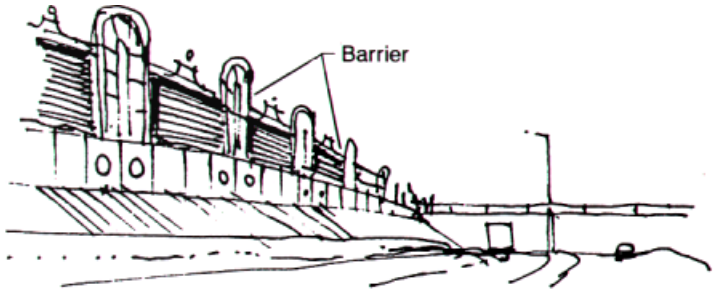


2.20.a)



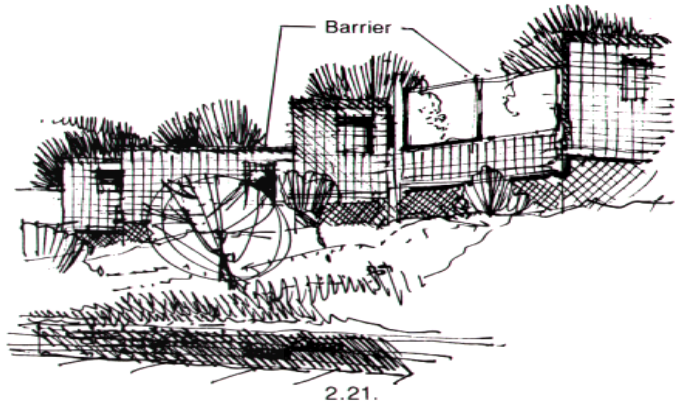
2.20.b)

d) Barriers from the motorist's viewpoint should reflect the character of the locally through which the road passes in order to provide a sense of place. However, when long lengths of conspicuous barrier are necessary, varying the form and materials will add visual interest and avoid the monotony of a uniform barrier solution.



Barrier in Urban Areas
2.20.d)

2.21 The size of barriers will largely be determined by requirements for noise attenuation. Considerations of structural stability, safety and maintenance will also influence their appearance. However, this still leaves a considerable amount of freedom to vary the form and finish to reflect the character of the neighbourhood through which the road passes. The use of materials and structural forms appropriate to the adjacent landscape or townscape and the application of architectural principles to the design of barriers will reduce their visual impact

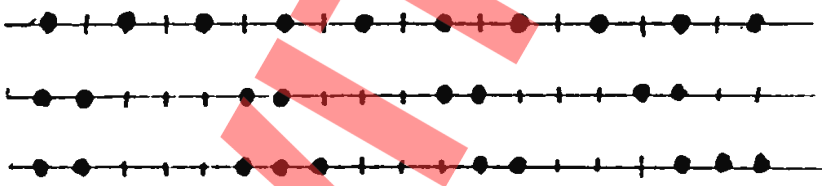


2.21.

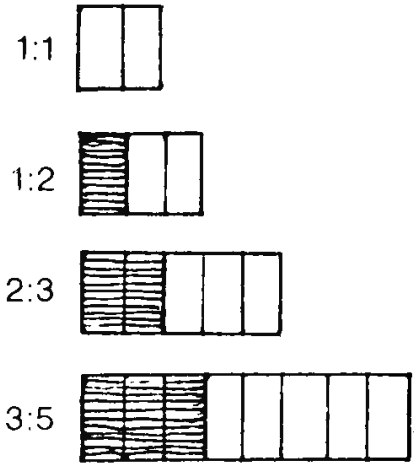
Architectural Input

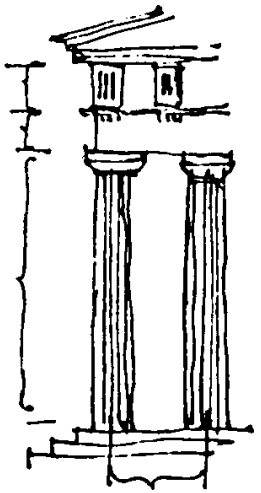
2.22 An architect will visualise the appearance of barriers in terms of aesthetic concepts such as proportion, order, rhythm, harmony and contrast. Such considerations are particularly relevant where tall or extensive lengths of barriers are needed in urban areas and where it may be desirable to break down the scale of an otherwise monolithic feature by using a combination of contrasting materials.

2.23 In order to clarify the use of terms which may not be familiar to engineers, the following illustrations may help to illuminate the text book definitions.

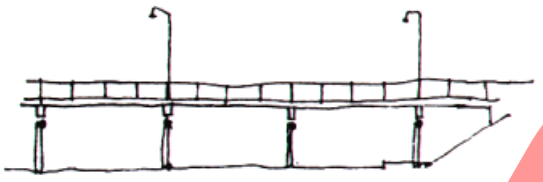


Rhythm:
The repetition of forms in a sequential pattern.



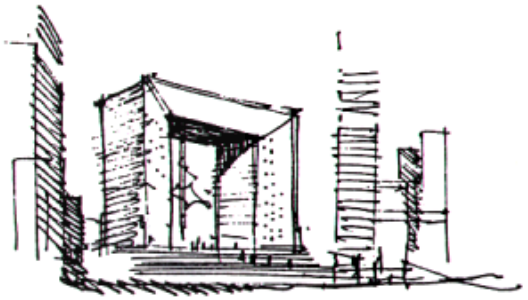


Proportion:
The comparative relationship in size or number of two or more components in juxtaposition.



Order:
The systematic, logical or controlled arrangement of components in a group.

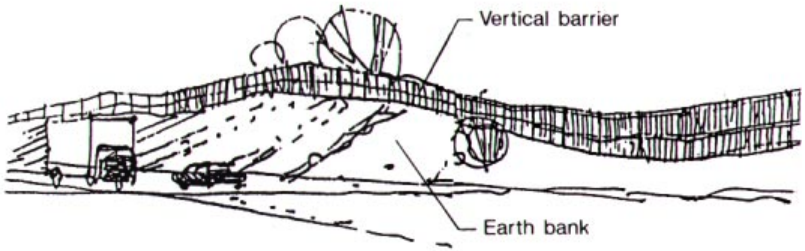
Harmony:
An agreeably proportioned or ordered composition.



Contrast:
The juxtaposition of strikingly different forms, colours or textures.

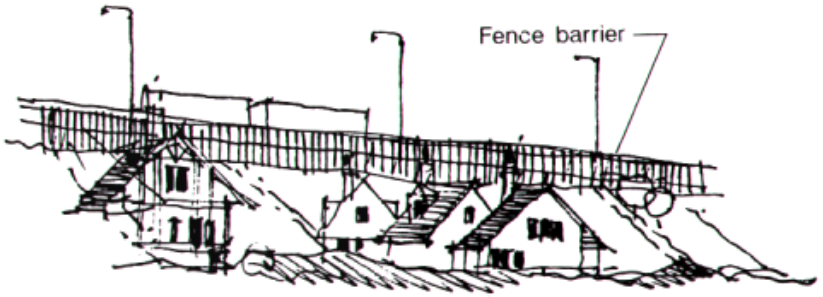
Barriers in the United Kingdom

2.24 Environmental barriers in the United Kingdom have been provided on road schemes variously in the form of earth banks, timber fences, concrete panel fences, and brick walls. Earth banks have been constructed up to 5m high where sufficient land has been acquired. The height of other types of barrier was generally been restricted to 3m because it was judged that vertical faces taller than this would be visually intrusive.



2.24.

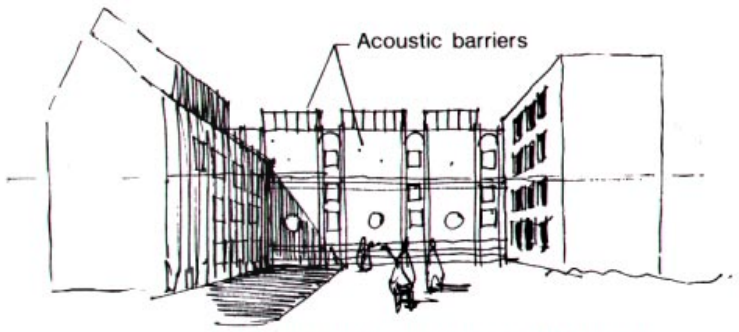
2.25 When the requirement for barriers has been identified at a late stage in the development of a scheme, the limited availability of land has often restricted the options to fence type barriers. This type of barrier also has cost advantages over some other forms of construction, which may be important when the cost of a barrier has to compare favourably with the alternative of providing secondary glazing for a number of properties. Space and cost considerations may also dictate that a barrier also acts as the highway boundary. In these circumstances, a timber close-boarded fence has often been selected as the cheapest solution. Concrete panel fences and brick walls have been used in urban areas where timber was thought to be vulnerable or otherwise inappropriate, but often insufficient weight has been given to the overall visual impact of the barrier in making these choices.



2.25.

Continental Practice

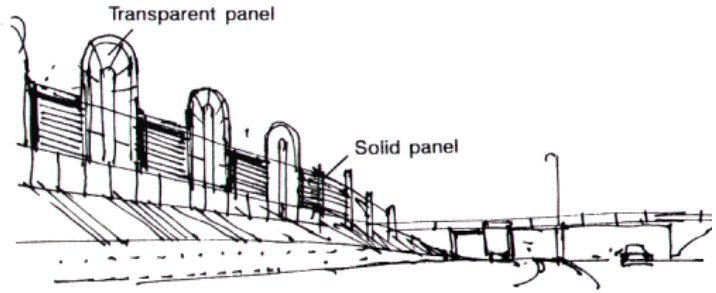
2.26 Barriers have been widely used in other European Countries to mitigate the impact of road schemes. There are believed to be no mechanisms comparable with the UK provisions under the Land Compensation Act for making financial recompense to those adversely affected. Legislation instead prescribes maximum levels for noise in the vicinity of any buildings or inhabited space; threshold levels are sometimes significantly lower at night than during the day. As a result, barriers have become part of the roadside furniture in built up areas. In some cases they have to be very tall by UK standards to achieve the required level of attenuation; where multistorey buildings have required protection, barriers up to 10m high have been built.



Road beyond buildings and behind barriers

2.26.

2.27 In order to reduce the visual impact of very high barriers, architects have often been commissioned to design solutions appropriate to their location. Designers have striven to break down the linear form of barriers, for example, by alternating solid and transparent panels and by using colour variations. Planting is commonly used to soften the sharp edges of barriers. The wide range of constructional forms and combination of different materials provides interest for road users, compensating for their loss of view of the surroundings. But designed solutions tend to be more costly than mass produced barrier systems.



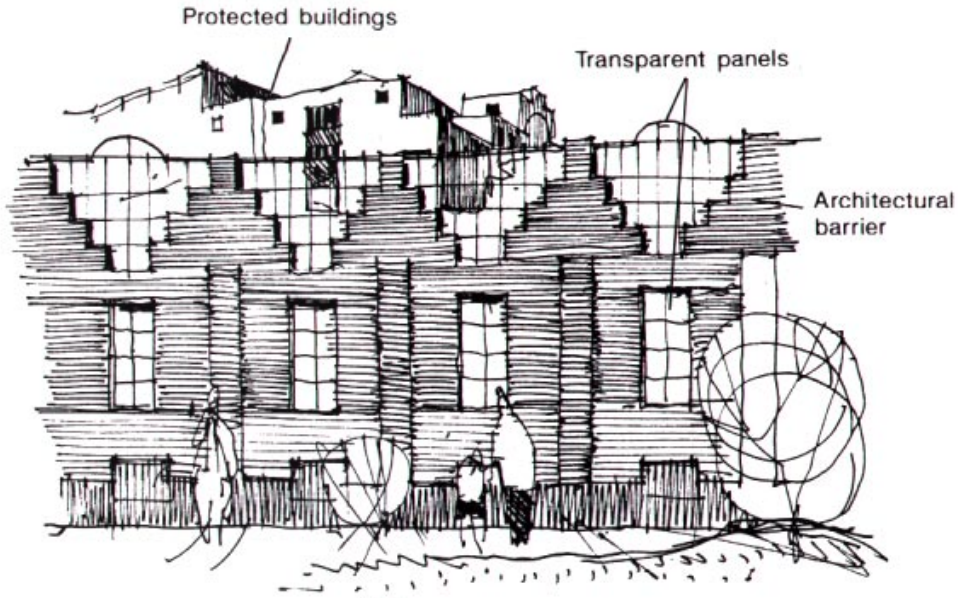
Architectural high barriers

2.27.

3. THE APPEARANCE OF BARRIERS

Visual Impact

3.1 Barriers incorporated into the scheme design can mitigate the effects of traffic noise and visual intrusion in the immediate vicinity of a road, but they themselves may have a significant visual impact. It is essential that the detailed design of barriers is appropriate to the scale and character of the local environment. When it is not possible to design a barrier which blends into the local environment, the aims should be to reflect some of its features, such as materials, colours, textures and shapes, in a form of barrier which has aesthetic appeal, without being dominant in the field of view. Transparent panels may be used to lighten the overall impact, either to create “windows” which partially restore views, or along the top section of a barrier to reduce its apparent height.



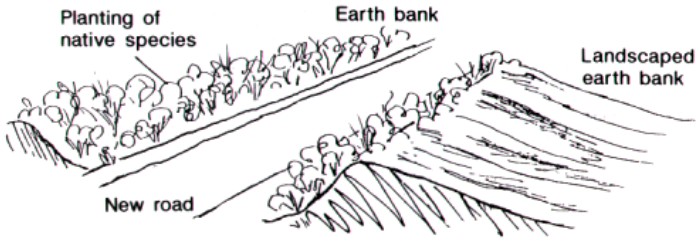
3.1.

Compatibility with Local Features

3.2 A barrier is more likely to be acceptable to local residents if it has some relationship with its surroundings and is compatible with the appearance of the adjacent neighbourhood. Equally, a barrier which alludes to the locality hidden behind it will help motorists avoid boredom or disorientation.

3.2.

3.3 In a truly rural situation, once the need for a barrier has been established there should be a strong preference for a solution in which protection is provided by a 'natural' form. The use of earthworks, in lowering the alignment into cutting, or by providing a landscaped "false cutting" is recommended (see also 4.6). Landform, in conjunction with planting of native species, should be designed to create a visual impression which preserves the rural environment.



3.3.

3.4 In a semi-urban and urban contexts, an analysis of the character of the neighbourhood should be made to provide a checklist of its distinguishing elements. The design of a barrier needs to capture something of the neighbourhood, such as the prevalence of a particular material or style in buildings, for a leafy suburb a barrier incorporating planting might blend in more readily. Alternatively, the design of a barrier in the vicinity of a focal point such as a church spire, a group of high rise blocks, a steel works or other industry might best echo the visual dominance of that image.

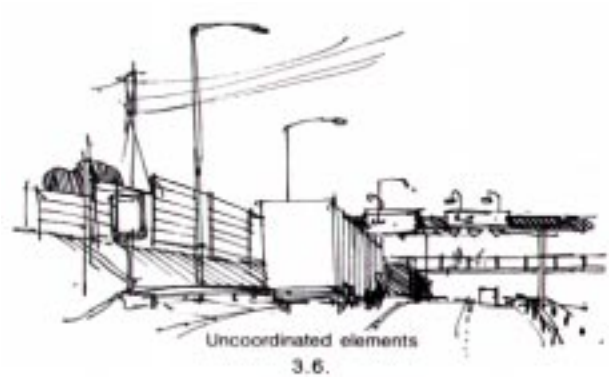
Barrier designed to blend with surroundings

3.4.

Co-ordination with Road Furniture

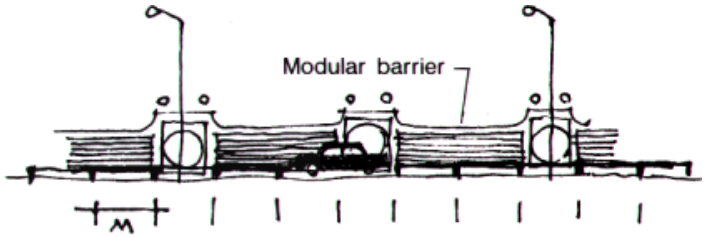
3.5 The design concept should give priority to the protected side since the purpose of a barrier is to protect the environment enjoyed by people. However the design of barriers must take into account the visual effects on the traffic side, recognising their role as a backdrop to the motorists' view of the road.

3.6 Considerable efforts are made in the design of roads and bridges to ensure that their visual impact is acceptable. The visual unity is often spoiled by uncoordinated elements such as road signs, lighting columns, gantries, safety fences and parapets. The design of an environmental barrier should complement the engineering design of the road and therefore needs to be developed as part of an overall concept. Consideration of visual impact early on in the design process will help designers to avoid unnecessary conflicts.



3.6.

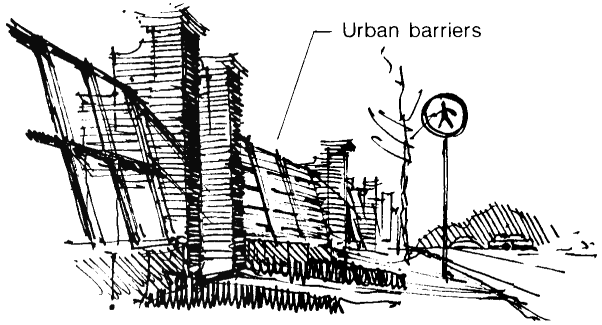
3.7 There are several advantages to be gained from identifying a suitable module for a barrier which will help to co-ordinate it with other elements. As well as being cost effective in terms of installation and maintenance, the repetition of units can create a sense of order and harmony which is conducive to road safety.



3.7.

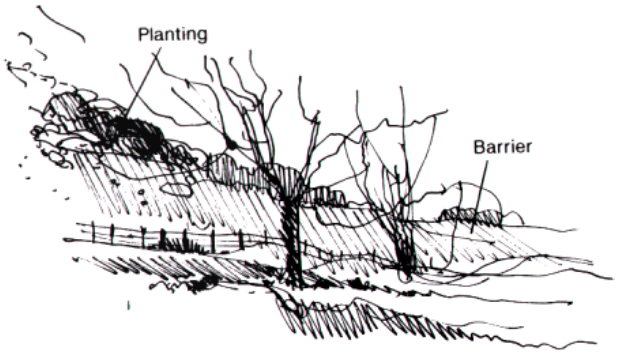
Response to the Road Environment

3.8 The character of the road corridor, particularly its width and the surroundings, effects the choice of the barrier solutions. In urban situations the high cost of land will usually dictate the need for barriers to be sited close alongside the road. Urban barriers should be commensurate with the hard character of the adjacent road and nearby buildings. Materials which give the impression of solidity and durability should be used.

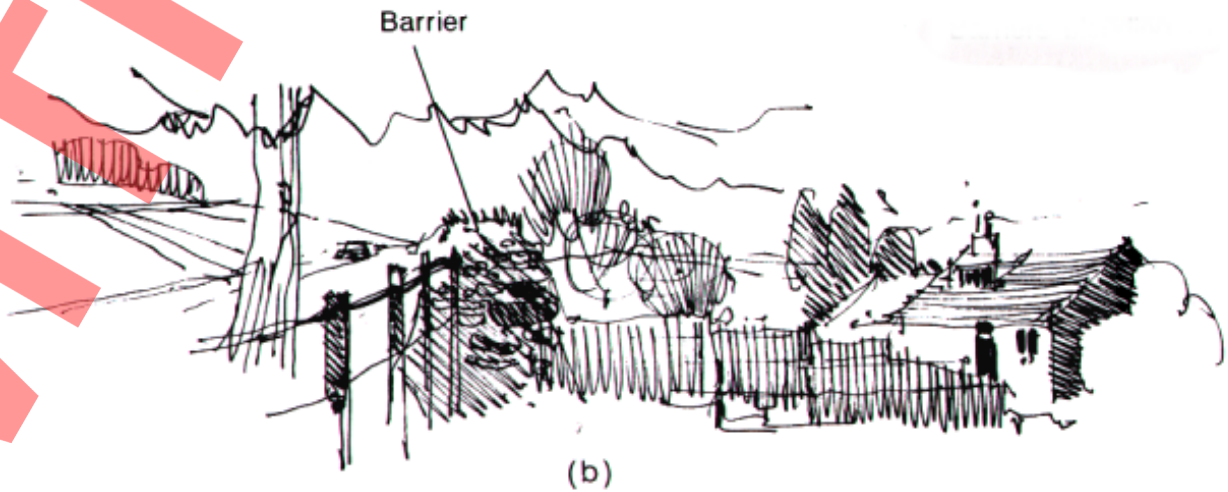


3.8.

3.9 In semi-urban and rural situations a wider swathe of land may be available. This will allow the barrier to be located away from the road edge, where it can be perceived not as part of the road environment, but as part of the surroundings. Where the road is in cutting for example, a barrier on the edge of the land take area is visually separate from the road environment and seem to relate instead to the character of the surrounding countryside. The barrier should be designed using materials which reflect the character of the local neighbourhood, such as earth banks, brick walls, or timber fences as appropriate, in conjunction with planting to impact a more natural appearance. Barriers can enhance the local environment if they blend successfully with their surroundings.



(a)

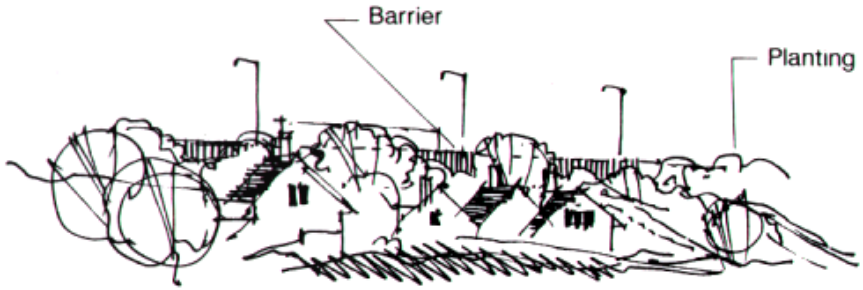


(b)

Barriers blending with their surroundings

The Protected Side

3.10 A barrier can drastically change the outlook for residents, who in addition to a loss of view, may also suffer loss of daylight. On the protected side a barrier is experienced as a feature which perhaps dominates the space, and whose impact remains constant unlike the impact of variable traffic volumes. A designer can provide a barrier which minimises this potential intrusion by using attractive materials which display a variety of texture and colour, or by creating an interesting shape in plan and elevation. Planting incorporated within the barrier design will soften its overall impact by imparting a more natural character and relieving the monotony of a horizontal skyline.

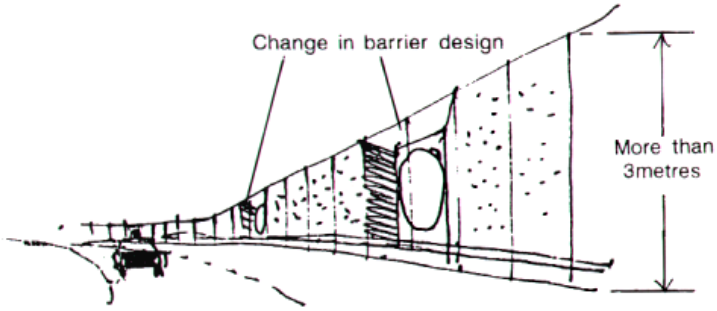


3.10.

The Road User's Side

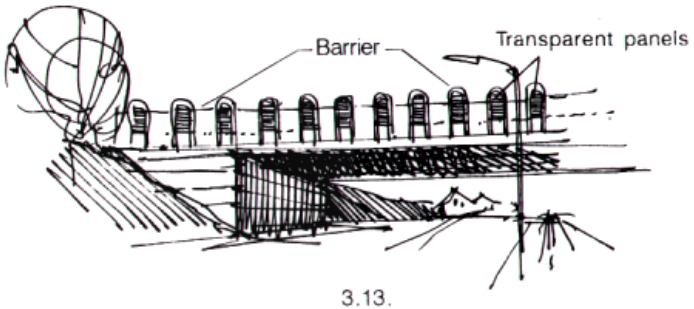
3.11 The road user experiences a length of barrier for a very short space of time and will nearly always view the design at an oblique angle. The road user in general will perceive only a broad impression of the design, its pattern of colour and its contrast with the surroundings. The driver in particular will absorb a very limited amount of visual information because of vehicle speed and concern for other traffic on the road.

3.12 Barriers over 3 metres high substantially conceal the view of existing landmarks from the road, but they also conceal visual clutter with might otherwise distract the attention of drivers. Where barriers are needed over considerable lengths in urban and semi-urban areas, their appearance should be designed to avoid monotony. Features which create a monotonous appearance are the unrelieved face of a barrier constructed from a single material, and a stark and unvaried horizontal top. Surveys of drivers in Holland have indicated that a view which is unchanging for 30 seconds is monotonous, this suggests that changes in design every half a mile, or approximately 800 metres, are desirable for long barriers adjacent to a high speed road.



3.12.

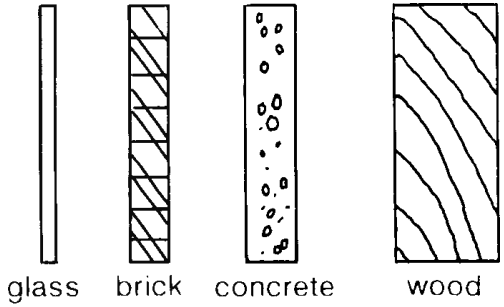
3.13 Variation in the type of barrier, changes in its longitudinal profile, and transparent panels over structures, will all act as visual signposts helping drivers to recognise where they are along the route. Changes should be introduced at natural “break points” and care should be taken to ensure that barriers complement or even enhance the road users’ broad picture of the road.



3.13.

Materials

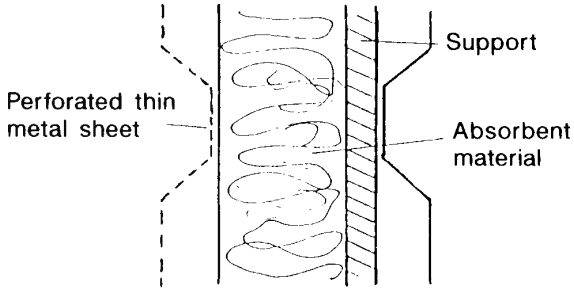
3.14 Barrier fences or walls can be made from virtually any construction material, or combination of materials but must be sufficiently durable to have a low maintenance requirement. The effects of weathering on appearance should be taken into account, especially when considering the use of man-made materials.



Materials with same mass/area

3.15.

3.15 The barrier must not resonate with the noise of traffic since this would transfer the sound energy to the 'protected' side. Simple forms of solid barrier obey a "mass law", which gives the minimum weight per unit area required to ensure that the barrier is effective in providing a particular level of noise reduction. In general, the thickness of material required to provide structural rigidity exceeds that needed to prevent resonance. However there is a possibility of noise leaking through any gaps between elements or at the supports.



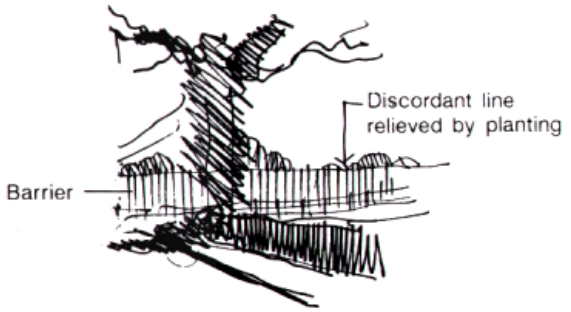
Typical cellular absorbent barrier

3.16.

3.16 Lightweight forms of barrier are now made using thin-walled cellular construction, which do not obey the "mass law". The performance of such barrier systems needs to be verified by acoustic tests; these are described in HA 66 (DMRB 10.5.2).
Cellular barriers may also have sound absorbent properties, which are discussed in 6.11.

Use of Vegetation

3.17 Planting can be used to soften and enhance the appearance of a barrier, providing variation from season to season and in different daylight conditions. Vegetation which overtops a barrier will relieve the stark horizontal line which otherwise draws attention to it, so reducing the intrusion on its surroundings, but care must be taken to make use of species which blend into the natural landscape. Vegetation can be used to advantage in urban areas to enhance earth retaining forms of barrier.



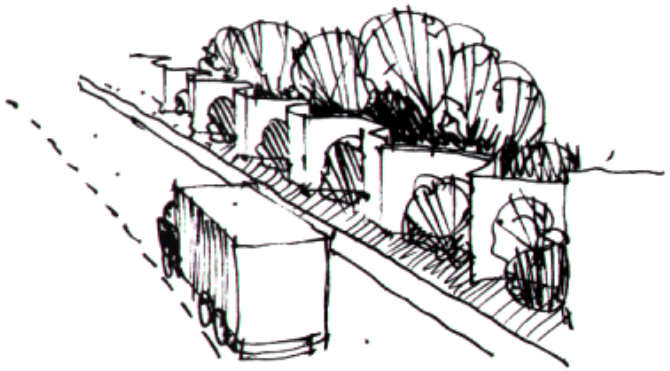
3.17.

3.18 Account will need to be taken of the harsh roadside environment in selecting species which can resist baking sun, buffeting by wind, grit and salt spray in winter. Relatively intensive care is needed to establish and manage planting under such conditions. Sufficient space should be allowed for growth and if necessary, for access to inspect and maintain the barrier.

3.19 There is a common belief that vegetation can by itself considerably reduce traffic noise - this is not the case. Measures of noise within extensive mature woodland indicate increased attenuation of noise with distance. This is thought to be due mainly to the density of the underbrush and leaf litter enhancing the “soft ground” absorbency. However, no benefit in reducing noise should be attributed to screen planting (of whatever species) since this does not provide the relevant ground conditions over a sufficiently wide area.

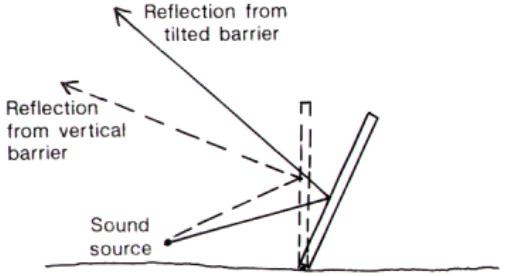
Modification to Barrier Design

3.20 Small variations to the alignment of the barrier, such as stepping or zig-zags, may have only a marginal effect on noise attenuation, and so they can be used to create a more attractive design, particularly on the protected side. They can also assist the establishment of planting to soften the appearance of the barrier.



3.20.

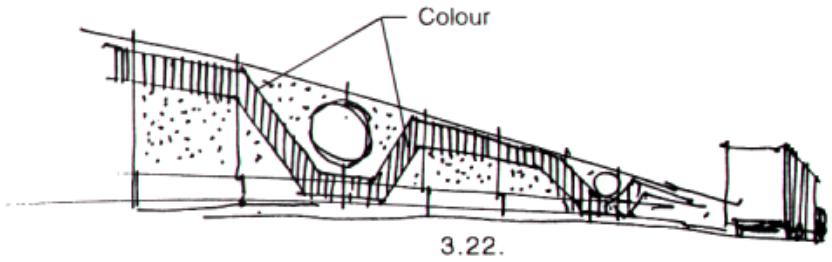
3.21 It may be cost effective to reduce the effects of reflected noise in certain cases by tilting the barrier away from the noise source by 10º to 15º. The top edge of the barrier however will then be further from the noise source and so the path difference will be slightly less than with a vertical barrier of the same height. The resulting sloping surface may also appear visually unstable and discordant from the protected side. It is particularly important to consider three dimensional views if there is any doubt about the visual impact.



3.21.

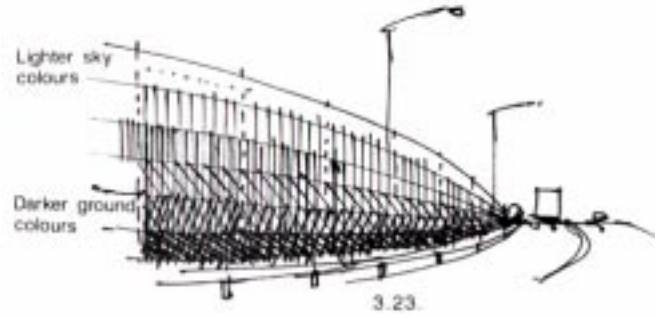
Use of Colour

3.22 Many proprietary barrier systems comprise acoustic panels which can be produced in a range of colours. The appearance of a barrier can be toned down to help it merge with its surroundings, or made to stand out as a striking and highly visible addition to the environment by the use of colour. In general, it is beneficial to use cooler blue/grey shades at the top of a barrier and warmer brown green earth colours near to the ground. This variation in colour tends to reduce the apparent height of a tall barrier at the roadside. Colour gradation may be less effective at some distance, where the barrier appears in silhouette.



3.22.

3.23 The local setting for the barrier should determine whether it is appropriate to add a splash of colour to an otherwise drab scene. The use of bright colours to create a feature should be sparing. They are most effective when restricted to key parts of the barrier, for example, to emphasise its structural form. Large areas of strong colour on a barrier can result in a garish rather than attractive appearance.

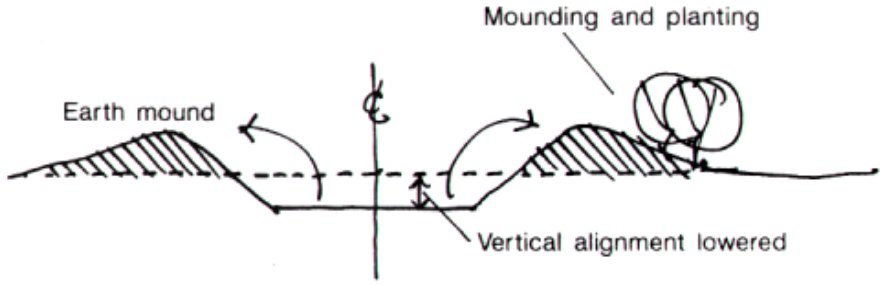


3.23

4. BARRIER DESIGN FOR RURAL CONTEXTS

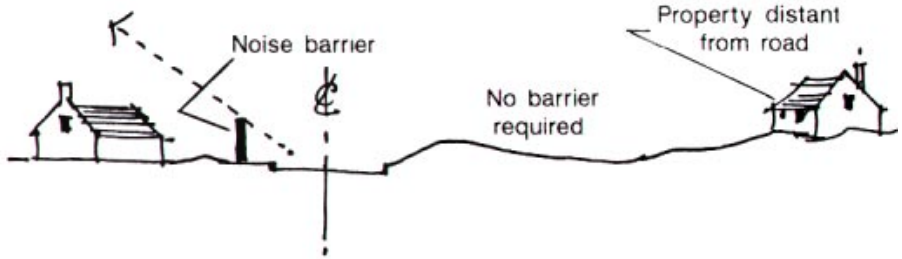
Design Considerations

4.1 Decisions on the alignment of the road will affect the scope of barrier design options and consequently they should be informed by early consideration of the need for environmental barriers. The need for barriers can be reduced by maintaining a greater distance between the road and properties, and by lowering the vertical alignment. Creating the maximum distance between the road and adjacent property will allow the acquisition of sufficient land for landscaped barriers, while lowering the alignment will provide additional fill material for use in mounds.



4.1

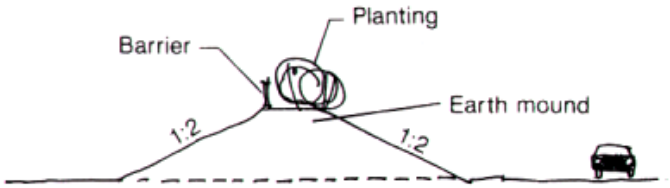
4.2 If there are properties at some distance on either side of the proposed road, especially where these are at a higher level (eg on the sides of a valley) the 'obvious' route mid-way between properties may not be optimal in general landscape terms. It may be preferable to displace the route away from some properties sufficiently for barriers not to be needed, and to protect those which are closer more effectively with a barrier of modest proportions.



4.2

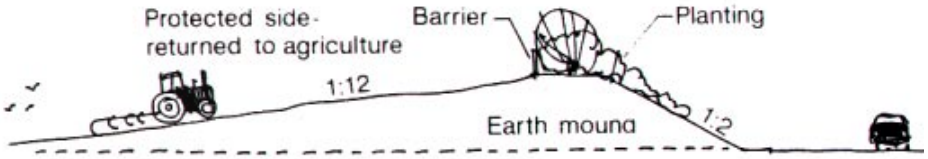
Earth Mounds

4.3 In a rural setting the most appropriate barrier form will be one which reflects its surroundings. The soft "natural" outline of an earth mound in conjunction with planting is likely to be more attractive both to local residents and to road users. Where space alongside the road is restricted, there are a number of alternatives to consider. Earth mounds can be combined with barriers if the skyline is softened with planting. They can be built with steep faces by supporting them using structural or naturally occurring materials; such barriers can imitate traditional methods of field enclosure or include integral vegetation.



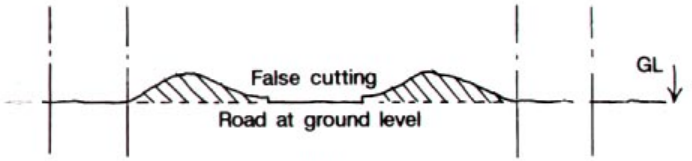
4.3.

4.4 An earth mound is an obvious solution to noise pollution in rural areas because it can be made to fit in with the landscape more naturally than any vertical structure, especially as it can support planting which greatly improves its appearance in most rural contexts. The amount of space with an earth mound requires is a major constraint - a 3 metre high earthmound with 1 in 2 side slopes requires a minimum width of 13 metres. Gentler side slopes, particularly on the protected side, are further more often desirable to blend the road with the natural slopes of the area. Consideration should therefore be given to acquiring additional land under licence, if possible, so that the slopes on the protected side can be graded out to 1 in 6 or less, allowing them to be returned to agriculture. Mounded areas outside the highway boundary may need a legally binding condition placed on them to prevent the landowners subsequently removing the mounding or vegetation.



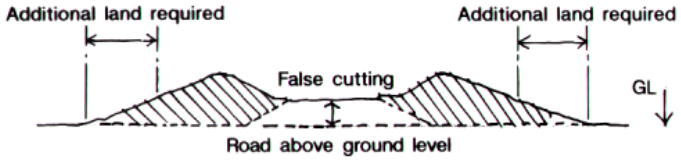
4.4.

4.5 Where barriers of more than 4 or 5 metres high are required, an earth mound provides the most visually acceptable solution to both residents and travellers, not least because it requires a wide margin and therefore minimising the visual constriction or corridor effect which vertical faced barriers can produce. However, because the top of the slope is several metres further away from the source of noise, the mound may need to be somewhat higher to give the required level of protection.



4.5.

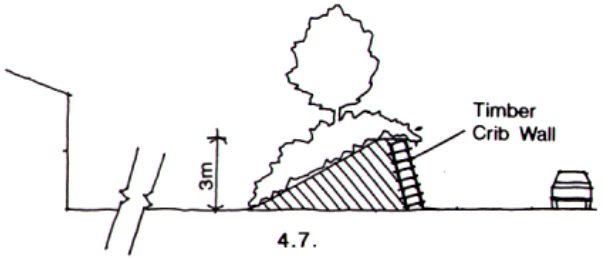
4.6 Landscape mounds alongside a road create the impression to the road user that it is in cutting. The 'false cutting' can continue even as the road rises above the level of the adjacent land, but the area of land taken into the highway corridor then increases rapidly.



4.6.

Supported Earth Mounds

4.7 Where space is restricted there are a number of proprietary systems such as crib walls, anchored or reinforced earth, which can be used to support one or both faces of a barrier. In the rural context, timer will appeal more natural than concrete, but may not be as durable. Structures with a narrow cross section will increase the likelihood of soil drying out, particularly if the slopes are south facing. Vegetation takes a long while to soften the faces of crib walls and changes in height will be abrupt with modular systems.



4.7.

4.8 Gabions (wire cages filled with stones and some soil) can also be appropriate to retain steep slopes in a rural context, but where there are changes in height, adding another layer of standard cubic cages creates steps which are visually unsatisfactory. It is recommended that cages on either side of a step are modified to minimise it and create a smoother line along the top edge. In filling with local sources of stone will also help towards harmony with the environment. Gabion wall designs should be submitted for geotechnical certification or technical approval as indicated in HA 66 (DMRB 10.5.2).

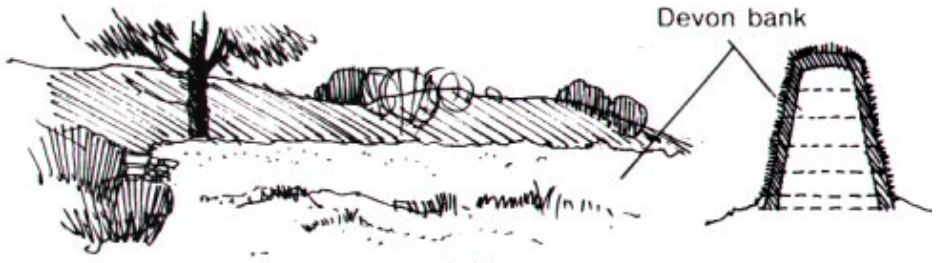
Stone filled gabions

4.8.

Traditional Methods of Enclosure

4.9 In those parts of the country where there is a local tradition of using banks or walls as a means of field enclosure, these can be adapted for use as barriers alongside the new road. If environment barriers in this form are tied into existing banks, they will appear as part of the traditional enclosure pattern. As an example, simulated dry stone walls may be appropriate in hilly areas, where there is a ready supply of rock fragments.

4.10 In a traditional *Devon Bank*, deeply cut turves in which native wild flowers may already be established are built up as a wall. Because of the comparatively high rainfall in the West Country, vegetation can be viable on banks up to 1.7m high. Vegetation may not establish properly on elevated exposures in areas where there is less rainfall. These barriers will not blend so naturally where other methods of enclosure are traditional.



4.10.

4.11 Alternatively, in a *Cornish Hedge* an earth mound is retained with steep faces by building natural stone slabs into them, while native plants can subsequently colonise and overgrow the top. Where a barrier is prominent in the view from properties, the Cornish Hedge may be preferred because its stone facing provides an interesting and varied appearance, especially in the initial years before vegetation has become fully established.

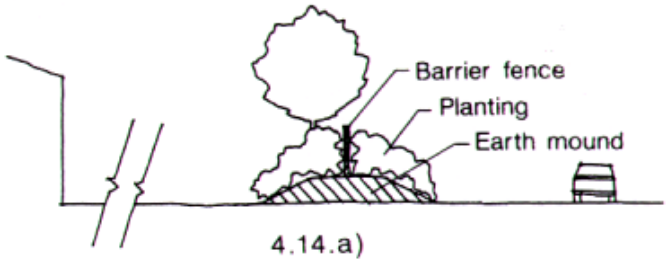
4.11.

4.12 Attempts to reduce the amount of hand labour involved by using steel or synthetic mesh reinforcement to support the faces have not always been successful because the tendency of these banks to dry out makes it difficult for vegetation to get established. Banks should not be made steeper or narrower than can be achieved using traditional methods. A substantial mass of moisture retentive topsoil is essential for banks to sustain vegetation through dry periods.

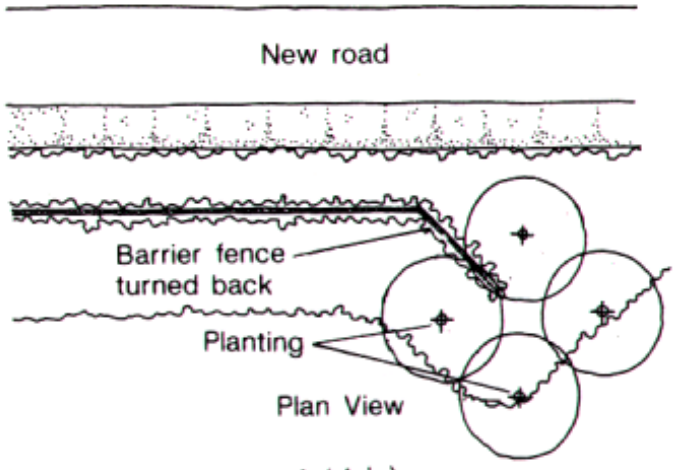
Earth Mounds with Barriers on Top

4.13 Where high barriers are necessary and cannot be fully provided by earth mounding, a short fence type of barrier can be used on top of a mound to increase the degree of screening. Barrier fences should not be used on their own in rural areas, although they are acoustically efficient, as this will introduce a semi-urban character. A low fence on top of a mound will need to be slightly higher than one adjacent to the carriageway, but it will tend to recede into the landscape.

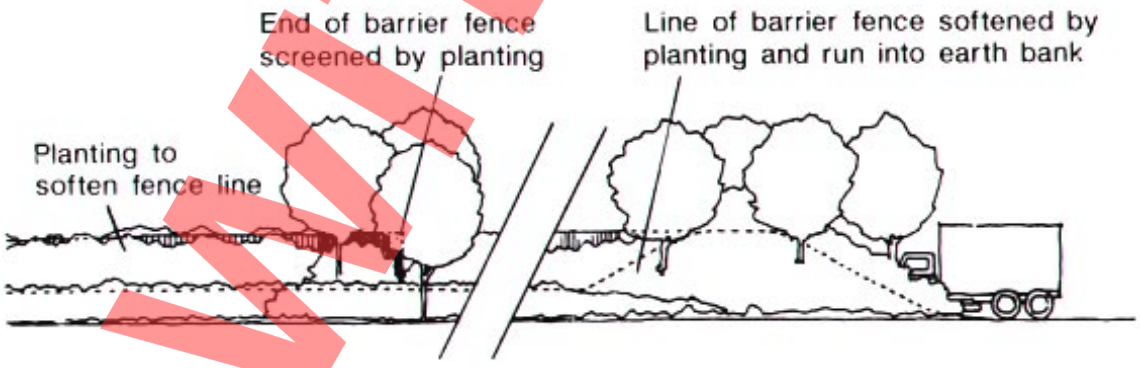
4.14 While the top edge of the fence improves the acoustic efficiency of a mound, it creates a strong horizontal line which will be out of place in rural surroundings. Judicious planting can in time create a softer vegetated skyline and sufficient space should be provided for this. Screening is particularly important at the ends, where the arbitrary cut-off can appear isolated. The fence can also be turned back for a short distance to create the illusion of depth, or it can be extended behind an adjacent section of earth mound of sufficient height.



4.14.a)



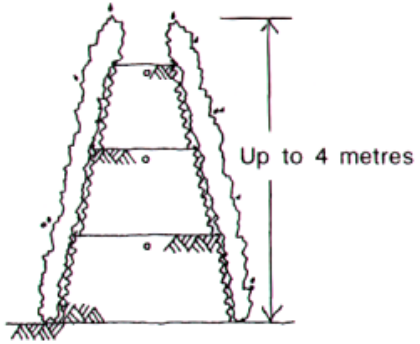
4.14.b)



4.14.c)

Vegetated Barriers

4.15 A number of “green barrier” systems have been developed which use living plant material in conjunction with soil-filled supporting structures up to 4 metres high. In most cases these need careful maintenance, including irrigation in dry weather. If planting fails through lack of water or disease, the barriers lose their visual appeal and may not be easily restored. In the longer term, well-established living barriers may need to be rebuilt if the planted material causes the supporting structure to deteriorate. Any consideration of this type of barrier should take account of the appropriateness of the planted species to the locality and to their maintenance requirements.



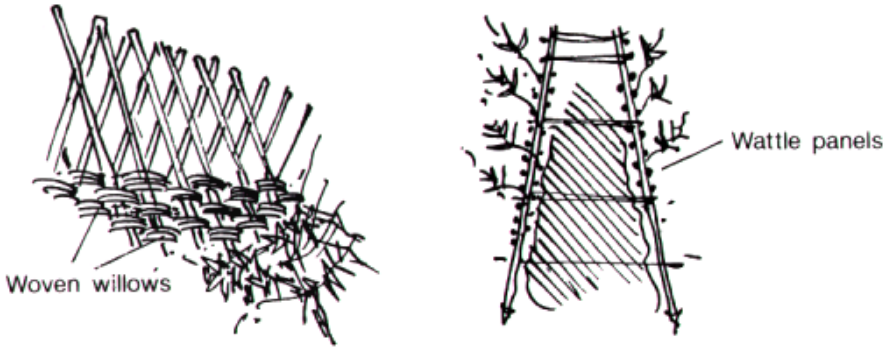
4.15.

4.16 Several purpose made systems have been seen elsewhere in European in which hardy and self propagating species are established in planters supported by various forms of inert framework. The structures vary from fairly massive sloping concrete frame and plank constructions - Figure 4.16a, to relatively slim vertical fences on which densely planted units are hung like turves - Figure 4.16b. Experience with these relatively new forms of barrier is limited, even on the Continent. Some other types are illustrated in chapter 5. Advice should be sought from the Overseeing Organisation about the suitability and fitness for purpose of these barriers.


4.16.a)


4.16.b)

4.17 One “green” system is constructed of live willow, woven into a wattle structure filled with soil. The willow puts out roots into the soil and grows outward and upward, creating an effect similar to a dense hedge. This would be appropriate to low lying or westerly wetland areas with a high rainfall, such as the Somerset Levels, but less so in areas where willow is not already part of the landscape; it could be particularly at risk in areas of low rainfall. Maintenance of this barrier would be a significant burden. The rapid growing willow shoots would require annual pruning - this both reduces the danger of damage in strong winds and prevents the upper shoots overshadowing the base of the barrier, stunting growth and causing it to expose the unsightly bare timber structure. A monoculture of willow would also be susceptible to pest and disease attack; and near to the road, willow is susceptible to salt damage - a replacement programme may be needed to keep the barrier looking healthy.



4.17.

4.18 A modification of the living willow barrier which does not require so much attention uses the wattles only as supports, but has evergreen creepers planted in the interstices. However, there has been less experience of this type of barrier and further advice should be sought from the Overseeing Organisation.

Road Safety

4.19 The sloping face of all forms of barrier which use earth fill and planting may present a hazard if placed close to the carriageway as errant vehicles can ride up the face or become snagged on it. Barriers within 4.5m of the carriageway are regarded as highway structures. The need to provide a safety fence in such cases will affect both cost and visual appearance.

5. BARRIER DESIGN FOR SEMI-URBAN CONTEXTS

Design Considerations

5.1 A barrier in a semi-urban or suburban landscape can reduce adverse effects for a large number of residents alongside the route. Aligning a new road close to the edge of a town will often be a preferred option in landscape terms as incursion into undeveloped and unspoilt countryside is thereby avoided. It is essential that the interests of nearby residents, who previously enjoyed open views, are considered at the earliest planning stage to allow the most acceptable barrier option to be adopted.

5.2 The space available for barriers in semi-urban situations will vary; fingers of development may create pinch points where an acoustic fence will be the only feasible option. Where sufficient space is available, barriers described in chapter 4 may be more appropriate. Earth mounding with planting can be particularly beneficial, creating a vital finger of green landscape in the view from adjacent properties.

5.3 Planted mounds can provide communities with physical separation from the road and a landscape setting. Where possible, sufficient land should be acquired to grade out mounds to natural slopes and so assimilate the road into the landscape. The height of mounds can be varied (above that required simply to reduce noise to a specified level or eliminate the view of the road) in order to create more natural contours.

5.4 Where the margins alongside the road are constricted, barrier designs might appropriately combine planting with an acoustic fence. There are a number of proprietary systems available but the important consideration is the need to select materials which complement the appearance and character of the surroundings, while meeting functional and engineering requirements. The potential for interaction with adjacent communities must be taken into account. For example, stepped barrier systems incorporating planting may be unsuitable on the protected side if they are likely to be used as a playground by children and an alternative solution should be sought.

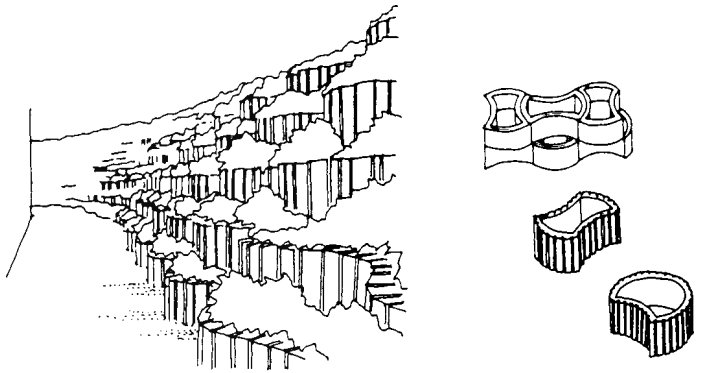
Earth Retention Systems

5.5 Steep sided earth mounds can be created using a variety of geotextile mats and other forms of reinforcement. Whilst a cover of grass and wild flowers can be established on quite steep sided barriers, a more attractive shrub vegetation is best achieved by creating a series of retained terraces having a level soil surface which is able to absorb rainfall. Hydroseeding may be necessary to establish vegetation on very steep slopes where conventional forms of seeding and planting are less effective.

5.6 Timber crib walling and gabions can look attractive from the road users' side in semi-urban contexts, but the difficulty of establishing a vegetation cover over these structures may limit their value as barriers on the protected side. The drab appearance of plain concrete crib walls is unsympathetic to residential surroundings.

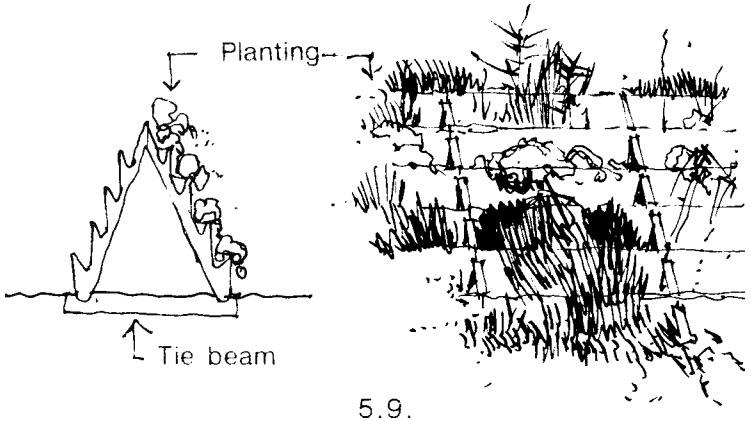
5.7 A relatively low cost solution which has been used on the Continent consists of stacked concrete manhole rings filled with earth. Whilst in its initial state the barrier appears crude and unattractive, but planting on the terraces softens its hard lines in time. However, its appearance in winter may remain unsatisfactory unless a proportion of evergreen species is included in the planting.

5.8 In one proprietary system planting is established in separate interlocking concrete trays which are stacked on top of each other. The shape of the trays and rough exposed aggregate ribbed finish to the concrete is designed to create a visually interesting surface with subtle variations of light and shade.



5.8.

5.9 A form of barrier which requires a smaller plan area uses concrete A-frames linked by one metre wide horizontal concrete panels; the supporting structure is partially obscured in due course by low spreading species planted in the retained soil fill.



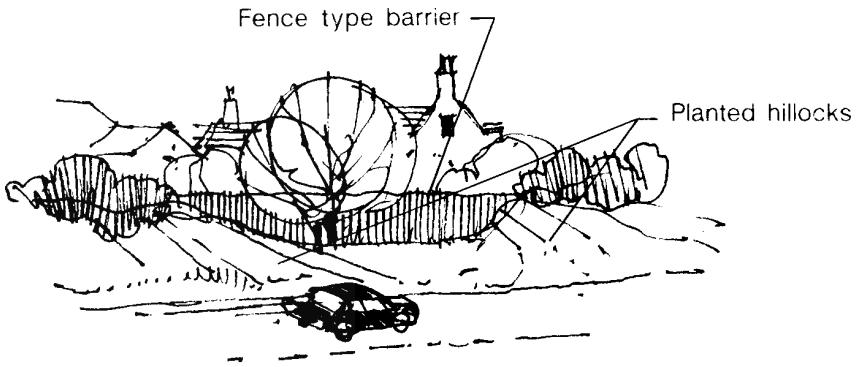
5.9.

Mounding and Planting

5.10 As in rural contexts, an acoustic fence should not in general be used on its own - mounding and planting combined with vertical panels will produce a more appropriate solution. A mound less than a metre high can reduce the impact of an acoustic fence in semiurban situations. The increased verge width will allow space for planting to soften the appearance of the barrier, which may then be perceived more as part of the surrounding landscape.

5.11 Mounding can also be effective when used at intervals along the length of an acoustic fence wherever local widening of the road corridor can be achieved, to break up the visual continuity of the barrier and make it less intrusive. The mounding would create a series of planted hillocks linked by the fence type barrier between. This allows the planting to dominate the view, improving the barrier appearance from both the protected site and the road users' side.

5.12 One barrier system which allows scope for planting consists of a pre-cast concrete panel wall set alongside the road in a zig-zag pattern. The triangular recesses provide niches for planting on both sides of the barrier to soften its appearance. The plan shape of the barrier makes it generally able to withstand wind loading without additional supports; it may also help to shelter planting from the wind buffeting from passing vehicles. The exposed surfaces can be modified to mimic a wide range of masonry and brick constructions. As with any type of barrier, long runs of standard design will become boring. This system is perhaps best used over relatively short lengths to relieve the monotony of long runs of acoustic fences where there is insufficient space for mounding.



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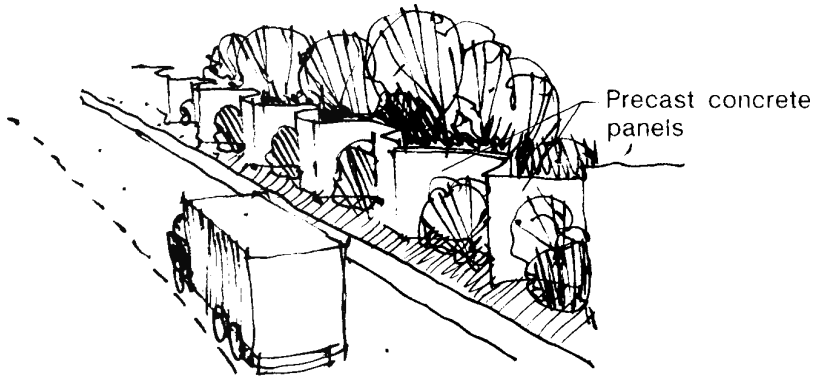


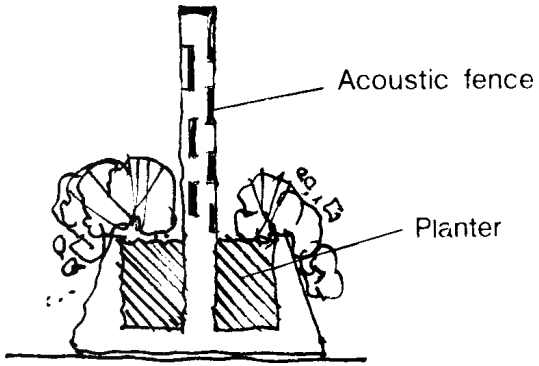
5.12.

Vegetated Forms of Barrier

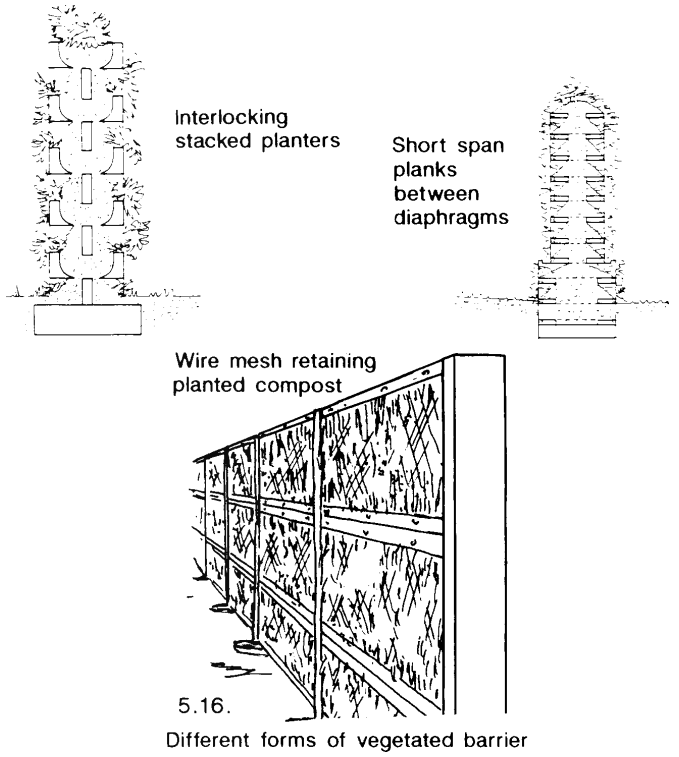
5.13 Where only limited space is available, an acoustic fence in combination with a retained planter at its base may be appropriate for both the protected side and the highway side, allowing planting to soften the barrier and relieve the monotony of the horizontal barrier top. But the tendency for small volumes of soil to dry out and the harsh roadside environment should be taken into account in selecting species.

5.14 The subdivision of the barrier into two elements - planter base and vertical panels - helps to reduce its apparent height. The planter walls, of solid durable appearance, provide a pronounced base line which anchors the fence-type barrier to the road edge in visually acceptable way. The finish of the planter sections should be chosen to reflect the local character, perhaps by using an exposed aggregate or riven finish to reflect the use of traditional building materials in the area.

5.15 Barrier panels may need to be noise absorbent, but local character can be reflected by an appropriate choice of construction material. Careful attention should be paid to details at ends, changes of level and junctions between different types of panel to ensure that the effect is in harmony.



5.16 Several forms of vegetated barrier have been developed which take up little more space than a fence, but they have not been in use for long enough to demonstrate long term viability. The maintenance commitment in sustaining vegetation on near-vertical faces of rather shallow soil containers might be a fairly high. There will be a high rate of water loss from the large surface area per unit volume and it is not certain that the growing medium would retain its integrity if allowed to dry out. This type of barrier should only be contemplated where there is an assurance of adequate water supply and drainage. Maintenance costs will be an important consideration, particularly if traffic management is needed to protect operatives and equipment. The Overseeing Organisation should be consulted about the use of barriers which have special maintenance requirements.



5.16. Different forms of vegetated barrier

Traditional Hard Material

5.17 In suburban areas the character of the surroundings may justify a barrier constructed as (or simulating) a brick or stone wall. Features should be provided especially on the protected side, to reduce the scale of the wall. Traditional details such as piers, recess brick panels, blue brick banding, and stepped copings will all help to reduce its prominence. If space is available, sections set back from the highway edge can be incorporated which allow tree planting to be introduced, so soften the appearance of the wall and to relieve the stark horizontally of the skyline. If these short set-back sections are unobtrusively located they can be constructed using timber panels in conjunction with planting which helps to break up the scale of uniformity of the wall especially on the protected side. Additional decorative treatment such as trellis work can be applied to add texture and to allow climbing plants to cover the wall.

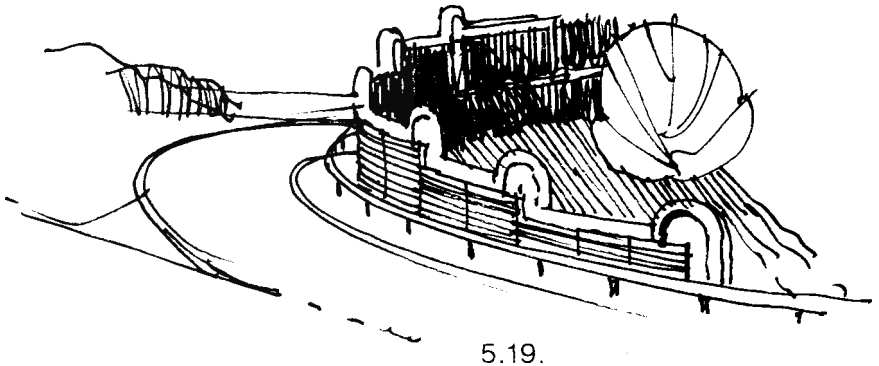
3.2.

Noise Absorbent Barriers

5.18 Where the alignment passes through the gap in development, for example a build-up area and a fringe community, properties on both sides of the road may need protection. It may be desirable to use absorb barriers to deal with the problem of reflected noise. Within the range of barriers available, the basic materials and their finish should be chosen to complement the character of their surroundings. Noise absorbent barriers may only be needed over a relatively short length and their compatibility with other forms of barrier used in the vicinity must be considered.

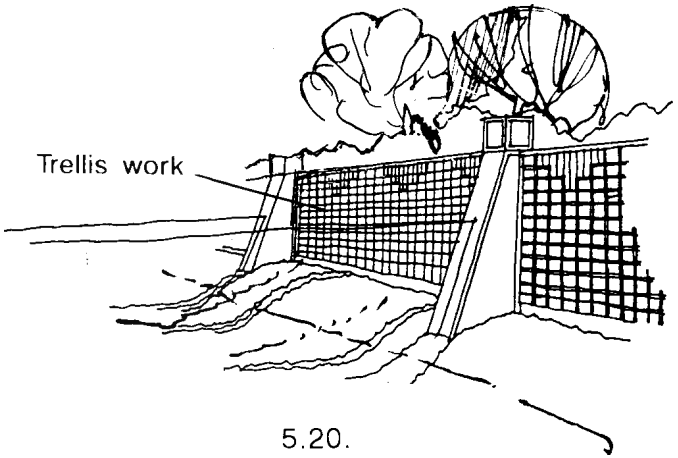
Detailing on the Protected Side

5.19 Where the new road cuts through a semi-urban area there will be locations where the barrier is particularly visible from public areas - for example where a secondary road is crossed, or where the road adjoins public open space. The problems which arise at the ends of barriers, at changes in height, and at junctions with bridge parapets, are sufficient to merit special details which help to resolve the inevitable conflicts of form, shape and colour. These details can be used as a way of creating a distinctive character for the barrier, making it appear more acceptable on the protected side.



5.19.

5.20 Where private gardens abut the barrier, a solution which reflects the domestic scale of the space enclosed will be the most appropriate, and may adopt devices such as the use of trellis work applied to the face of the vertical barrier. The pattern of the trellis work and climbing plants will help to soften the intrusive effect of the barrier.

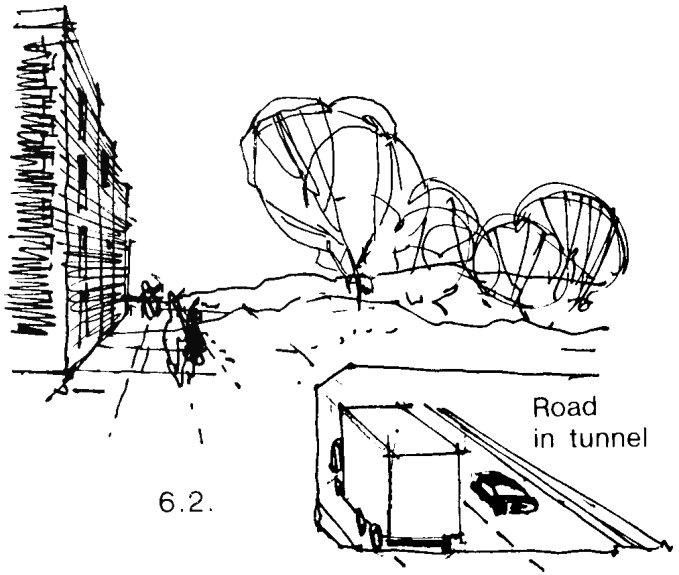


5.20.

6. BARRIER DESIGN FOR URBAN CONTEXTS

Design Considerations

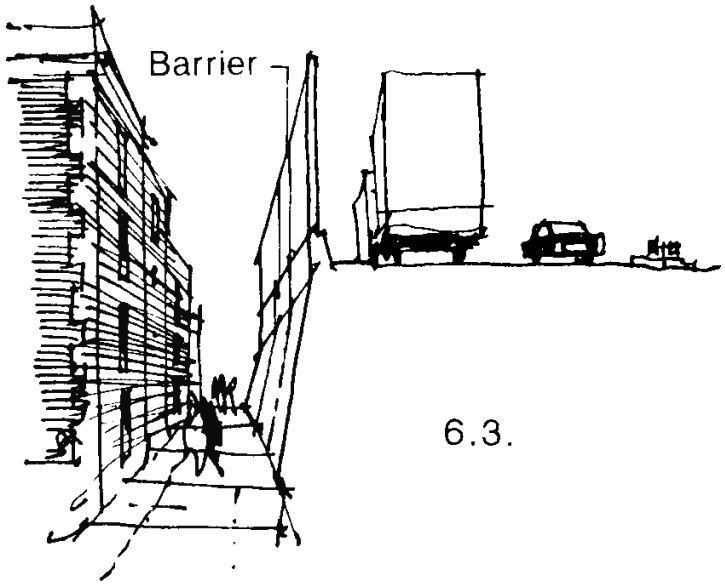
6.1 Where protection is required in urban locations, the considerations for barrier provision can be complex. For example, there may be a need to maintain public services including both traffic and utilities, or a need for integration with the Local Development Plan. The design team should consider the overall and local impacts of the scheme at the earliest planning stage; the team should include architectural and landscape advisors who are townscape specialists.



6.2.

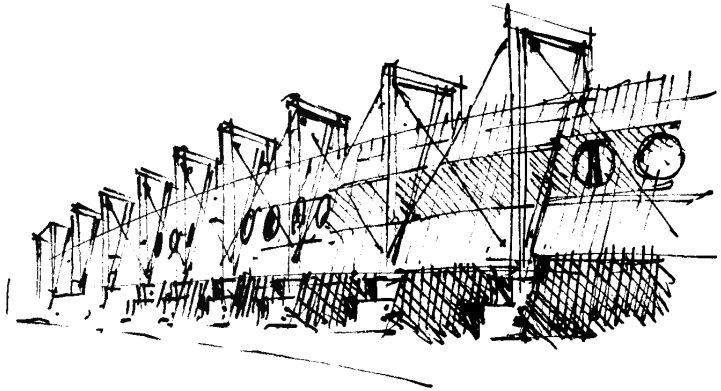
6.2 In urban areas, barriers may not offer the wider benefits of other scheme options. Possible alternatives which might dispense with or reduce the need for a barrier include tunnel or “cut and cover” solutions. An assessment of the value of benefits arising from improvement of access, including the use of space above the road where a tunnel option is employed, and the level of estimated compensation payments will all affect the search for the most cost effective route.

6.3 Once the optimum alignment for the scheme has been determined, the main constraint on the design of barriers will be the limited width of land available alongside the road. The proximity and height of the adjoining properties should dictate its height; the townscape character of the locality will affect the choice of materials for the protected side of the barrier.



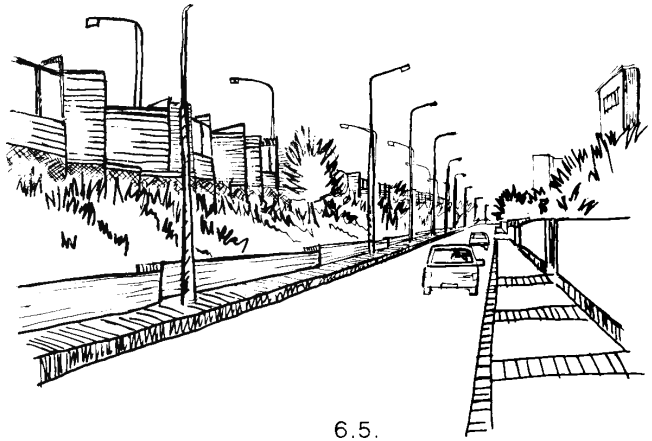
The Impact of Tall Barriers

6.4 In urban areas limited land availability alongside the route will often dictate that a fence type barrier is the only feasible option, but the resulting vertical surface may in fact be visually more compatible with an urban environment. A careful study of the areas requiring protection should be carried out to determine whether the barriers would be acceptable as a dominant feature in the protected area, or whether they should be subordinate to the existing townscape elements. Design objectives should include breaking down the scale of the barrier structure to fit the scale and character of the surroundings, as evidenced by the size of the adjoining spaces, and the appearance of the adjoining buildings and their component parts.



6.4.

6.5 The scale of the barrier can be reduced by alternations to the plan forms, with the introduction of set back or recessed panels, or by the arrangement of elements on the facade of the barrier, so that the juxtaposition of the component parts (such as the structural frame and the infill panels) harmonise with the pattern of the surroundings. The sensitive choice of colours will also help to integrate the barrier with its setting. In some areas the barrier could take the form of a facade, as a new feature designed to enhance the character of the townscape. But in most cases a solution which does not emphasise the presence of the new road is likely to be more acceptable to local residents.



6.5.

Use of Transparent Barriers

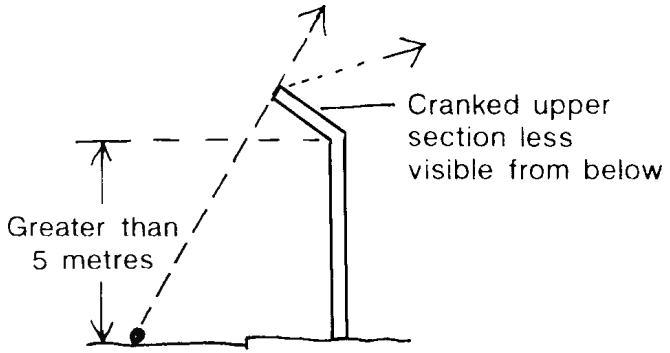
6.6 Where a barrier is required to provide noise protection to properties in close proximity to the highway there are likely to be adverse effects due to the loss of view, loss of daylight, and enclosure effects which can engender a sense of claustrophobia. Experience in Holland indicates that residents living behind a high noise barrier quickly forget the former high noise levels, and instead become dissatisfied with the loss of view which was once enjoyed. The need for high barriers typically arises where an existing road is widened by the demolition of properties along one side, so that the remaining facade overlooks a heavily trafficked route once road construction is complete.

6.7 The loss in the quality of the view and the need for light will need to be assessed for each property affected by a taller barrier alongside the route, and the design of the barrier should be adjusted to mitigate these adverse effects. Measures to be considered include the incorporation of transparent panels coordinated with the windows of properties behind the barrier. However such panels should be kept clear of the lower 1.5 metres of the barrier to avoid being obscured by dirt from the road.

6.8 Transparent barriers can also be used as a more general mans of reducing the prominence of the barrier as perceived both from the protected side and from the new road. A reduction in impact can be achieved by incorporating transparent panels at regular intervals along the barrier, or by glazing the top part of the barrier (typically one third of the height) to reduce its apparent height and dominance.

Protection of Tall Buildings

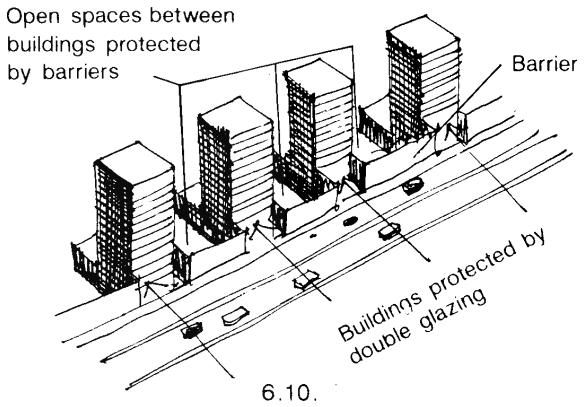
6.9 Where there are multi-storey buildings alongside the route, barriers need to be very tall to intercept noise at upper windows. If barriers higher than 5 metres above the carriageway level are necessary, it will make them acoustically more effective to cantilever the upper part towards the road. The visual impact of a sloping or horizontal section of the barrier at a high level and the possibility of snow accumulating on it need to be considered. In extreme cases in Europe, barriers have been cantilevered out over the traffic stream to protect tall buildings. The realisation of this concept involves designing a major structure, and the cost-effectiveness of the solution needs to be carefully considered.



6.9.

Secondary Glazing

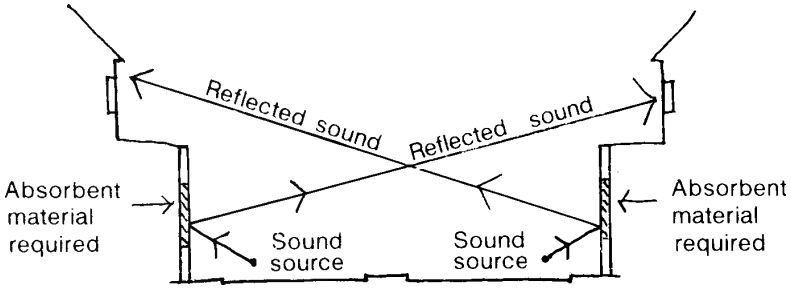
6.10 It may not always be desirable to protect the facades of tall buildings with barriers; secondary glazing may be a better solution overall, if tall barriers would obstruct views to an unacceptable degree. However, it may be appropriate to add a barrier of modest height to protect the pedestrian environment surrounding the buildings. The barriers must then be returned to prevent sound leaking around the ends. In some cases it may be beneficial to carry the barrier past the front of the buildings to protect the lower storeys and only provide secondary glazing for the upper storeys. This barrier might also incorporate transparent panels where a solid barrier would be too prominent or intrusive in front of properties. (See also 6.6 - 6.8 above).



6.10.

Absorbent Materials

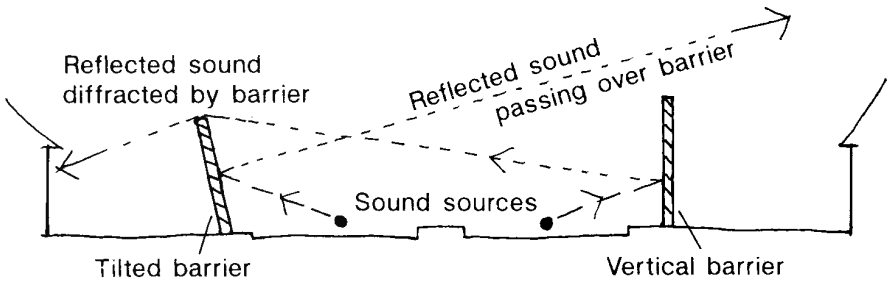
6.11 Where it is considered that reflection of sound from a barrier (or retaining wall) may exacerbate the need for protection, the cost effectiveness of applying absorbing material on part or all of the vertical face should be investigated. Absorbent materials are not equally effective at all frequencies and the particular circumstances must be considered in specifying acoustic performance. The desirable frequency response may constrain the choice of material and influence the chosen solution.



6.11.

Other Considerations

6.12 Wherever noise absorbing material is used on a barrier, transparent materials are effectively precluded. As an alternative to using absorbing materials, barriers can be titled slightly away from the road to reflect sound upwards (see also 3.21 above). But this may not necessarily help distant properties and may not be visually acceptable if silhouetted against strong vertical elements. The designer may thus have to find a compromise in arriving at an acoustically effective barrier which is not visually intrusive.



6.12.

7. CONSTRUCTION AND OPERATIONAL FACTORS

Timing of Construction

7.1 Planned environmental barriers might help to protect residents from the noise of construction machinery if they were erected at the beginning of a highway contract. It must be recognised however that they will be less effective at containing low frequency noise and vibrations associated with heavy earth moving equipment than their design performance might indicate, because this is based on high speed traffic noise measurements. Such protection will impose some restrictions on the choice of barrier and perhaps also on access to the site. Earth moving with heavy plant would be necessary to create barriers in the forms of mounds. The provision of barriers early in the contract would need to be clearly specified; the contractor may consider these to be vulnerable to damage during subsequent operations and quote rates to reflect this element of risk.

7.2 If a barrier needs to be installed adjacent to a road already under traffic there may be other constraints. While it may be possible to erect a standard 3m high barrier alongside a live road safely without disrupting traffic, excavating and concreting the foundations required for higher barriers may involve traffic restrictions for a significant length of time. Where such considerations apply, modular barrier systems which can be installed by lorry-mounted crane into supports founded on mini-piles may offer some advantage.

Barriers over Structures

7.3 Environmental barriers may need to be continuous over bridges and viaducts in order to attenuate noise effectively. Barriers on bridges will generally be close to the road edge and the structure may also provide some screening, so their height may be reduced. It will be advantageous to design the barrier and the bridge together. The visual impact of a solid barrier over a bridge may be oppressive and consideration should be given to lightening it with transparent panels. Where an environmental barrier to be added to an existing bridge, a separate supporting structure may be needed. Existing bridge parapets should not be modified to support environmental barriers unless the safety performance of such combinations has been verified - advice on approved systems should be sought from the Overseeing Organisation.

Sight Lines

7.4 A barrier will have maximum acoustic benefit if it is placed as close as possible to the edge of the carriageway. However, it must be set back to maintain the stopping sight distance on the inside of curves as required, and for visibility at road junctions. Standards for visibility are to be found in TD9 - Highway Link Design (DMRB6.1). The further a barrier is set back from the road edge the higher it must be to provide the same level of protection. The possibility of snow driving against environmental barriers so as to restrict visibility may be a consideration in some areas.

Light and Shade

7.5 Under some circumstances, sun or other sources of light reflected from a smooth surface can dazzle or distract drivers. Matt surfaces could be used, but might need more frequent cleaning; facets to disperse reflections may provide an alternative if this would be compatible with the surroundings. A low sun shining through transparent barriers can also distract motorists by causing a flickering light. The long shadows created by barriers in winter may cause ice and snow to remain in patches, which will have implications for safety and maintenance costs.

Access for Maintenance

7.6 Routine maintenance requirements can be minimised by self-cleaning details; transparent sections should be kept clear of splash zones, but will need cleaning occasionally; and vegetation may need to be trimmed. Space should be allowed between planting and the face of a barrier sufficient to give access for maintenance. However, in some locations there will be a need to consider restricting public access to the protected side to prevent vandalism.

7.7 Access for repair (and routine maintenance on the road user side) should normally be from the verge or hard-shoulder - ie within highway land. Unless space within the highway is severely restricted, there should be no need for frequent access to the protected side. But adjacent landowners should be restrained from incorporating a barrier into their property. An easement for occasional access to the protected side is more appropriate than retaining land behind the barrier, which might become overgrown, used as a dump and infested by vermin.

Escape Doors

7.8 Where there is no means of access for other purposes, doors should be provided in an environmental barrier to ensure means of escape from the roadside at intervals of not greater than 200 metres. The width of escape doors should be sufficient to allow stretchers to be carried through. Doors should be designed to maintain the acoustic integrity of the barrier, to be opened by members of the public from the traffic side and to be capable of being opened with a key from the protected side. The location of escape doors should be cleared indicated. If doors are located at the top of cutting or embankment slopes the provision of steps or ramps with handrails should be considered. The needs of disabled drivers should also not be overlooked. All ancillary features need to be carefully designed to avoid visual intrusion.

Pedestrian or Cycle Routes

7.9 Routes for pedestrians or cyclists can be maintained through a barrier, without detriment to its sound reducing qualities, by creating a gap between two sections of overlapping barrier. The overlap length must be several times the width of the gap in order to prevent noise from leaking through it. A considerable length of overlap is needed to attenuate the reflection of noise from side to side; the overlap can be significantly reduced if the gap is lined with noise absorbing material. However, the vulnerability of the barrier to vandalism will need to be considered where there is such direct access to it.

8. ENVIRONMENTAL BARRIER DESIGN PROCESS

STAGES IN THE DEVELOPMENT OF THE PREFERRED SOLUTION

A Consider Initial Alignment Options

- Investigate potential routes in order to minimise adverse environmental impact of the new road.

B Identify Affected Communities and Areas

- Highlight communities, facilities, recreation areas and designated areas alongside the route potentially affected by noise and visual intrusion.

C Review Alignment Options

- Investigate modifications to vertical and horizontal alignments, in order to reduce the impact of the road in terms of noise and visual intrusion.

D Identify Noise Reduction and Visual Screening Objectives for Each Location

- Determine location(s) and height(s) of barriers required to achieve the target reductions and establish the most effective profile providing an acceptable level of protection.
- **Confirm the need for a Barrier before processing further.**

E Assess Landscape or Townscape Character

- Identify the main features of the locality which could influence the range of barrier solutions considered, drawing on the landscape assessment for the route (DMRB 11.5).

F Design Options to Suit Local Context and Alignment

- Decide on the form of the barrier (earth mounding, fence, wall, structure or proprietary system etc), which would be most compatible with the neighbourhood.
- Select the most appropriate materials for the protected side compatible with the landscape or townscape character of the neighbourhood.

G Compare the Effectiveness of Alternative Solutions

- Consider whether there is a case for using noise absorbing or dispersing surfaces to reduce noise reflected from the barrier. Confirm that target reductions in noise would be achieved.
- Confirm whether the target reductions in noise would be accepted.

H Assess the Visual Impact of Alternative Solutions

- Clarify the visual impact of alternative designs on affected residential or other sensitive areas using 2 or 3 dimensional sketches.
- Consider the use of planting to reduce the visual intrusion of the barrier itself.
- Consider the use of transparent materials to reduce adverse impacts such as loss of views or light.
- Confirm whether the target reductions in visual intrusion would be achieved.
- Should the barrier have the same appearance on the road user side as that selected for the protected side.

I **Consider Advantages/Disadvantages for Each Design**

- Compare the characteristics of options, including implementation and maintenance costs, to inform choice of preferred option.

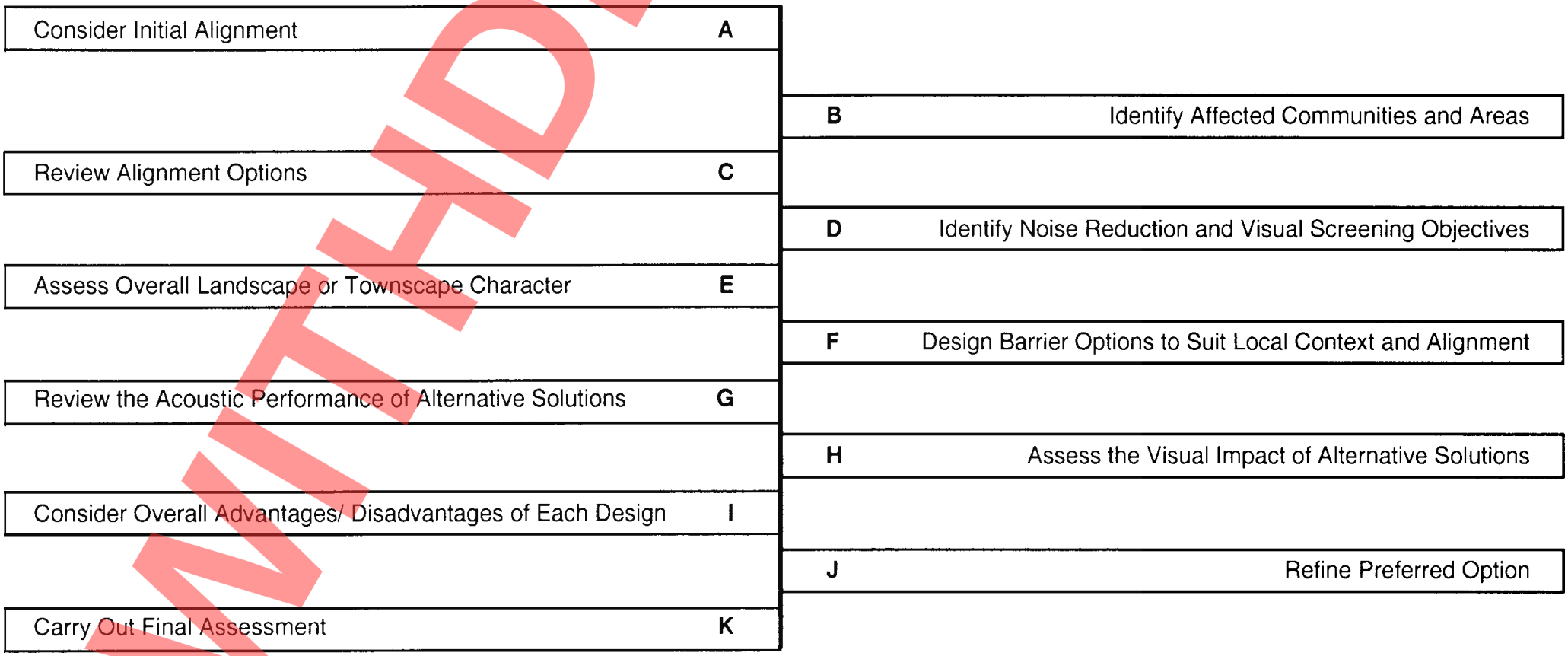
J **Refine Preferred Option**

- At detailed design stage refine preferred solution to optimise visual and noise benefits.
- Consider visual impact on road user, including: monotony - the need to provide drivers with visual relief street furniture - harmonisation of lighting, signs, etc.

K **Carry Out Final Assessment**

- Ensure all relevant criteria have been met.

Environmental Barrier Design Process - Summary Chart



9 BARRIER ASSESSMENT FRAMEWORK

Overview

9.1 An assessment framework provides a format for summarising the main environmental impacts of alternative options in order to assist the comparison of both subjective and objective evaluations. All the relevant factors which need to be taken into account are presented in the form of a table. The overall objectives of an assessment framework are summarised below:-

a) To ensure consideration of the likely significant effects on people and the environment.

b) To provide a balanced presentation of a set of comparative data, so that decisions can be made in full knowledge of their environmental, and economic consequences.

c) To show clearly that the effects of the alternatives have been considered before coming to a decision regarding the best solution.

d) To enable the public to give their views in full knowledge of the implications of the various alternatives.

9.2 The Environmental Impacts Table set out in DMRB 11.4.4 provides a framework for comparing major alignment options. The impact of noise and visual intrusion on properties are effects listed for each option. These impacts are common to the Barrier Assessment Framework, which considers in greater detail the possibility of mitigation. The number of properties which are subject to noise and visual intrusion will be shown in the “do nothing” column of the Barrier Assessment Framework. The effects of alternative barrier proposals within each alignment option are then compared in order to arrive at the optimum solution.

9.3 DMRB 11.4.4 indicates that as a scheme is progressed, the number of options shown in the Environmental Impacts Table reduces but the level of detail increases. An assessment framework may be appropriate to record refinements to barrier proposals. It is particularly important that the implications of alignment changes introduced during detailed design of the scheme are reflected in the assessment process for barriers.

9.4 The example of a framework for comparing alternative barrier designs in this guide is not exhaustive. The choice of data it contains should be appropriate to the size and complexity of the scheme and to the decision stage to which it relates, for example, public consultation or public inquiry. The levels of detail required at the different assessment stages are indicated in DMRB 11.4.

9.5 The barrier assessment framework should indicate the effect of different options at each location. Typical considerations might include the effect on occupants in residential, commercial or industrial premises, institutions such as schools and on uses of facilities such as shopping centres. If the barrier adjoins recreation areas the effects should be described. The impact on the landscape or townscape of barrier options should be considered in relation to any relevant national and local planning on policies, and an assessment should be made in the context of a townscape or landscape assessment of the locality undertaken by appropriately qualified members of the design team. Lastly the framework should consider the effect of the barrier on a road user.

9.6 Factors relevant to sites under consideration should be included as appropriate. In rare cases the design solution may appear to be “obvious”, or the length of barrier is so short that its visual impact will be insignificant. Although a full design study may not be warranted, the assessment framework should be used as a checklist and a method of recording the design criteria. The framework may be used in its own right as a design tool, or the relevant information may be incorporated into the main scheme impact assessment tables.

Barrier Assessment Framework - Comparison of Options at Each Location
Visual and Acoustic Factors

Affected Areas and Activities**	Effect	Unit	Do Nothing	Barrier Option A	Barrier Option B	Barrier Option C	Comments
Residential Properties	Noise	exposure to Level changes in bands of 5 dB(A)					
Schools and Hospitals	Visual effects of road	Substantial Moderate Slight					
Other Facilities Shopping/Recreation	Visual impact eg barrier	Substantial Moderate Slight					Need to take account of relative scale
Conservation Areas, AONBs, SSSIs, Public Open Space Landscape/Townscape	Compatibility with landscape and local planning policies	Brief description (with sketches)					
Road Users	Contribution of barrier to road scene	Brief description (with sketches)					Need to balance consistency and variety between barriers at different locations.

** Each affected area should be considered in turn against all effects

Barrier Assessment Framework - Comparison of Options at Each Location
Cost Considerations

Cost Element	Unit	Do Nothing	Barrier Option A	Barrier Option B	Barrier Option C	Comments
Construction	£					
Land	£					
Compensation	£					
Maintenance**	£					
Total	£					
Summary of Advantages and Disadvantages	Overall Description					Should conclude by indicating preferred solution

** including allowance for any traffic management needed to protect operatives maintaining the barrier or planting on the road side

10. RURAL CASE STUDIES

SITE A - MOORLAND

Description

The new road passes close to a group of properties on the edge of a small country town. The road crosses the slope above the town on sidelong ground and is partly in cutting to reduce its impact on the open moorland AONB to the south. The road and traffic will have a significant impact on this small community. A barrier about 200 metres long would protect properties from noise and visual intrusion.

Design Process

A Consider Initial Alignment

The selected alignment avoids encroaching on the adjacent AONB.

B Identify Affected Communities and Areas

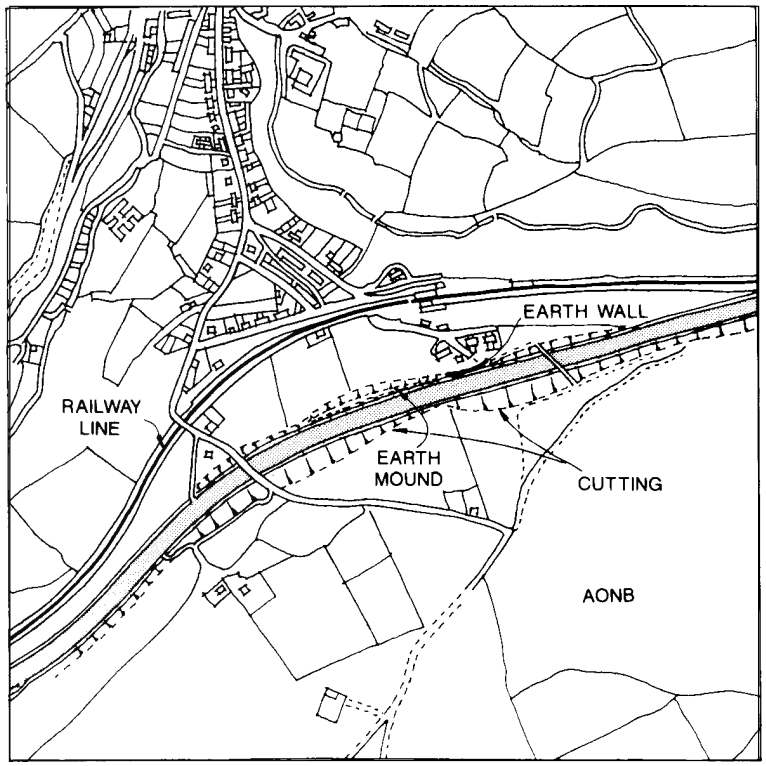
The new road passes 10 metres away from 7 cottages and a hotel, which are part of a satellite community on the outskirts of the town and separated from it by the railway.

C Consider Route Alignment Options

There is limited opportunity for adjustment because of impact on the countryside.

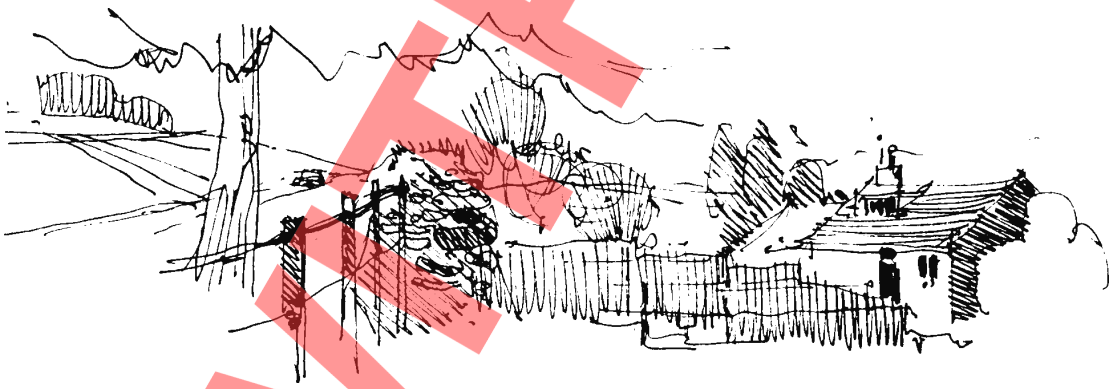
D Identify Noise and Visual Criteria of Selected Alignment

Noise mitigation objectives would be met by a barrier rising to 3 metres above the carriageway. Siting the barrier at the top of the cutting slope reduces the vertical face to 1.7 metres. A barrier of this height also provides a visual screen, but obscures views of the open countryside.



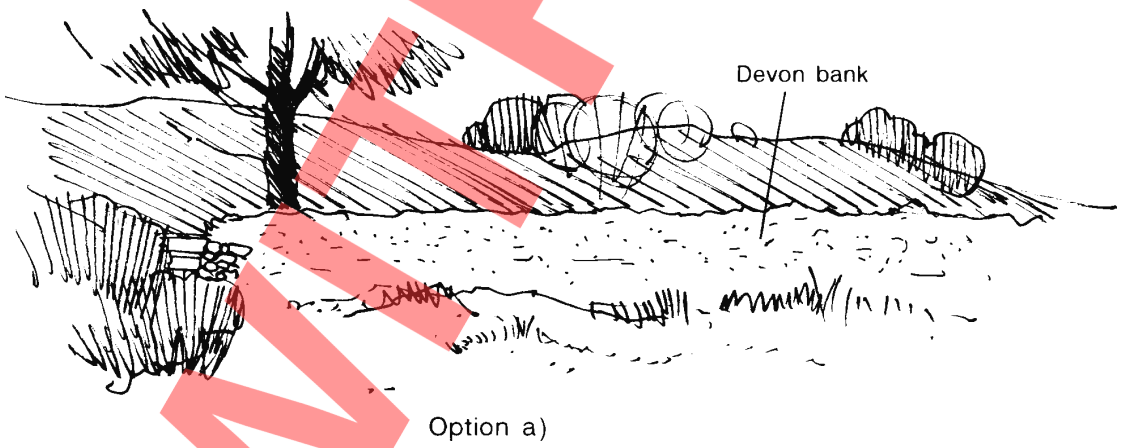
E Assess Landscape Character

The adjoining countryside has a rugged character, comprising rough pasture interspersed by oak woodland on a sloping hillside with moorland higher up. Adjacent field boundaries are Devon banks.

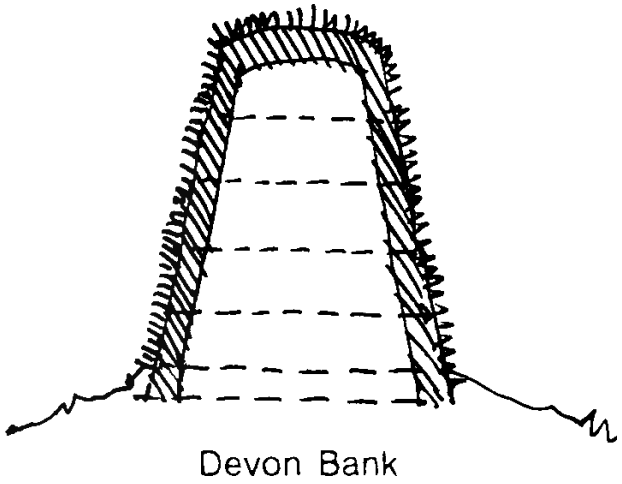


F Design Barrier to Suit Local Context

The rugged rural surroundings suggest natural forms as being most appropriate. Properties in the neighbourhood are characterised by white painted rendered elevations, with roofs and gable ends in slate; property boundaries are mostly stone walls. Appropriate barrier designs which mirror the boundary features already found in the locality include retained earth banks (Devon banks), stone faced earth banks (Cornish hedges) or free standing stone walls.



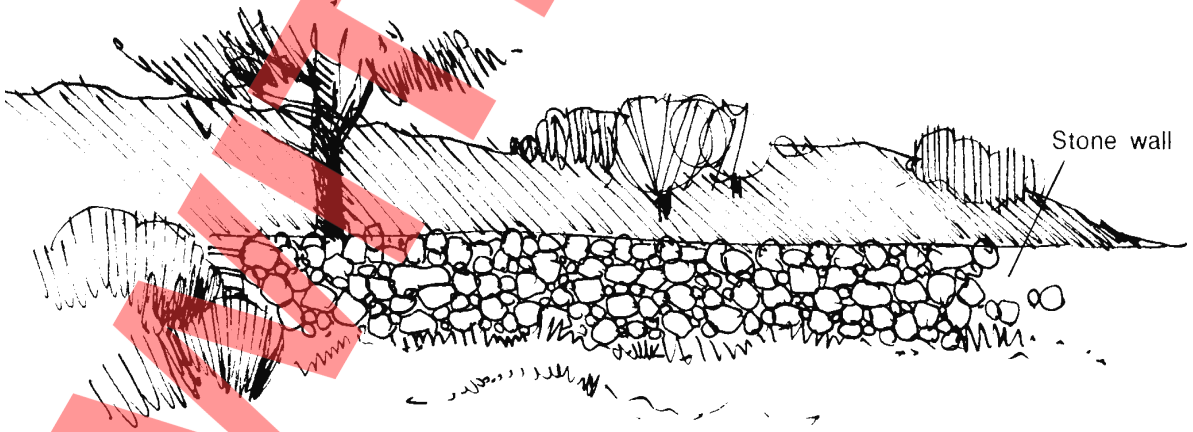
Option a)



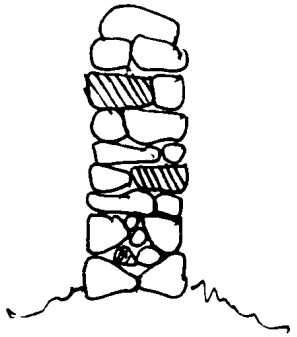
Devon Bank

Option b)

Cornish Hedge



Option c)



Stone Wall

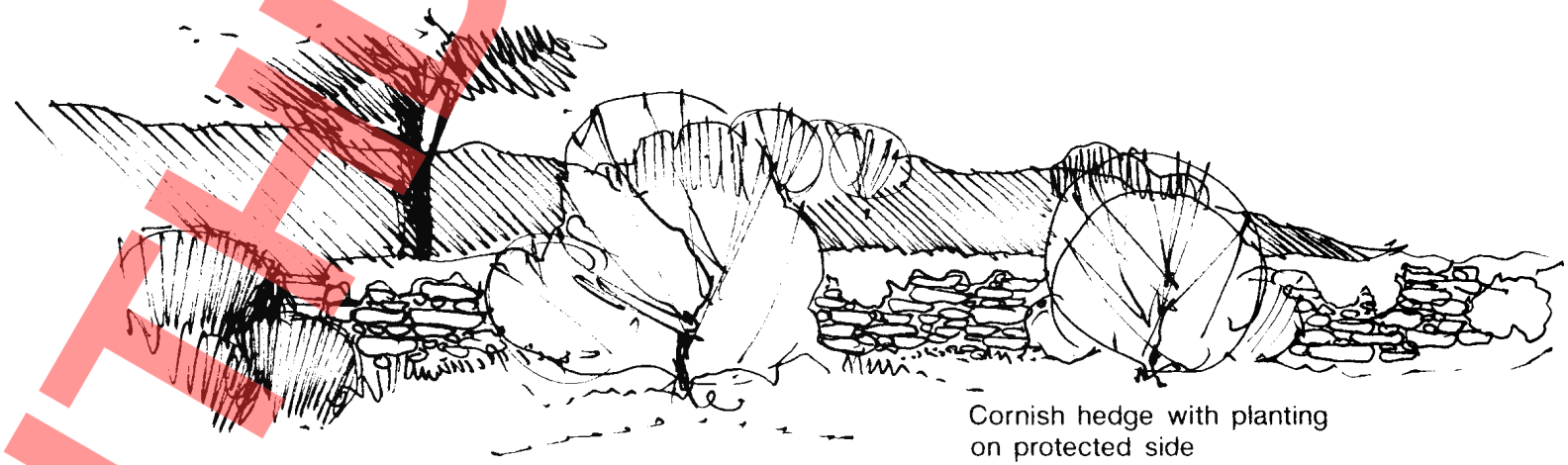
G **Reappraise the Noise Benefits of Alternative Option**
All of these barriers would achieve the requisite noise reduction for the affected properties.

H **Assess Visual Impact of Alternative Options on Protected Side and on Road User's Side**

	Option a	Option b	Option c
Type	Devon bank 1.7 metre high on top of 2 metre deep cutting	Cornish hedge 1.7 metres high at 2 metre cutting.	Stone wall 1.7 metres high above 2 metre retaining wall.
Impact on Protected Side	Mirrors surrounding field boundaries but might appear inappropriate in the context of a garden.	Stone facing would relate well with garden walls in the vicinity; attractive at outset.	Coursed random rubble stone wall to match traditional walls in the area would be an attractive boundary.
Impact on Road User	Devon bank would relate well with earthworks alongside road and be little noticed by the motorist.	would reflect more distant rock out-crops of the moorland.	wall 3.7 metres high would be out of scale with others in the area.
Comments	Grass cover might take more than one season to establish in dry summers.		

I Consider Advantages/Disadvantages

The initial appearance of a Devon bank is a disadvantage and vegetation growth can be retarded by dry summers. A stone wall would be appropriate to the close relationship between the houses and the barrier but would be out of scale with other boundary walls. It would also require more elaborate foundations than the other barriers with consequently greater cost. A Cornish hedge will have an attractive pattern of stone facing initially and vegetation will soften its appearance in time. It is therefore the preferred solution.



Preferred Solution

J Refine Preferred Solution

Consider planting of trees and shrubs within the gardens behind the barrier to soften further its appearance in the view from affected properties.

SITE B - ARABLE PLAIN

Description

The new trunk road has been built to bypass a string of settlements along the original road and take a more inland route along the northern part of a flat, open coastal plain. There are intermittent settlements scattered throughout the area. The road passes at ground level through a gap 150 metres wide between two clusters of rural properties. Ambient noise levels in this rural setting were low and the noise from road traffic would have a significant impact on houses nearby.

Design Process

A Consider Initial Alignment

The alignment is equidistant from properties on either side.

B Identify Affected Communities and Areas

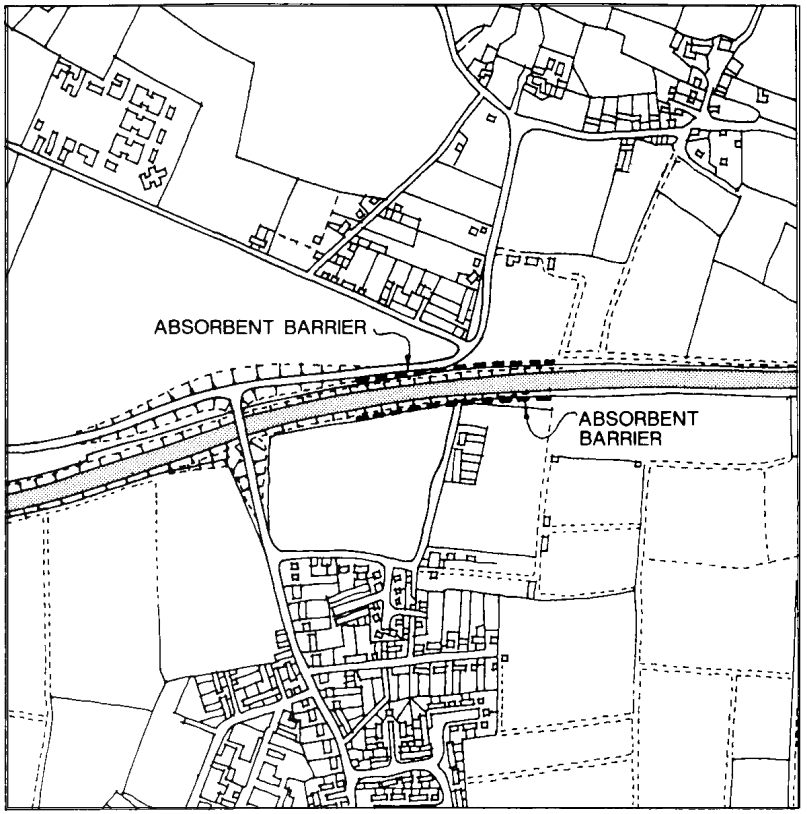
Properties in communities on both sides of the road are as close as 70 metres from the carriageway edge.

C Consider Route Alignment Options

The alignment was fixed as a compromise. The high water table precluded putting the road in cutting.

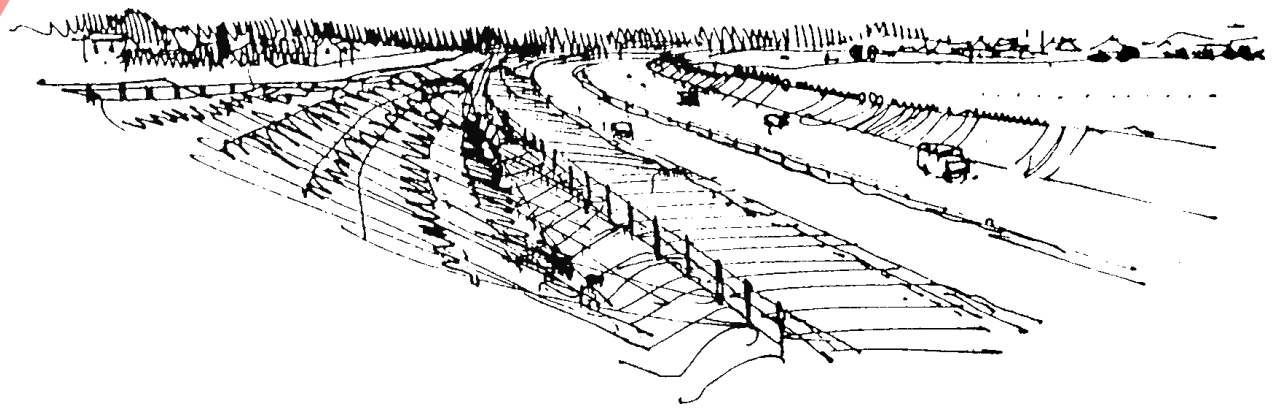
D Identify Noise and Visual Criteria

A barrier 3 metres high is needed for about 350 metres on both sides of the road to provide screening. Absorbent faces are necessary to avoid the loss of effectiveness caused by noise reflections. The introduction of the new road into an area of pleasant rural landscape results in a high degree of visual intrusion on properties. Visual screening needs be compatible with the landscape.



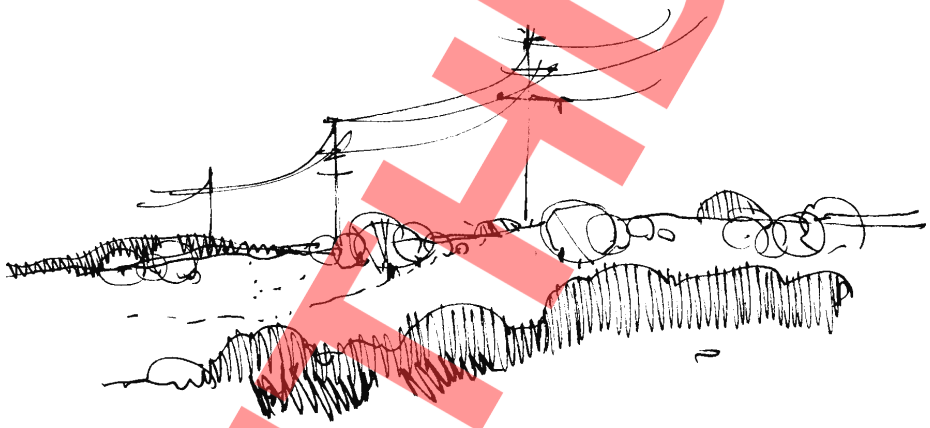
E Assess Landscape Character

Settlements are dispersed across the costal plain with large open arable fields between. Thee is distant skyline of woodlands where the land rises to the north. Dwellings in the vicinity are one and two storeys, with brick or rendered elevations and tiled roofs. A new bridge over the trunk road is to be situated about 400 metres from the affected properties. With its associated approach embankments up to 5 metres high, this will be a prominent new feature in the flat landscape.

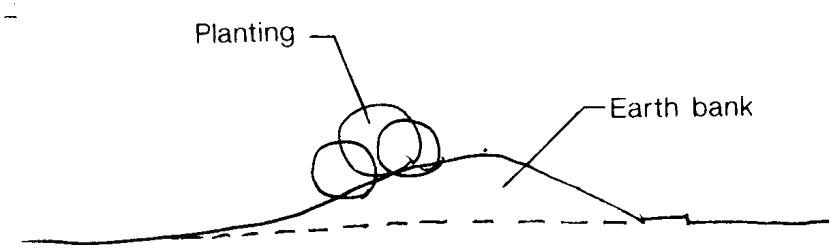


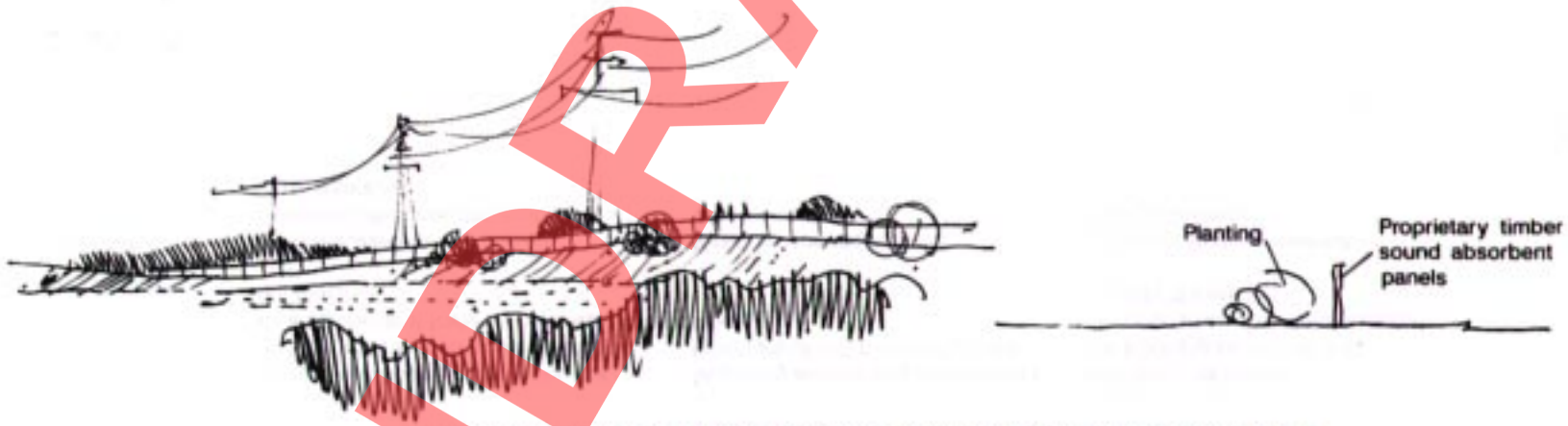
F Design barrier to Suit Local Context

The predominantly open rural character with scattered settlements suggested that natural forms are appropriate for the barrier. The design should take account of the nearby embankments for the new overbridge as a prominent new feature in the locality. However, difficulties with land acquisition enforces consideration of fence type barriers.

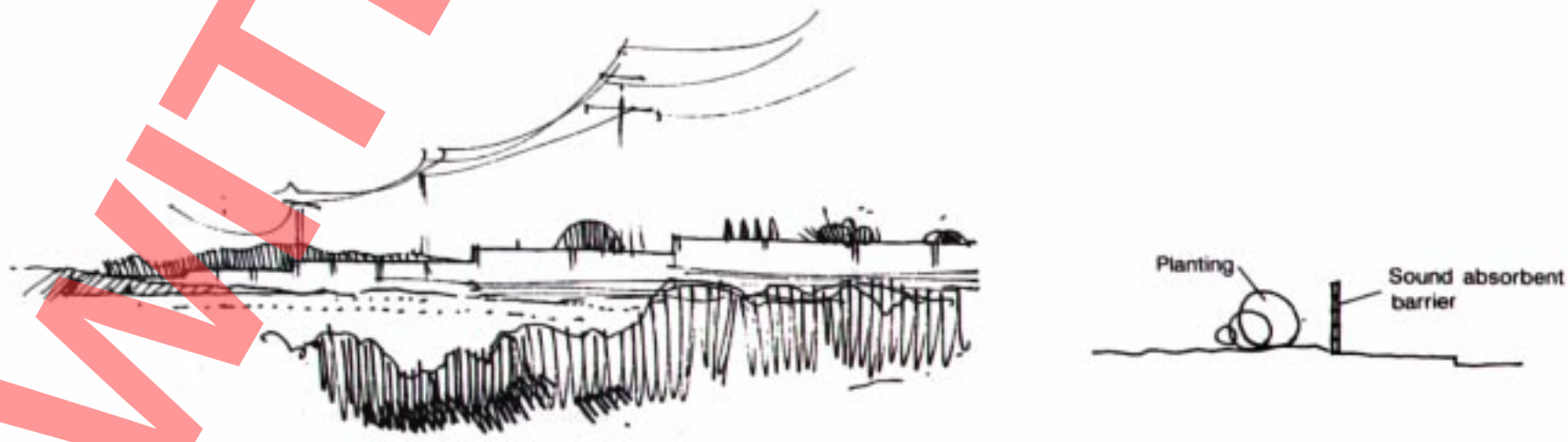


Option a) Earth Banks and Planting





Option b) Full height proprietary timber sound absorbent panels with planting



Option c) Full height sound absorbent barrier with planting

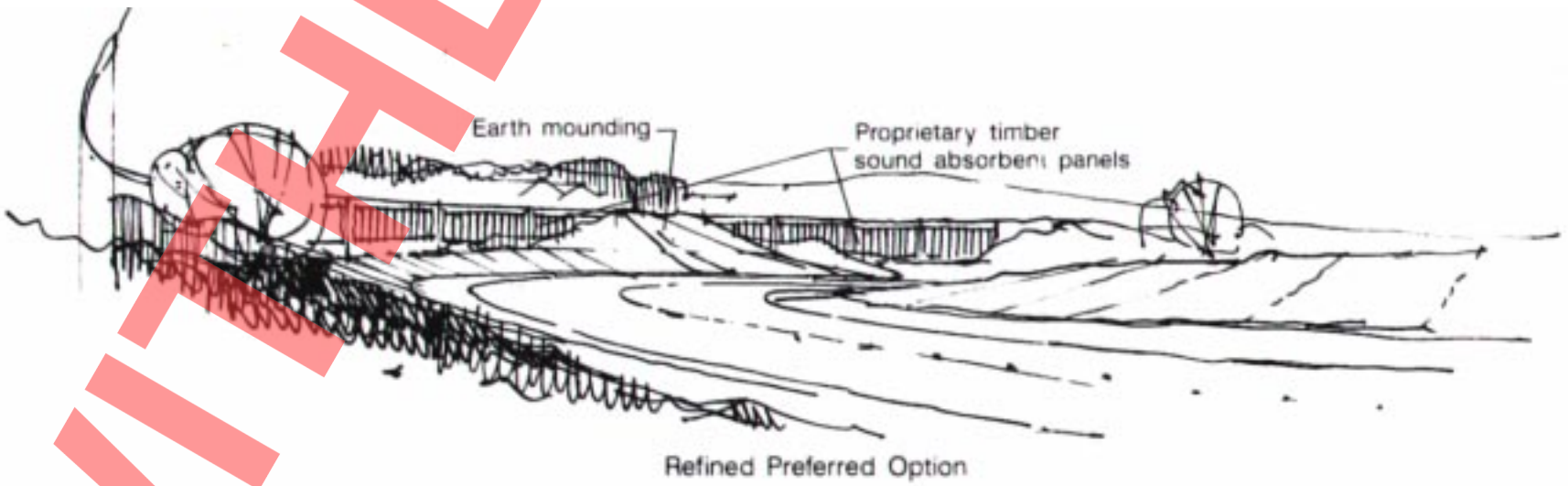
G **Reappraise the Noise Impact of Alternative Options.**
Detailed noise calculations show that 3 metres high absorbent barriers would suffice.

H **Assess the Visual Impact of Alternative Options on Protected Side and on Road Users' Side**

	Option a	Option b	Option c
Type	Earth banks and planting	Timber absorbent barrier 3 metres high with planting.	Hollow metallic absorbent barrier 3 metres high with planting.
Impact on Protected Side	Earth banks would link up with the nearby embankments for the over bridge. Planting would integrate barrier and earthworks together.	Timber fence would relate to garden boundaries nearby. But 350 metre length of 3 metre high panels would appear out of scale with the rural setting. Planting would reduce their impact in time.	Metallic barrier would look alien in rural context. Full height barrier would appear out of scale with nearby boundary fencing. Planting would soften impact in time.
Impact on Road User	Planted earth banks 350 metres long on both sides of road would be seen as a natural rural feature when threes are mature.	Mounding and planting would reduce monotony of 350 metre long timber fence.	Metallic units would be incongruous in rural area. Stepped ends of barriers would be visually discordant.
Comments	Land requirement may present problems; otherwise this option is most appropriate.	Minimum land requirement. Ease of erection.	Minimum land requirement. Ease of erection.

I Summarise Advantages/Disadvantages

All options would satisfy the noise objectives. Whilst earth mounds and planting would have a desirable natural appearance and would integrate the barrier with the embankments for the nearby overbridge, the extensive land requirement and the need for imported fill present difficulties. Metallic barriers would look incongruous in the rural setting. Absorbent timber panels on their own would appear out of character initially, but planting would soften their impact. Overall the absorbent timber panels would best meet the requirement for a barrier of natural appearance to fit the rural setting whist requiring the minimum of additional land.



J Refine Preferred Option

Consider mounding where space permits alongside the road to reduce the prominence of the barrier in its setting.

SITE C - PASTORAL

Description

The new trunk road runs through a rolling pastoral landscape, with scattered communities separated by fields and hedgerows. The route passes at ground level between a small country house in a parkland setting and a row of detached houses with mature gardens. Ambient noise levels were low so that the noise from road traffic will have a significant impact on nearby properties. Visual intrusion of the road on properties will also be high.

Design Process

A Consider Initial Alignment

The selected alignment follows the contour of the hillside below the country house.

B Identify Affected Communities and Areas

The country house is in an elevated position overlooking the road from a distance of about 200 metres. On the other side of the road, the nearest house is within 30 metres of the road.

C Consider Route Alignment Options

The alignment could not be moved or lowered without having a significant effect on the parkland.

D Identify Noise and Visual Criteria

A barrier 300 metres long and 3 metres high is needed on the north side facing the country house to provide a visual screen. A similar size of barrier would protect the row of houses at the end of the local road to the south from excessive noise.

E Assess Landscape Character

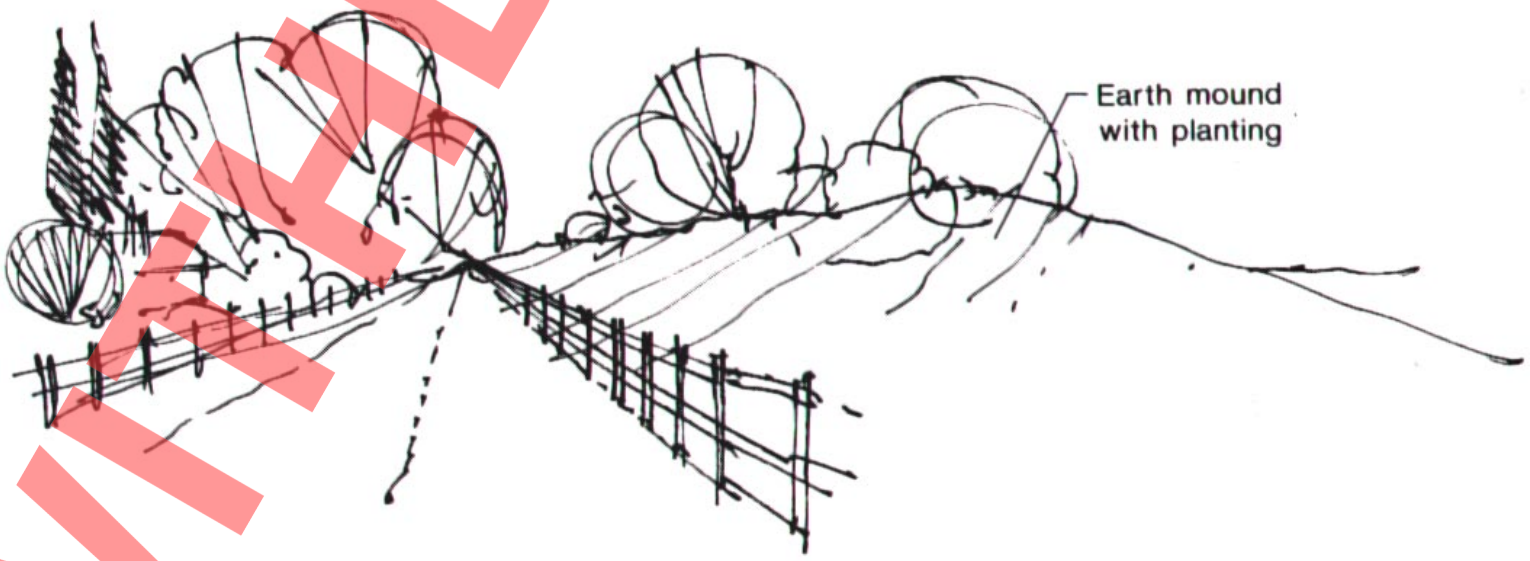
The locality contains mature trees, hedgerow, garden and parkland area associated with the country house, which together create an attractive landscape of intermediate scale. The houses in the vicinity are mostly of two storey constructed in brick with slate or tile roofs.

E. Two storey brick houses with slate on tile roofs.

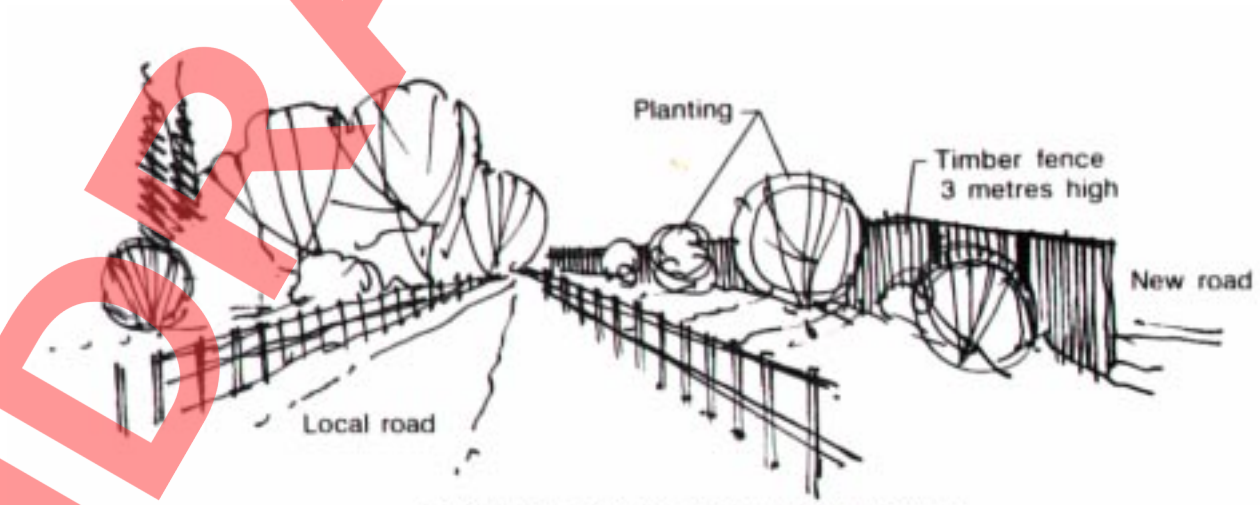
E. Country House and Parkland

F Design barrier to Suit Local Context

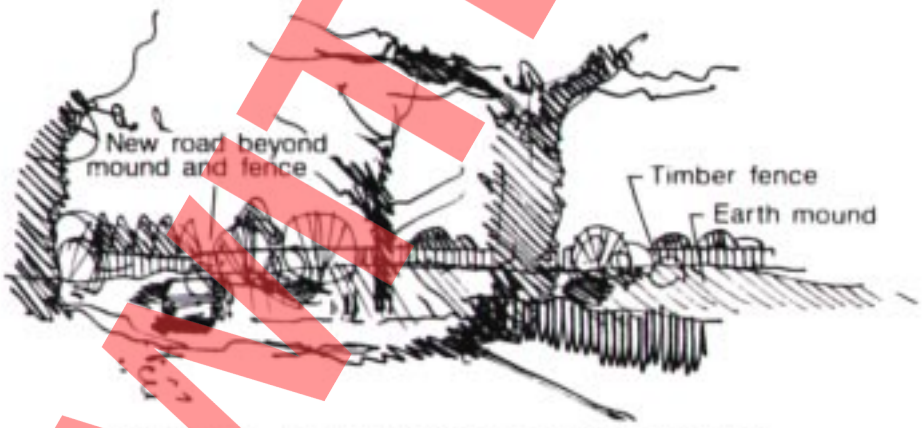
The preponderance of mature trees in the locality reinforces the rural character and suggests that natural forms would be most appropriate. Options adjoining the row of detached houses are constrained by limited space.



Option a) Earth Mound with Planting



Option b) Timber Fence with Planting



Option c) Timber Fence in conjunction with Mounding and Planting

G Reappraise the Noise Impact of Alternative Options

A fence type of barrier 3 metres high and 300 metres long would would significantly reduce noise levels at the nearest properties.

H Assess the Visual Impact of Alternative Options on Protected Side and on Road Users' Side

	Option a	Option b	Option c
Type	Earth mount with planting	Timber fence 3 metres high with planting.	Timber fence in conjunction with mounding and planting.
Impact on Protected Side	Earth mound and planting integrate well with parkland appearing as peripheral tree belt when mature.	Timber fence barrier relates to garden fences and the existing tall trees soften its appearance.	Short timber fence sections with intervening mounding and planting relate well to local context.
Impact on Road User attractive.	Earth mound would be less conspicuous.	300 metre long fence would be out of character in roadside context.	Combination of short fences, mounding and planting would be more.
Comments	Earth mounding on south side of road adjoining the row of houses restricted by lack of space.		

I Summarise Advantages/Disadvantages

Earth mounding is the most appropriate option in this rural context, but where there is insufficient space adjoining existing dwellings a combination of timber fence with mounding and planting (Option c) best satisfies the visual criteria.

J Refine Preferred Option

Consider taking licence for landscaping to reduce the slope of mound where it abuts the parkland so that it blends more naturally with the landscape.

11. SEMI-URBAN CASE STUDIES

SITE A - RAILWAY CROSSING

Description

The realigned trunk road passes obliquely through the 450 metre wide gap between the eastern outskirts of a large conurbation and an adjacent suburban dormitory town. It approaches to within about 100 metres of a post-war development consisting mainly of semi-detached dwellings.

Design Process

A Consider Initial Alignment

The alignment will be on embankment up to 5 metres high across flat arable land.

B Identify Affected Communities and Areas

About 40 dwellings between 100 metres and 150 metres from the edge of the carriageway are significantly affected.

C Consider Route Alignment Options

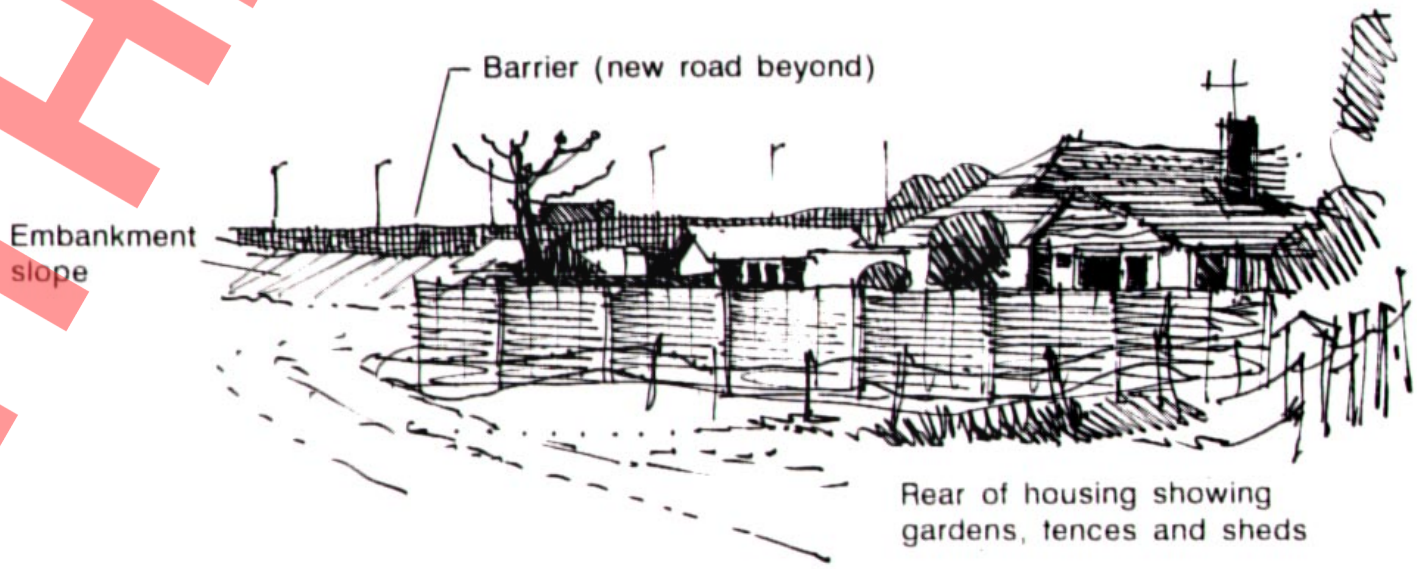
The alignment is tightly constrained. It must connect with the existing road to the south and must be elevated in order to cross the railway.

D Identify Noise and Visual Criteria

A barrier 3 metres above the road and 1100 metres long is needed to reduce noise levels. The embankment itself will block views from properties across open farmland and result in a high level of visual intrusion. A 3 metre high barrier on top of the embankment would eliminate the view of traffic, but would exacerbate visual intrusion. Planting might be required to mitigate the adverse effects.

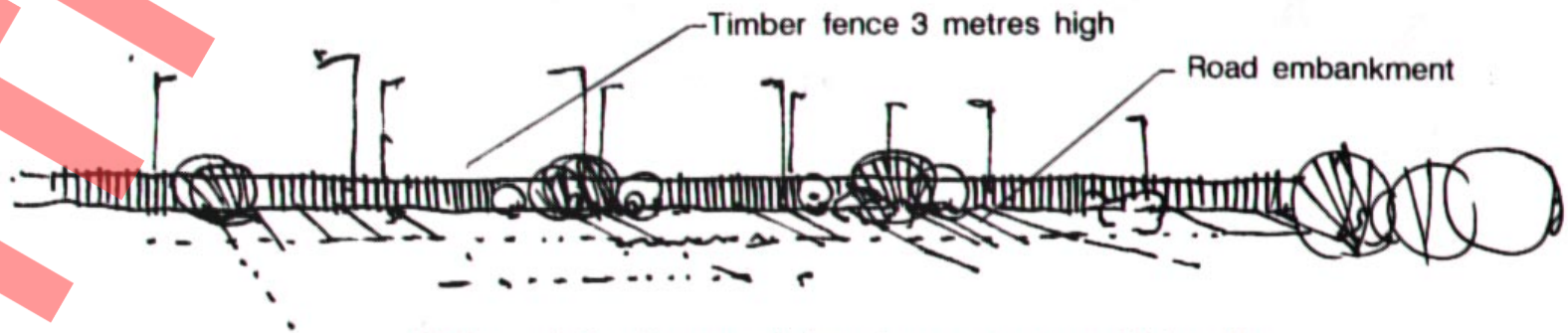
E Assess Landscape Character

The suburban area adjoining the road has no outstanding features, being similar in character to many post-war residential estate developments. It comprises a mixture of one and two storey dwellings constructed in brick with tiled roofs. Gardens with small trees are enclosed by timber fences and contain a variety of garden sheds. The terrain is low lying flood plain and intervening arable farmland is now used as pasture. Tall hawthorn thickets remain as the remnants of former hedgerows between fields.



F Design Barrier to Suit Local Context

The barrier on embankment will be visible from windows, from rear gardens and from public roads. The local character is created by houses and garden features, including trees and shrubs. Timber fences are common but are usually less than 2 metres high and quite short in length. The context therefore suggests that the barrier should consists of traditional materials incorporating planting to soften its appearance.



Option a) Continuous timber fence 3metres high with planting on embankment slopes below

Option b) Timber fence sections in conjunction with mounding and planting

Option c) Purpose designed concrete or metal barrier

G **Reappraise the Noise Impact of Alternative Options**

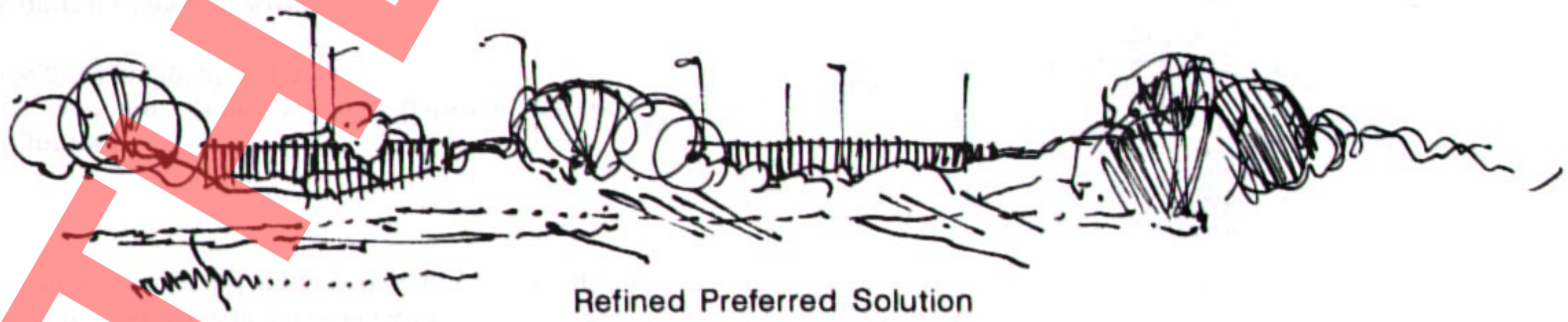
Detailed noise calculations confirm that a 3 metre high barrier at the top of the embankment slope is necessary.

H **Assess the Visual Impact of Alternative Options on Protected Side and on Road Users' Side**

	Option a	Option b	Option c
Type	Continuous timber fence 3 metres high with planting on embankment slopes below.	Timber fence sections in conjunction with mounding and planting.	Purpose designed concrete or metal barrier.
Impact on Protected Side	Long, unattractive horizontal skyline. Planting has little softening effect in first 7 years.	Varied skyline provides interest. Timber fence sections masked by mounding in oblique views. Planting on mounds an effective screen in a few years.	Elevated location increases the prominence of the barrier so that it would be out of character with its surroundings. Barrier should be designed specifically to provide variety form and colour to mirror the surrounding context.
Impact on Road User	1.1 kilometre long fence will appear as a dull and monotonous roadside feature.	Combination of fence, mounding and planting provides variety and gives more natural appearance.	Design could provide interest for road user if imaginatively designed.
Comments	Minimum land requirement. Ease of erection.	Mounding up to 8 metres high would require substantially more land and fill might be difficult to obtain in flat landscapes.	Costs likely to be substantially greater than timber fence.

I Summaries Advantage/Disadvantages

The timber fence option would be unattractive from both the protected side and in the motorists view. A combination of mounding and timber fence would give some variety and provide more scope for softening the appearance by planting. A barrier of concrete or metal panels would be a prominent feature in the view from both sides and more costly to erect. Option b is therefore preferred.



Refined Preferred Solution

J Refine Preferred Solution

Consider in more detail the location and extent of mounding to give the barrier an irregular outline which will promote visual interest.

SITE B - ROAD CROSSING

Description

The new trunk road is on embankment 3 metres high through the corridor created by an existing railway line between a suburban town and a satellite community. The development in the immediate vicinity consists of detached houses on the north side of the railway corridor, but a recreation ground nearby is also affected. Ambient noise levels were moderate, but the noise from traffic on the new road will impact on nearby properties.

Design Process

A Consider Initial Alignment

The alignment crosses over the connecting road between the two communities at a narrow point in the urban pattern.

B Identify Affected Communities and Areas

The road will significantly affect 10 houses within 100 metres of the bridge. The recreation ground about 100 metres away from the section on embankment.

C Consider Route Alignment Options

The alignment cannot be lowered to pass under the existing road.

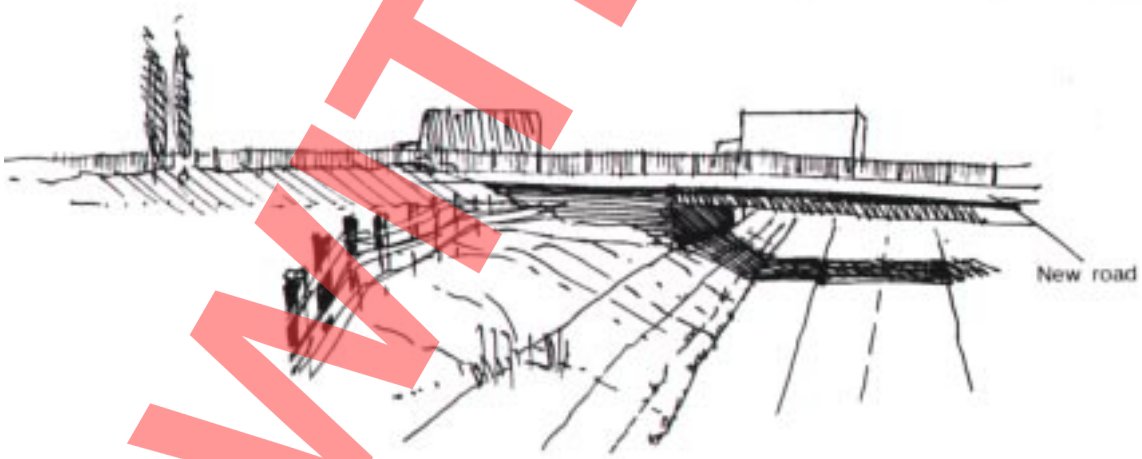
D Identify Noise and Visual Criteria

A barrier 3 metres high and 550 metres long is needed to reduce noise at properties on the north side of the new road. This would screen the view of traffic approaching the bridge 5 metres above the local road, but would be highly visible from nearby houses. The level of visual intrusion varies from medium to high.

E Assess Landscape Character

Development along the local road north of the trunk road consists of substantial detached brick dwelling with slate or tile roofs, with mature trees and shrubs within their gardens. A large gasometer is visible on the skyline to the south. Other land uses in the vicinity include the railway, a vehicle park and the recreation ground. The boundaries of these developments are softened to some extent by trees. The new overbridge will be a substantial new feature affecting the street scene.

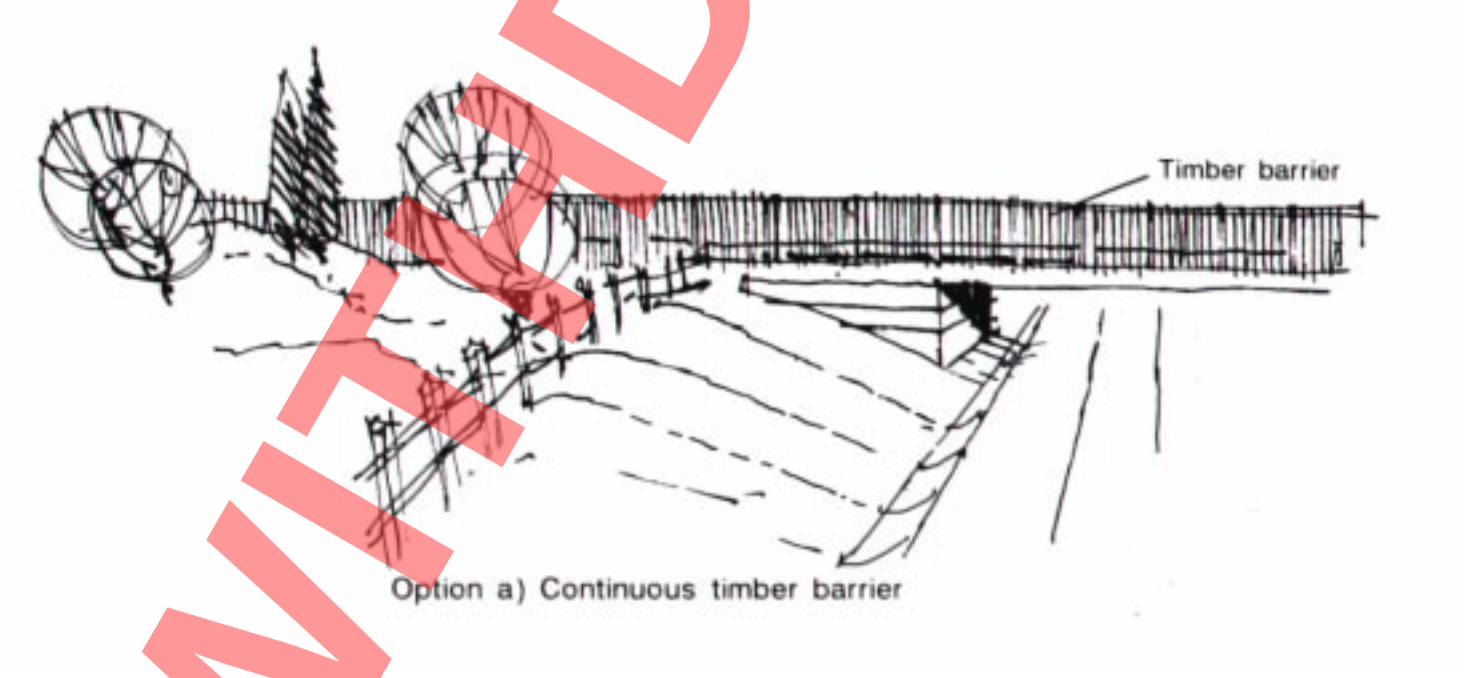
E. Detached houses of brick with tile or slate roofs



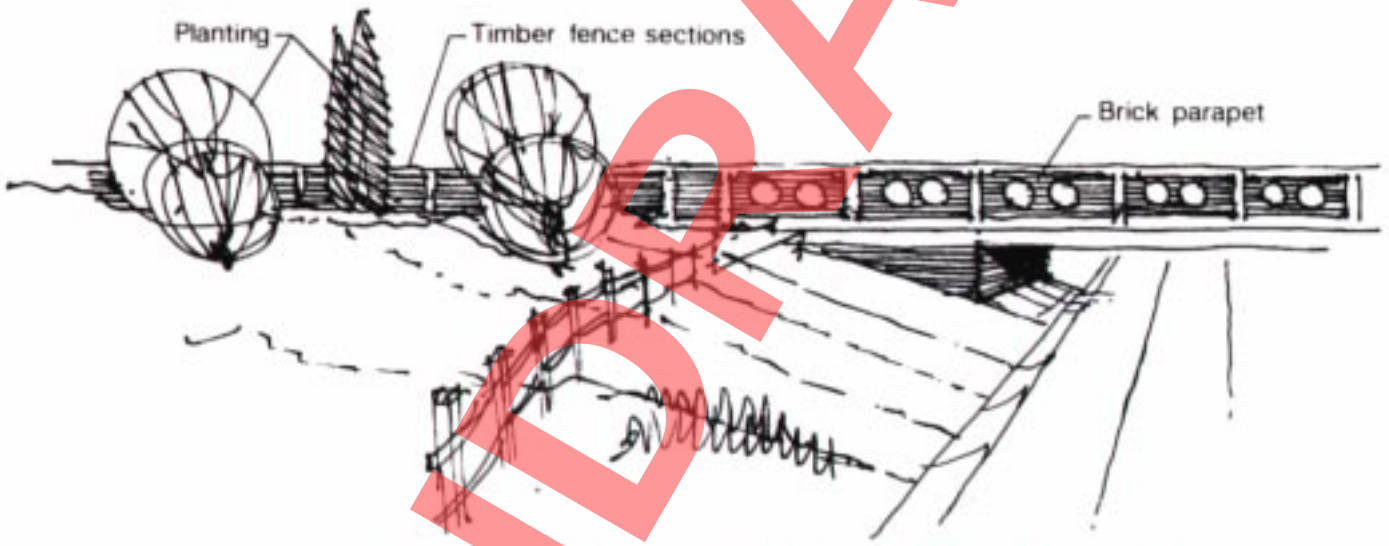
E. New Overbridge

F Design Barrier to Suit Local Context

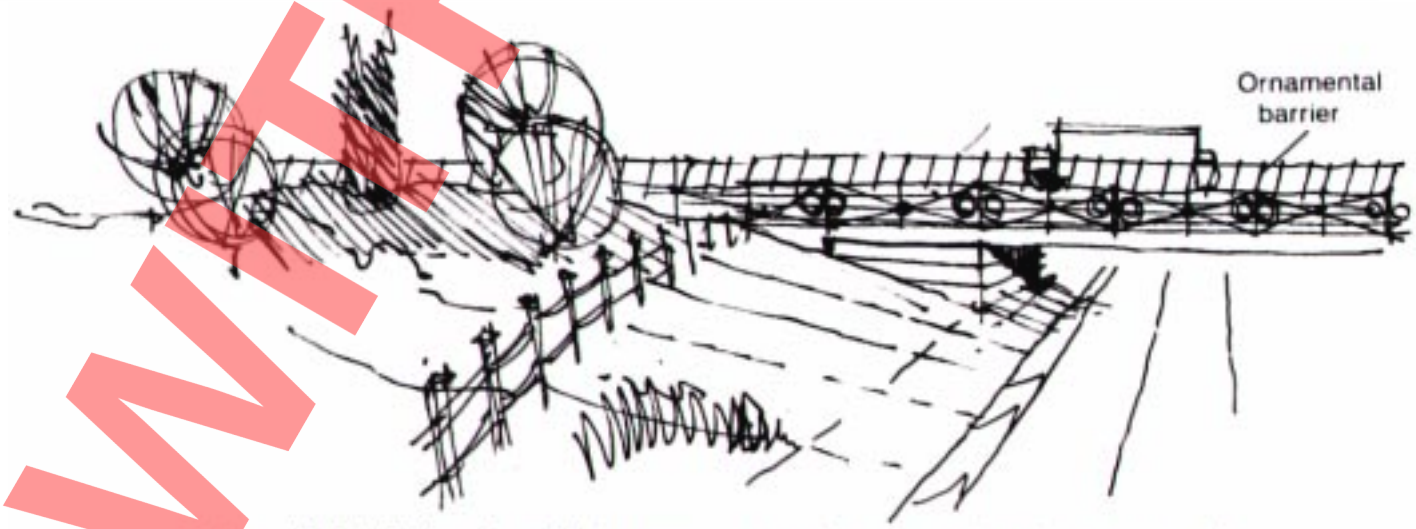
The character of the urban fringe along the north side of the railway is mainly derived from the mixture of substantial brick houses in mature gardens. But there is also an industrial influence arising from nearby railway and gasometer structures. The length of barrier spanning the bridge ought to relate to the street scene and to its supporting structure.



Option a) Continuous timber barrier



Option b) Timber fence sections in conjunction with mounding and planting with brick parapet at the overbridge



Option c) Metallic barrier with transparent sections in conjunction with planting

G **Reappraise the Noise Benefits of Alternative Options**

Detailed calculations confirm the need for a 3 metre barrier over the structure.

H **Assess the Visual Impact of Alternative Options on Protected Side and on Road Users' Side**

	Option a	Option b	Option c
Type	Continuous timber fence 3 metres high.	Timber fence sections in conjunction with mounding and planting, with brick parapet on the bridge crossing.	Metallic barrier having transparent sections over bridge, in conjunction with planting.
Impact on Protected Side	The fence on its own lacks interest. The appearance of the fence on the ridge over the coal road relates poorly to the structure and to the local street scene.	Mounding and planting would reduce the prominence of the timber barrier. Brick parapet would harmonise with the cladding of the bridge.	Transparent panels would lighten the appearance of barrier, particularly at the bridge. Metallic barrier would relate to nearby industrial artifacts.
Impact on Road User	Timber fence 550 metres long will appear as a dull and monotonous roadside feature.	Bridge treatment would serve as a landmark for road users.	Transparent barrier over bridge would help motorist orientation and add interest.
Comments	Timber fence is economical, light and easily constructed.		Most expensive option. Transparent panels require regular cleaning.

I Summarise Advantage/Disadvantages

The timber fence on its own lacks visual interest and is inappropriate as part of the street scene where it is visible across the bridge. The combination of a timber fence with mounding and planting, with a brick parapet across the bridge, would introduce some variety at moderate additional cost. The metal and transparent panel barrier would need to be purpose designed to fit the context. This could be an interesting feature enhancing both the local street scene and the road scene, but the costs are likely to be substantially greater than other options. On balance, option b is the preferred solution.

J Refine Preferred Solution

The appearance of the barrier across the bridge requires detailed study to ensure that it is complementary to the local street scene.

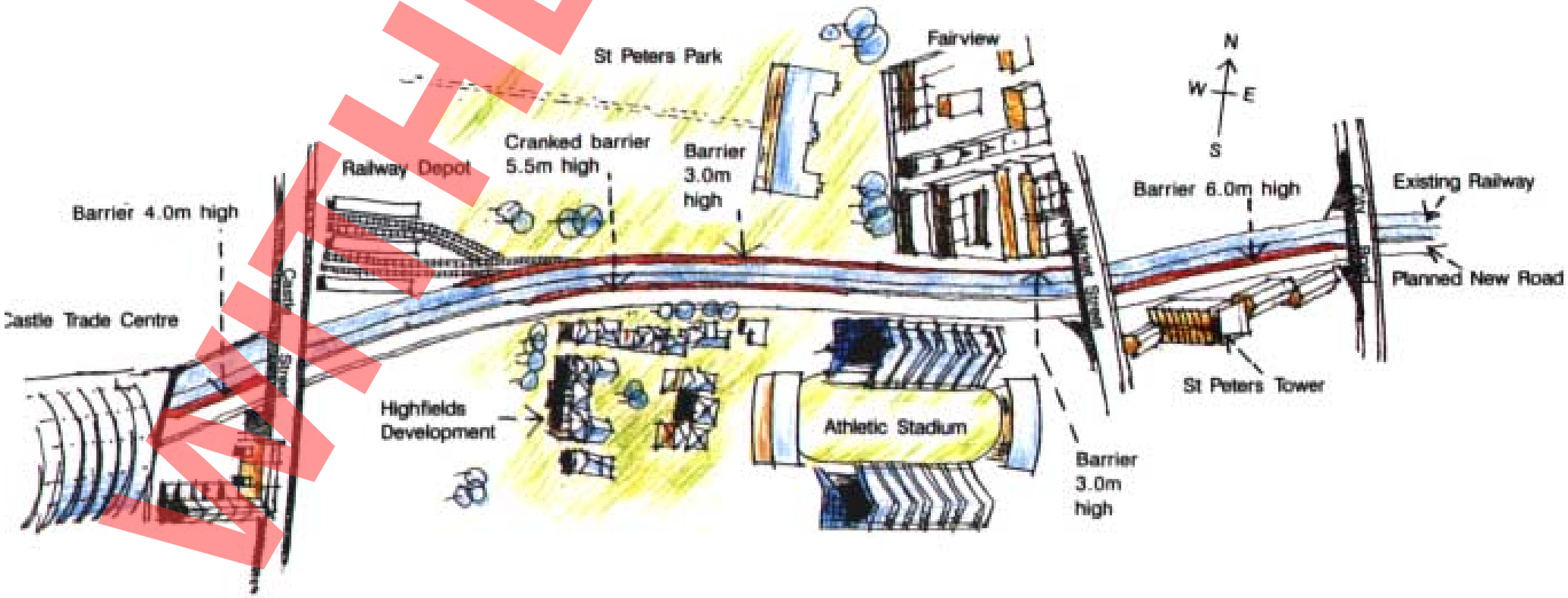
12. URBAN CASE STUDIES

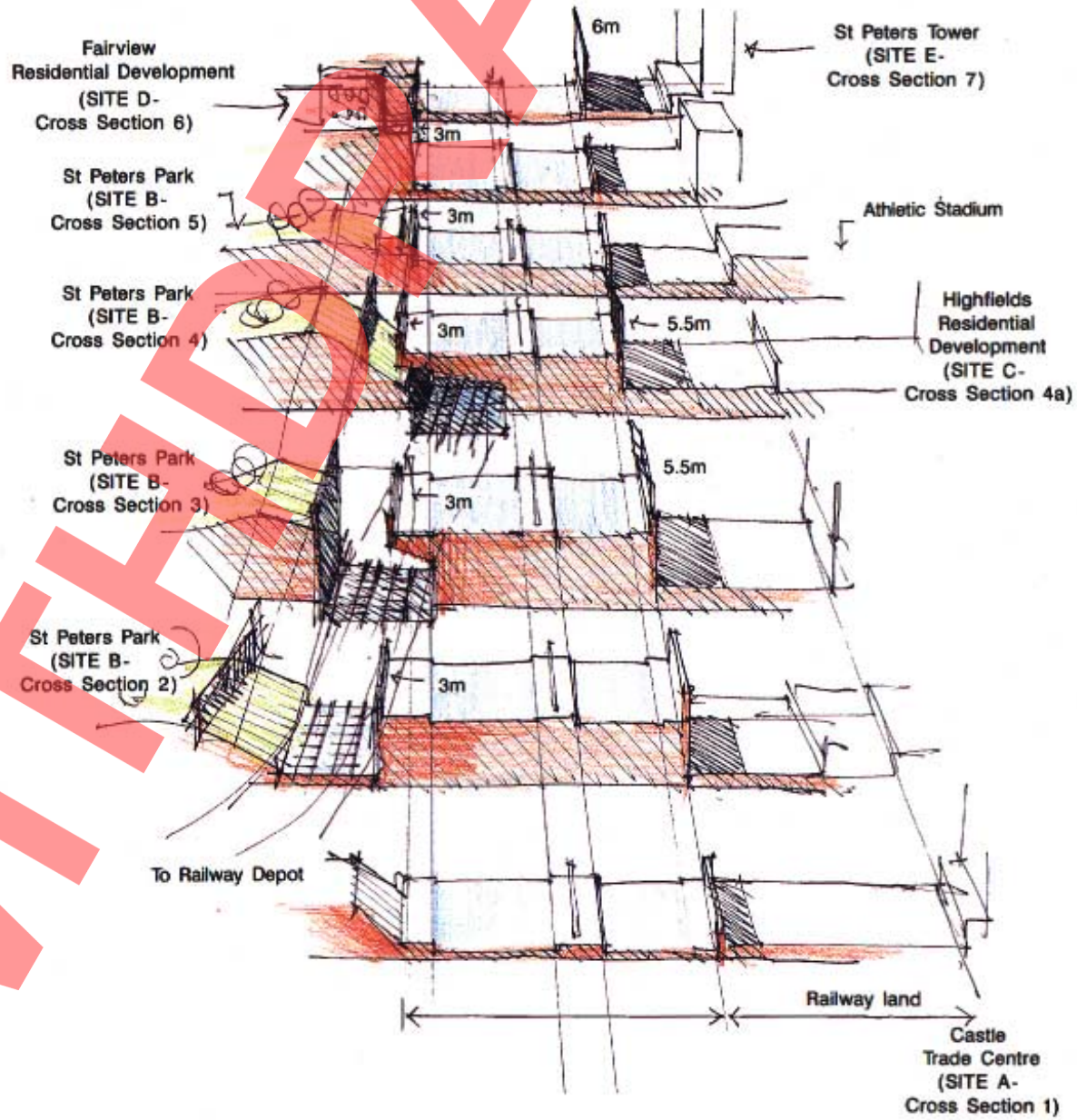
Background

12.1 An important feature of urban situations is the potential need for high barriers along contiguous sections of the route affecting quite different localities. The design of barriers should take account of this interaction and the following examples relate to a hypothetical route through an urban area, combining features drawn from experience on major schemes. The route utilises an existing railway corridor running approximately East - West between a large trade centre and a canal. Noise and visual intrusion have been identified as major impacts on a variety of housing, a park and a school. Some of the housing has architectural interest and the townscape also includes tower blocks, an athletic stadium and industrial areas. The case studies include working sketches to show how the design of barriers can be harmonised but tailored to different local environments to minimise the impact of a major urban scheme.

12.2 The railway line is an existing line of severance carried at or just below grounds level. The adjoining developments have "turned their back" on it. It is crossed by three roads, all carried over the railway on brick arch bridges. Castle Street is a major link just east of the trade centre; Market Street and City Road are quieter roads linking residential areas on either side of the railway.

12.3 The dominant visual features in the area are the Castle Trade Centre straddling the railway, the Athletic Stadium west of Market Street and St Peter's Tower, a 12 storey block of flats.



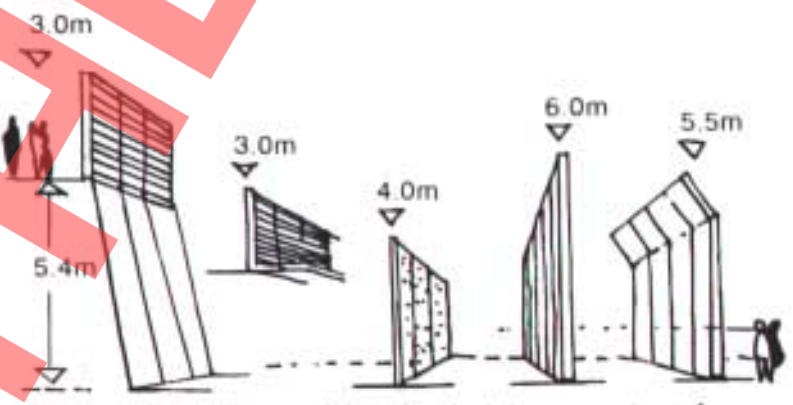


Proposed Barrier Heights At Various Locations

CONSIDERATION FOR PROPOSED BARRIER HEIGHTS

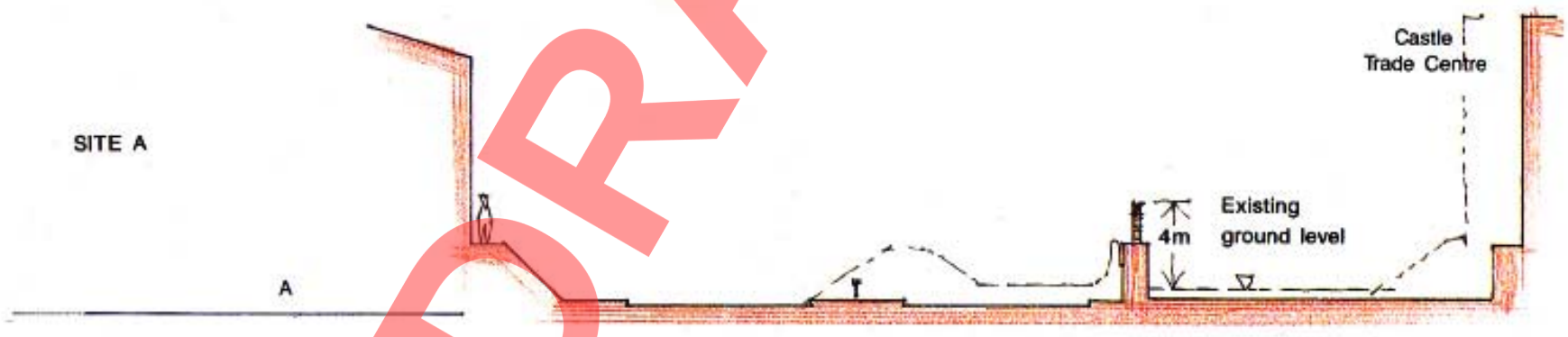
1) *The new road has to rise so as to clear the railway which runs parallel with St Peters Park.*

2) *Due to its height St Peters Tower is requiring 6m high barriers.*
Fairview residential development needs 3m, but very close to the house facade.
Highfield residential development needs a barrier also about 6 m but by cranking the top could be 5.5m.
St Peters park requires 3 m high barrier and the Castle Trade Centre area 4.0m.
However, along the road this gives a profile of heights which is not constant.

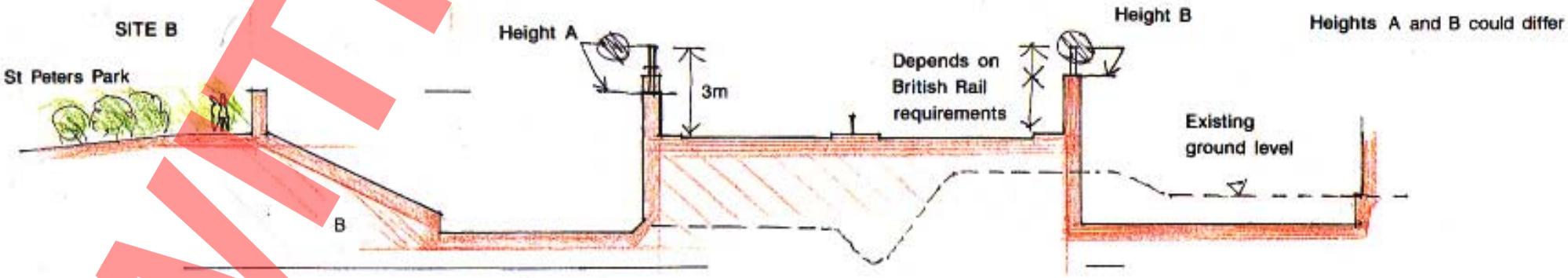


Miscellany of barrier heights required

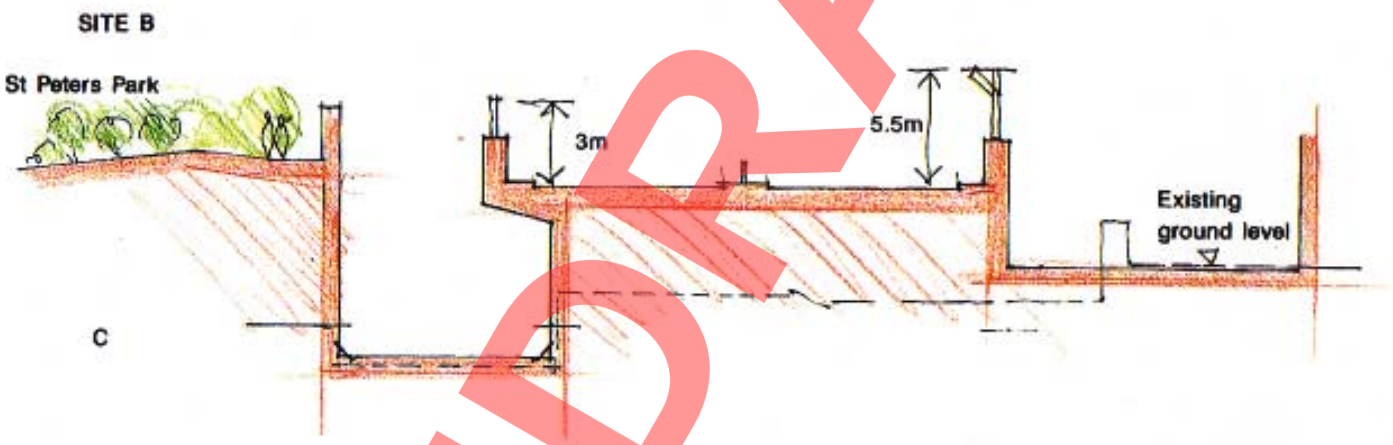
3) *Some kind of order needs to be applied by studying cross-sections that are shown on following pages.*



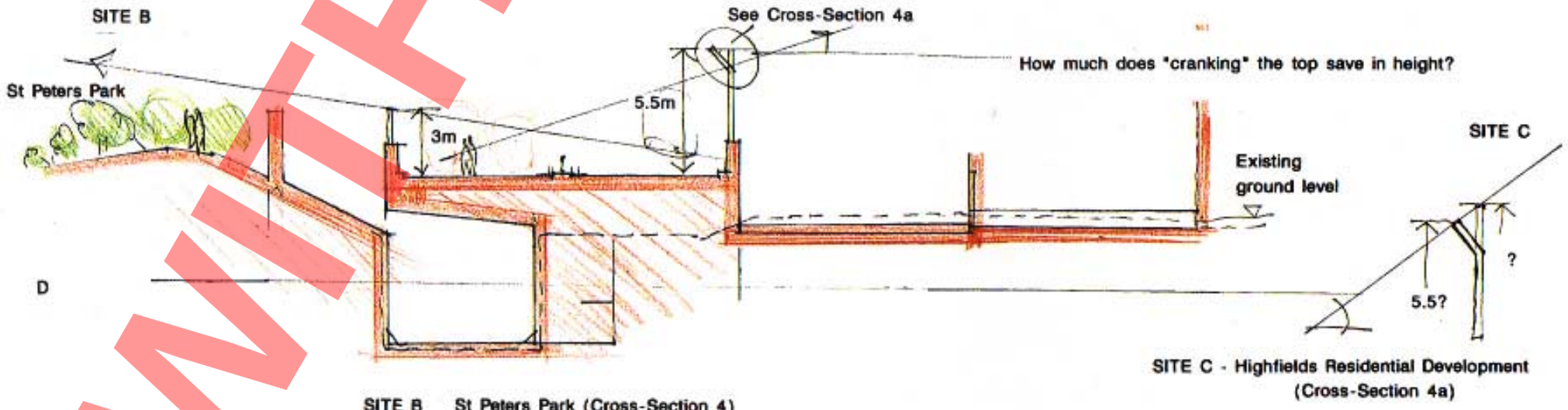
SITE A - Castle Trade Centre (Cross-Section 1)



SITE B - St Peters Park (Cross-Section 2)

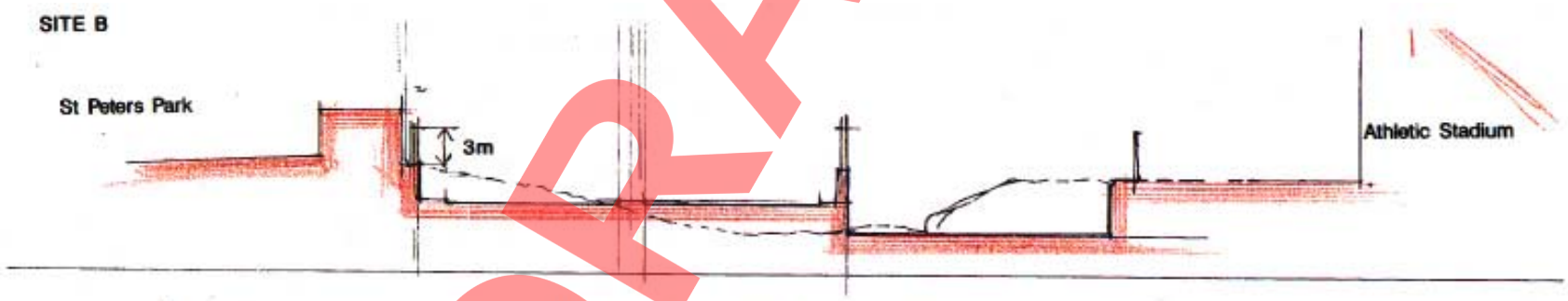


SITE B - St Peters Park (Cross-Section 3)

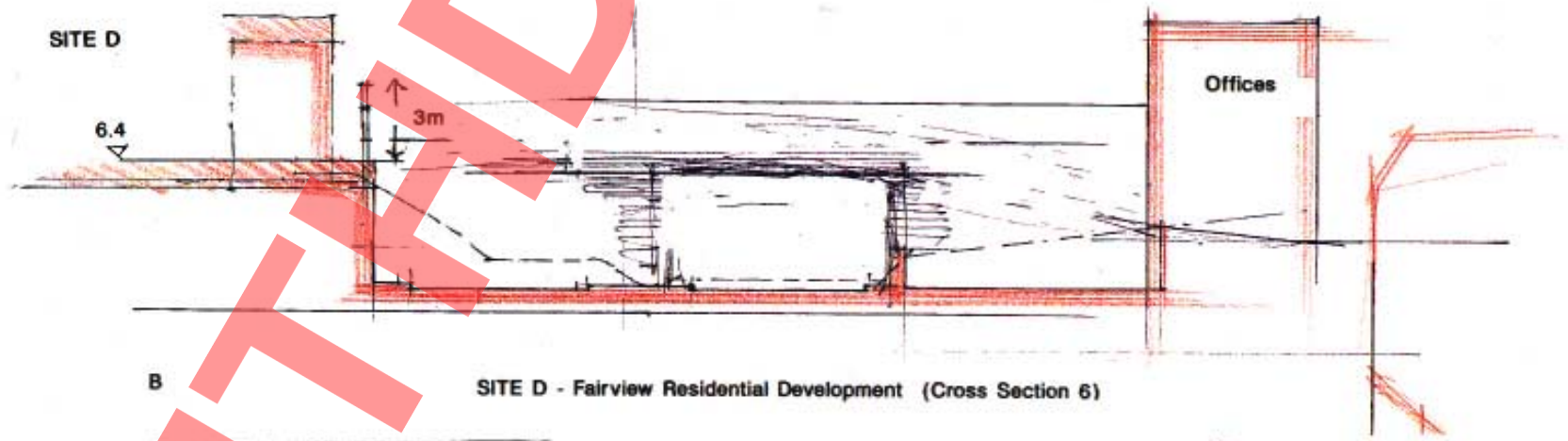


SITE B St Peters Park (Cross-Section 4)

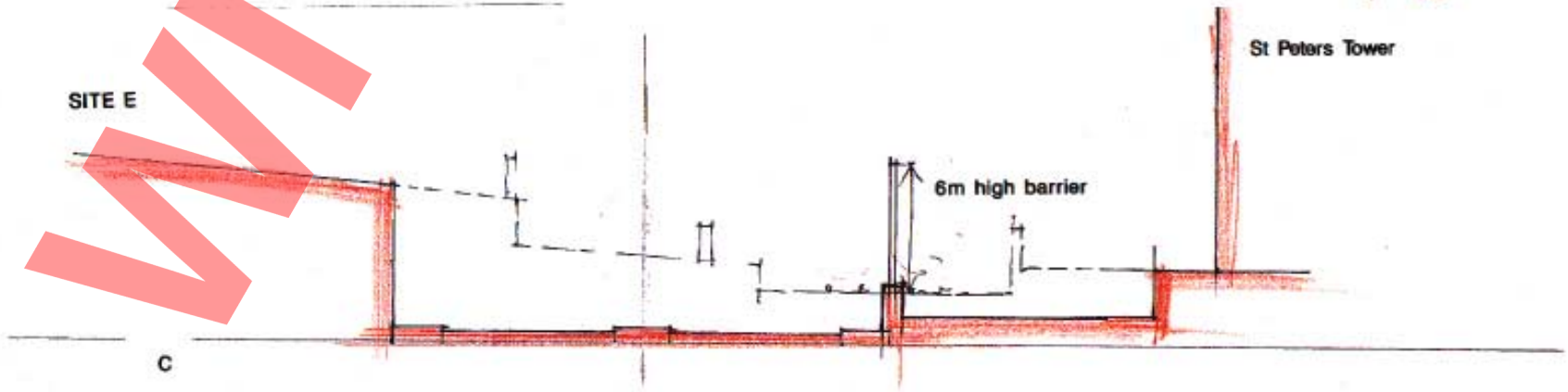
SITE C - Highfields Residential Development
(Cross-Section 4a)



SITE B - St Peters Park (Cross-Section 5)



SITE D - Fairview Residential Development (Cross Section 6)



SITE E - Market Street to City Road (Cross Section 7)

SITE A - VICINITY OF CASTLE TRADE CENTRE

Description

Between the Castle Trade Centre and Castle Street the scheme crosses a short section of open railway land in place of the existing railway tracks. The barrier proposed over this section is 4 metres high and 60 metres long on the north side of the road. The railway tracks are to be relocated on the strip of land between the proposed road and an adjoining row of nineteenth century terraced houses.

Design Process

A Consider Initial Alignment

Route determined by study team - at same level as railway, in 2 metre deep cutting.

B Identify Affected Communities

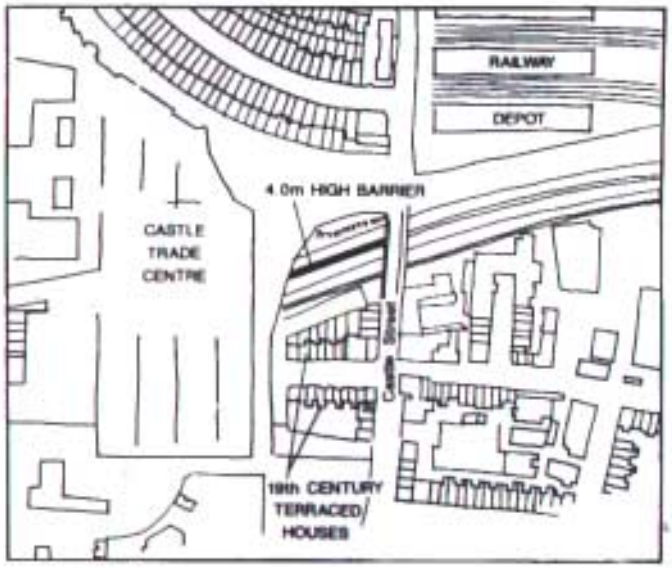
The route runs within 30 metres of a row of 2 and 3 storey properties.

C Consider Route Alignment Options

No opportunity to alter alignment because of engineering constraints.

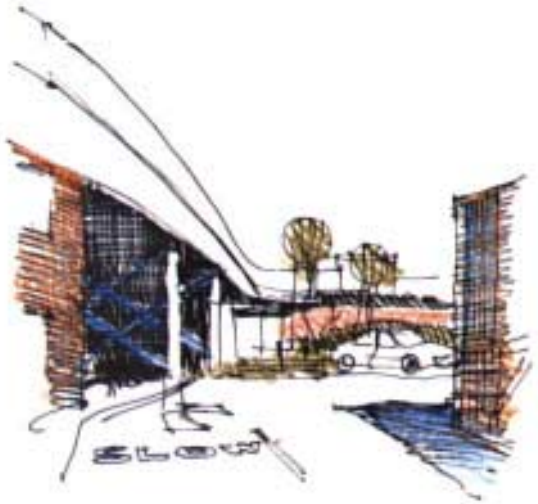
D Identify Noise and Visual Criteria

In order to reduce traffic noise levels, a 4 metre high barrier at the highway boundary is needed. The barrier should be in keeping with the character of the locality.



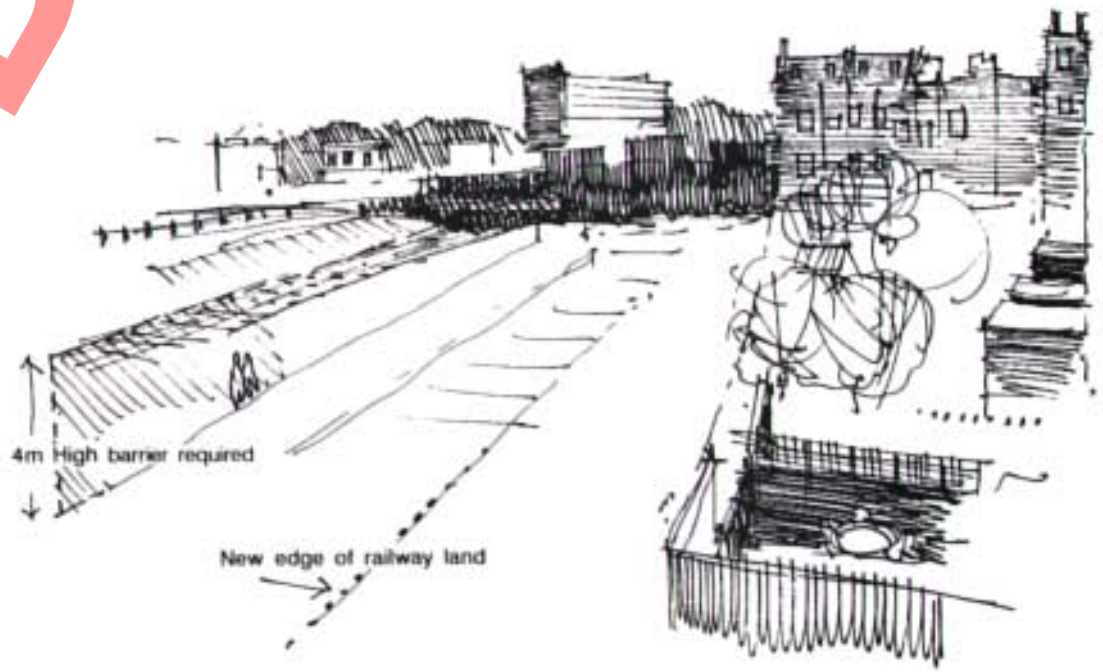
E Assess Townscape Character

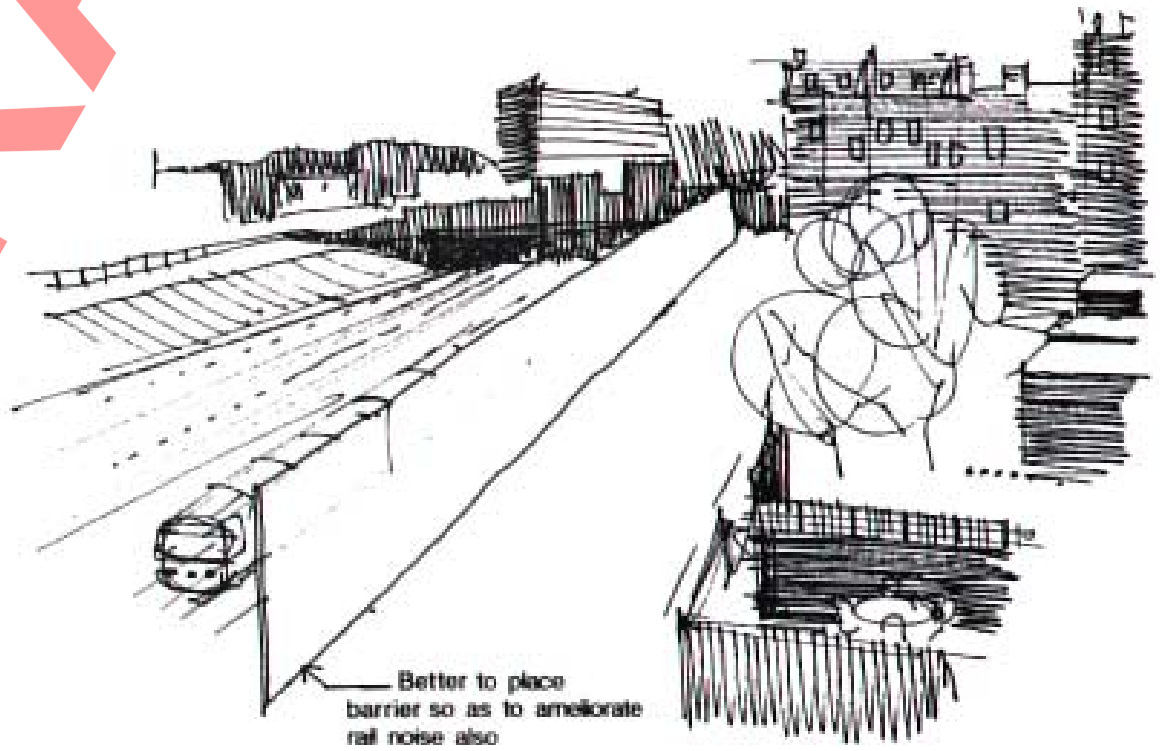
The locality has experienced considerable change over the years, particularly with the recent construction of the Castle Trade Centre. As a result the townscape of the area displays strong contrasts in style and materials, varying from the traditional residential terraced houses with sash windows and stock bricks, to the painted steel and tinted glass of the Castle Trade Centre.

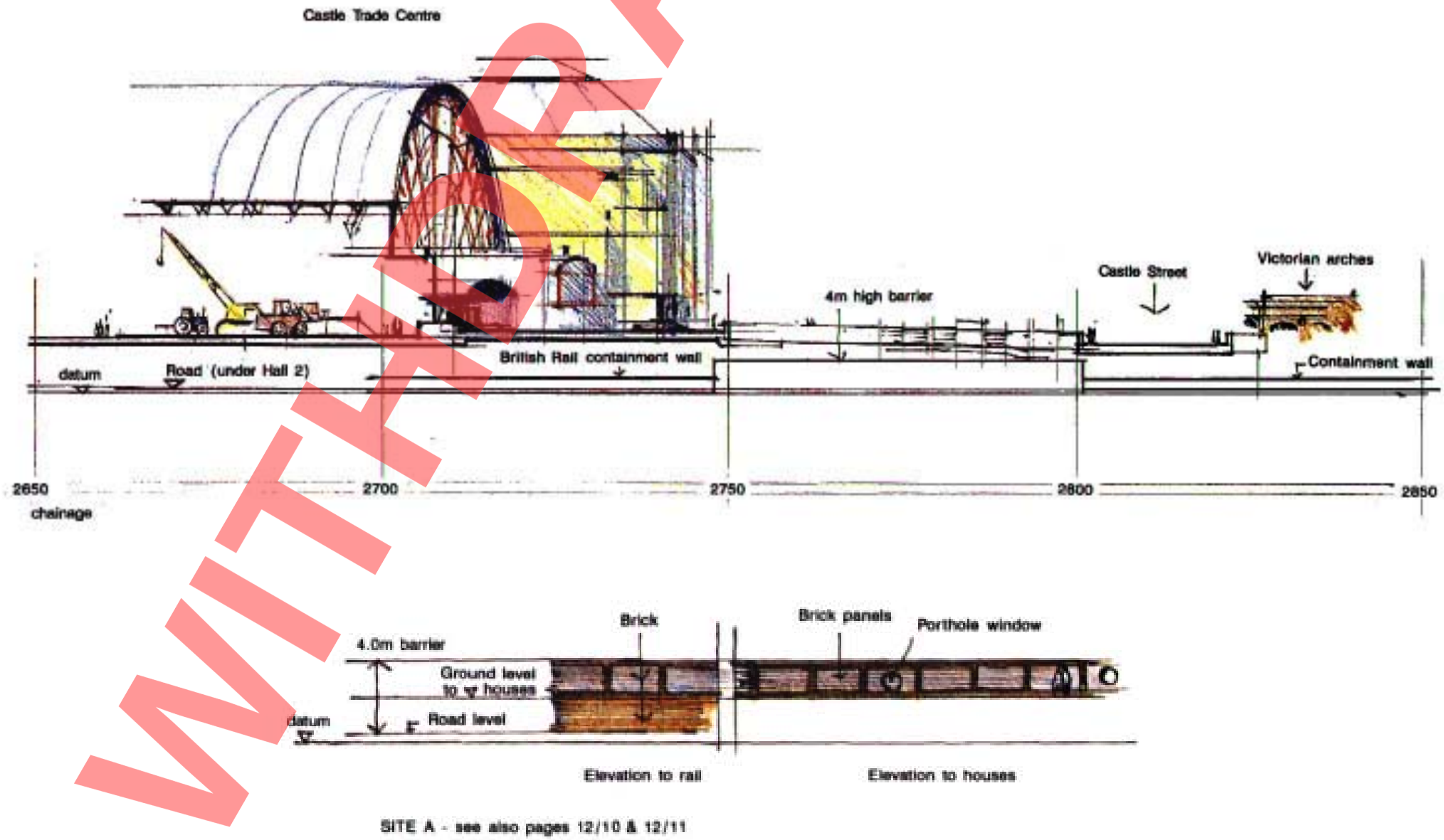


F Design Barrier to Suit Local Context

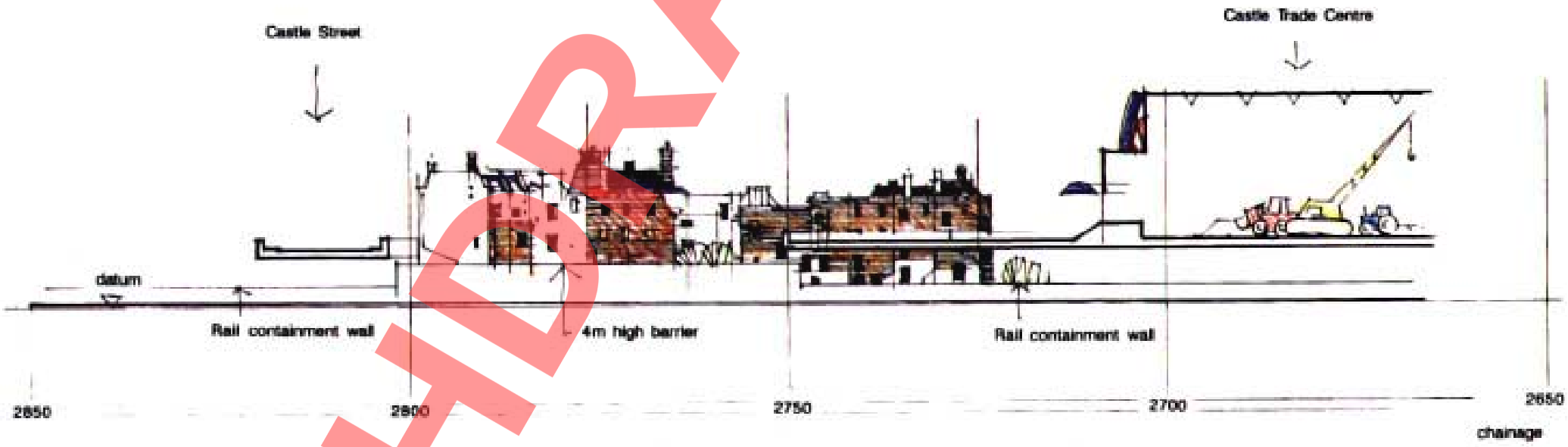
The barrier will reduce the sense of space previously experienced by the occupants of the nineteenth century terraced houses, and a barrier design relating to their familiar surroundings is likely to result in a more comfortable solution. An appropriate barrier design would therefore use traditional materials to match the stock bricks of the existing house facades, perhaps broken down into modules to reflect the house widths.

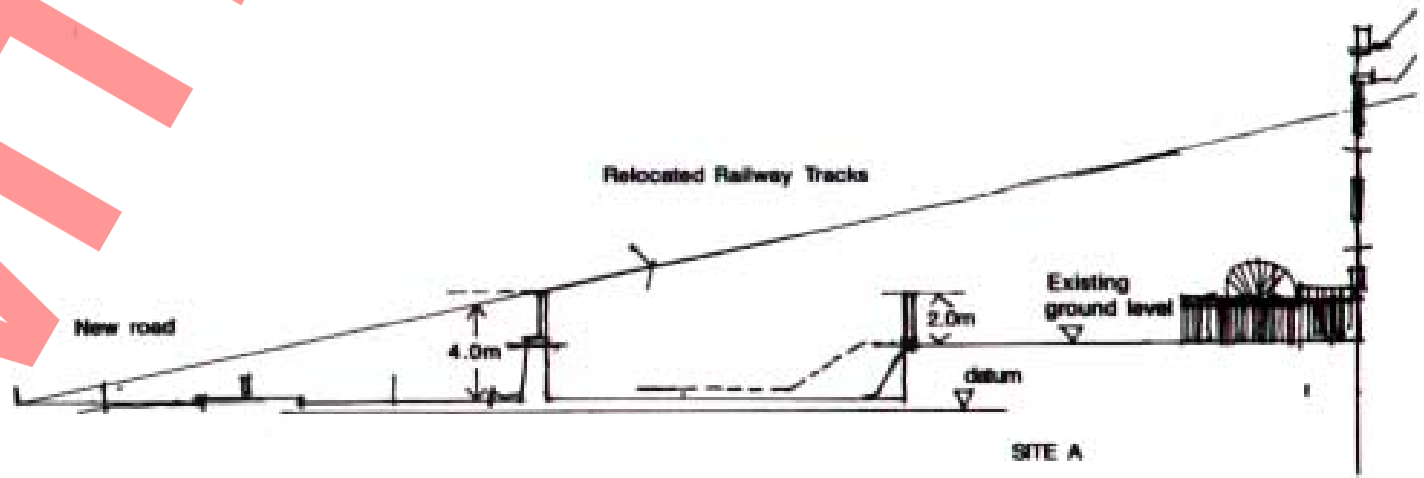






SITE A - see also pages 12/10 & 12/11





G **Reappraise the Noise Benefits of Alternative Options**

No freedom to increase the size of barrier because of visual impact.

H **Assess the Visual Impact of Alternative Options on Protected Side and on Road Users' Side**

	Option a	Option b	Option C
Type	Brick wall barrier constructed of piers and brick in full panels.	Brick wall barrier, but with part transparent panels.	Brick wall barrier but with timber panels and trelliswork for climbing plants.
Impact on Protected Side	Harmonises with local vernacular architecture but would be a prominent feature in view from properties	Transparent panels would relieve enclosure	Combination of brick, timber and climbers break up uniform wall surface and create a garden effect.
Impact on Road User	60 metre long barrier will not appear as a significant feature for the passing motorist	60 metre long barrier will not be significant feature for the passing motorist.	60 metre long barrier will not be a significant feature for the passing motorist.
Comments	4 metre high brick retaining walls associated with the railway system are commonplace features in the locality.	Cleaning of transparent panels and vandalism might be problems.	

I Summarise Advantages/Disadvantages

The brick wall alone would tend to enclose and dominate the garden space and the outlook of the affected properties. This effect could be relieved by the use of transparent panels (Option b) but entailing an additional maintenance commitment. The preferred alternative design (Option c) would provide a varied facade which mirrors the existing dwellings and incorporates climbing plants.

J Refine Preferred Option

Consider locating the barrier at the edge of the transport corridor (instead of between the road and railway), so that it would protect the houses from both road and rail noise.

SITE B - HIGHFIELDS RESIDENTIAL AREA

Description

Between Castle Street and Market Street the scheme runs along the north side of the Highfields residential area, a modern development of flats and houses up to 5 storeys high, set amongst attractive landscaped gardens.

Design Process

A Consider Initial Alignment

Route determined by study team; approximately at ground level.

B Identify Affected Communities and Areas

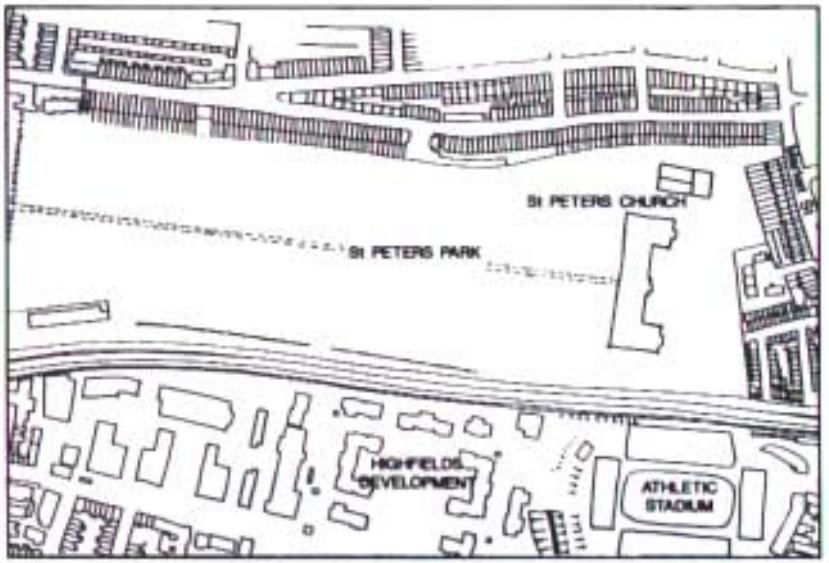
The route affects over 100 flats which look out from the 5 storey high residential blocks over the 3 metre high brick boundary wall which boarders the railway tracks. The view encompasses St Peters Park but is partly screened by a row of large lime trees up to 20 metres tall. The wall and adjoining trees would be demolished and the wall rebuilt alongside the realigned rail corridor some 5 metres inside the existing Highfields curtilage.

C Consider Route Alignment Options

No opportunity to alter alignment because of engineering constraints.

D Identify Noise and Visual Criteria

Predicted traffic flows on the new road will significantly increase noise levels. A 5.5 metre high barrier is needed over a 270 metre length, with the top cranked towards the road to increase its effectiveness. The barrier should be in keeping with the character of the locality.

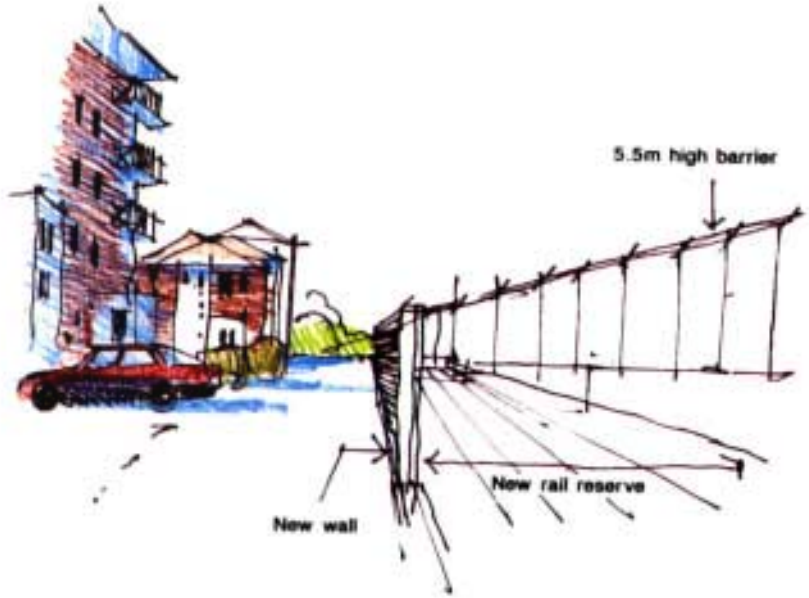


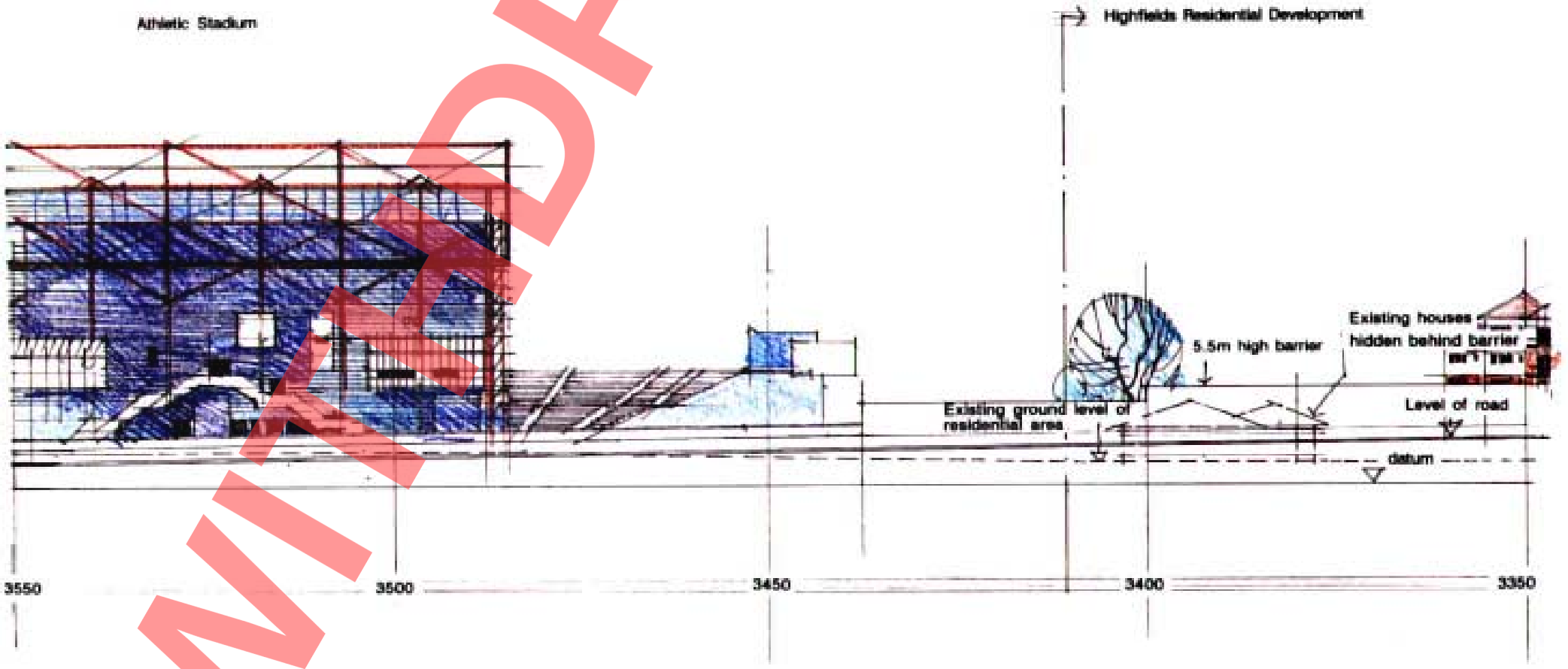
E Assess Townscape Character

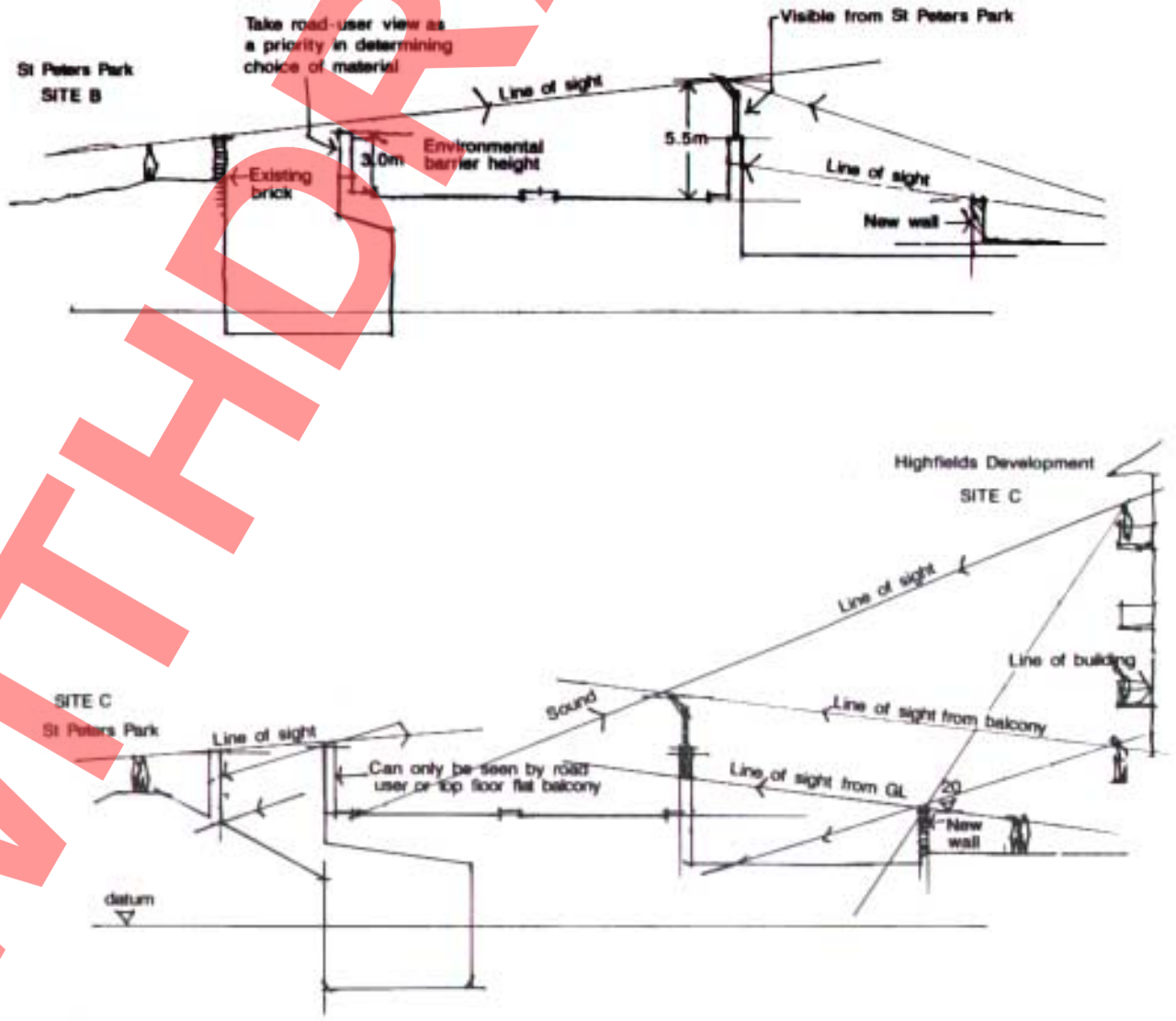
The appearance of the Highfields development is characterised by its pitched slate roofs of varying heights, with part brick and part white painted rendered elevations, set amongst attractive landscaped grounds. The imposing stone manse and church of St Peters Park are readily seen through the row of 20 metre tall lime trees from flats on the upper four storeys.

F Design Barrier to Suit Local Context

The new 5.5 metre high barrier would be separated from the Highfields development by the intervening realigned railway tracks, and would only be visible across a new 3 metre high boundary wall provided as part of the railway mitigation works. The cranked barrier would not therefore be perceived just as part of the residential setting, but in relation to the wider townscape of railway, road and park beyond, and so the barrier design should respond to these factors.







G **Reappraise the Noise Benefits of Alternative Options**

No freedom to increase the size of barrier because of visual impact.

H **Assess the Visual Impact of Alternative Options on Protected Side and on Road Users' Side**

	Option a	Option b	Option c
Type	Brick wall with piers and recessed panels with cranked steel extension	Concrete with steel tube members supporting cranked metal "roof".	Steel tube structure with metallic infill panels.
Impact on Protected tracks Side	Barrier would be visible across railway from Highfields flats at first floor level and above. Brick wall design links with railway architecture.	Concrete and steel design would reflect appearance of the nearby Athletic Stadium.	Steel tubes and metallic infill panels finished in bright colours would appear as an attractive piece of sculpture to enhance the area.
Impact on Road User	270 metre brick wall with overhanging steel roof would appear as an interesting feature along the road.	Concrete and metal structure 270 metres long would appear as a feature linking with the character of the stadium.	Colourful metal structures would be a feature of interest for the motorist.
Comments	Traditional design of brick and steel would fit with character of area - reflecting the Highfields residential development, the railway and historic St Peters Park.	Concrete and metal design would extend the influence of the Athletic Stadium which already contrasts unhappily with the scale and character of its surroundings.	"Exposed Structure" design would be a distinctive feature in its own right and could be successful as an imaginative addition to the town-scape, but it would be unrelated to its surroundings.

I Consider advantage/Disadvantages

The options considered include the traditional brick wall reflecting the residential and historic character of the surroundings; the concrete wall and metal design which would mirror the character of the nearby football stadium landmark, and lastly an imaginative “high tec” design which is likely to be controversial with the public. The least acceptable option would be the concrete barrier designed after the style of the local football stadium, which adversely contrasts with the locality because of its scale, materials and form. The choice between traditional brick wall and eye-catching steel would depend on the design quality of the options, their relative costs, and their retrospective maintenance requirements. The contextualist approach advocated in this guide favours the more traditional brick wall solution which would relate best to adjoining residential and park open space users.

J Refine Preferred Option

Barrier may need to be modified in response to design considerations for the barrier on the opposite highway boundary along the margin of St Peters Park.

SITE C - ST PETERS PARK LOCALITY

Description

East of Castle Street the scheme follows the line of the existing railway tracks for 630 metres alongside the St Peters Park. The whole area is used as a public open space with activities including walking, jogging, cycling and sports. Alongside the railway, the park is bordered by a brick wall 2 metres high on the park side, but on the railway side the wall acts as a retaining structure for the cutting and is up to 7 metres high.

Design Process

A Consider Initial Alignment

Route determined by study team; approximately ground level, rising above railway.

B Identify Affected Communities and Areas

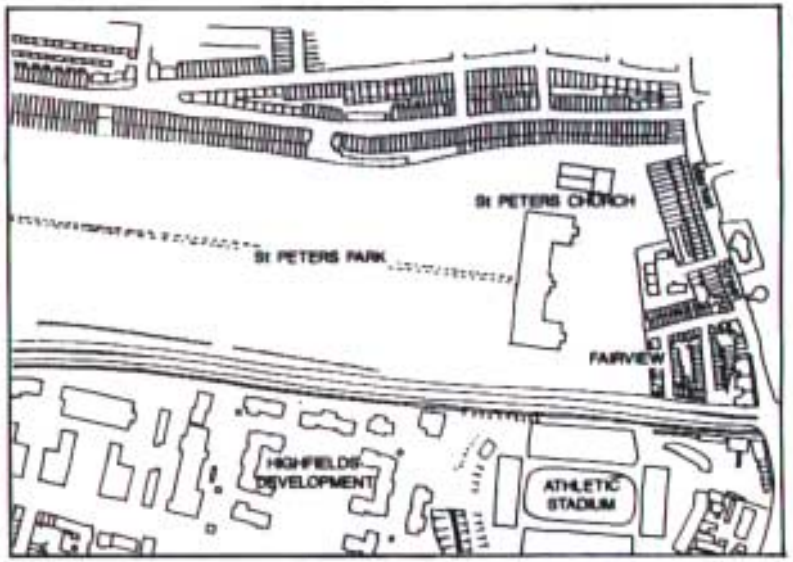
The route affects the St Peters Park which is an area of public open space much used for informal recreational purposes such as walking and jogging, and for junior school games.

C Consider Route Alignment Options

No opportunity to alter alignment because of engineering constraints.

D Identify Noise and Visual Criteria

In order to reduce traffic noise levels, a 3 metre high barrier at the highway boundary, 600 metres long is needed. The barrier should be in keeping with the character of the locality.

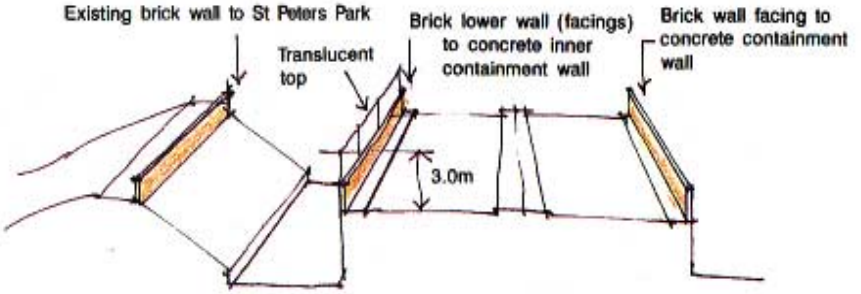


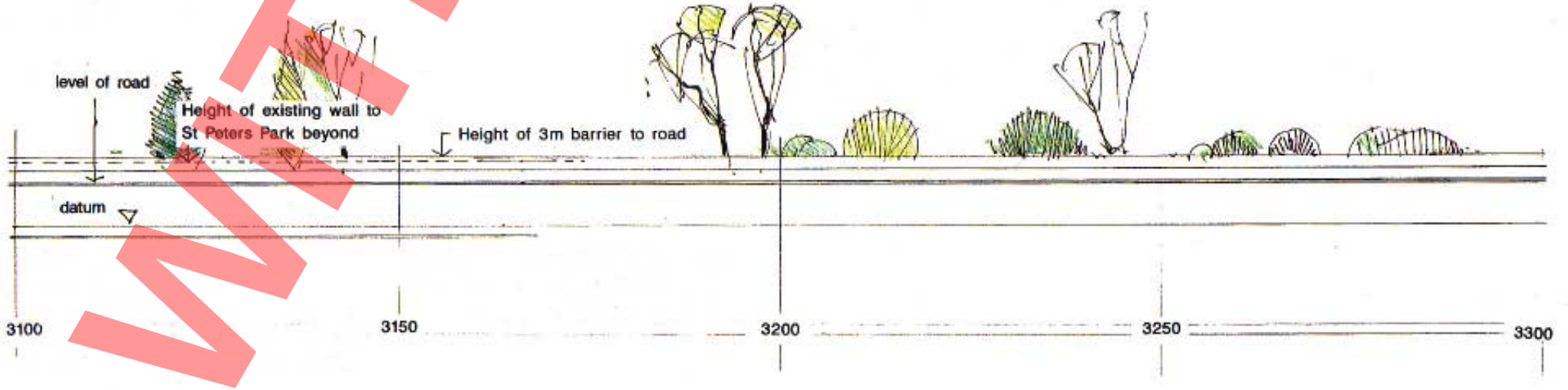
E Assess Townscape Character

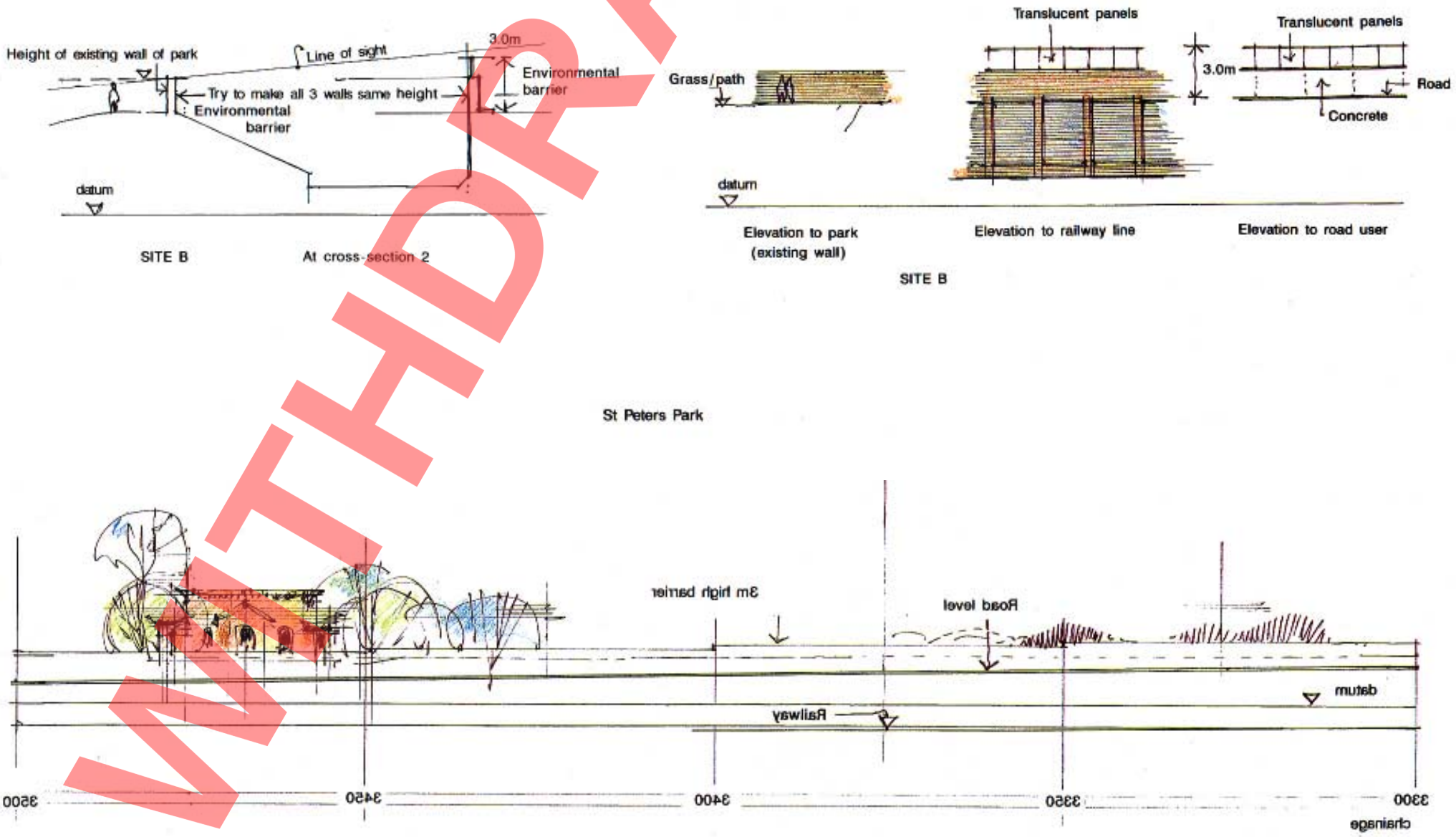
St Peters Park is a tranquil oasis with grass and trees surrounding the imposing manse and church which are examples of classic Victorian architecture, now used as the council offices. There is a network of paths linking the many access points to the park. Boundary walls enclosing the area are constructed of brick with some stone copings.

F Design Barrier to Suit Local Context

A3 metre high barrier over this section would not obtrude significantly over the top of the existing boundary wall to the park. The main determinant of the barrier appearance is therefore the view from the road and the need for it to relate to the 5.5 metre high barrier on the opposite side of the road. From the motorists' viewpoint, a 600 metre long barrier is potentially a monotonous feature. Skyline landmarks are important visual reference points along this section, for example Castle Trade Centre on the western horizon, and Athletic Stadium to the south. The barrier on the opposite side of the road should receive prior consideration as its roadside appearance will affect the preferred appearance of St Peters Park.







G **Reappraise the Noise Benefits of Alternative Options**

No freedom to increase the size of barrier because of visual impact.

H **Assess the Visual Impact of Alternative Options on Protected Side and on Road User's Side**

	Option a	Option b	Option c
Type	Brick wall with piers and recessed panels, to match design used for Highfields locality.	As the preferred option for the Highfields barrier dictates the design theme for the St Peters Park barrier, consideration of further options is not justified.	As the preferred option for the Highfields barrier dictates the design theme for the St Peters Park barrier, consideration of further options is not justified.
Impact on Protected Side	Brick wall would relate well to existing boundary wall of park.		
Impact on Road User	600 metre long wall should be strongly featured, with piers and panels emphasised in order to give distinctive and interesting appearance over this length.		
Comments	The existing 7 metre wall along the railway corridor bordering the park is a god example of a tall barrier relating well to its surroundings.		

I Consider Advantages/Disadvantages

The brick barrier is dictated by the prior choice for the Highfields barrier. This solution will also relate well to the historic landscape of the park.

J Refine Preferred Option

Consider sympathetic modification to the existing railway wall to achieve the required noise attenuation, as an option instead of the freestanding barrier as proposed.

SITE D - FAIRVIEW CONSERVATION AREA

Description

Between St Peters Park and Market Street the scheme runs alongside a compact neighbourhood of two storey houses dating from the late eighteenth century which has been designated by the Local Planning Authority as a Conservation Area.

Design Process

A Consider Initial Alignment

Route determined by study team; road in 3 metre deep cutting.

B Identify Affected Communities and Areas

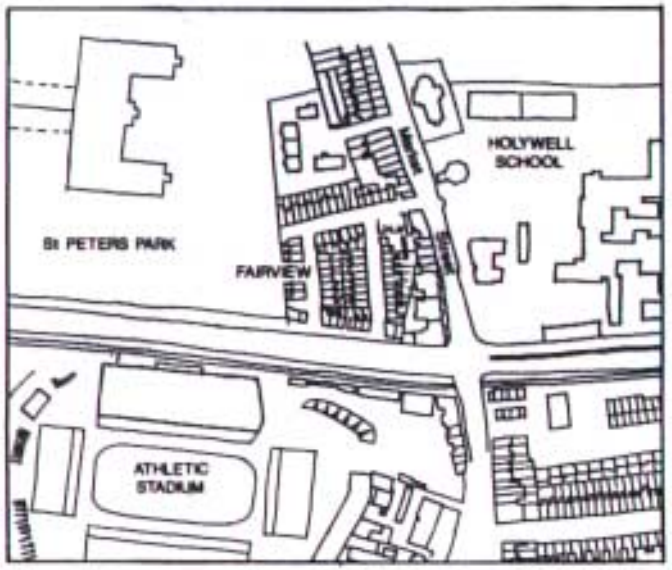
The southern margin of the Conservation Area comprises a row of houses which look out directly over the 3 metre deep cutting containing the railway tracks. The facade of these properties is only about 5 metres back from the edge of the cutting.

C Consider Route Alignment Options

No opportunity to alter alignment because of engineering constraints.

D Identify Noise and Visual Criteria

In order to reduce traffic noise levels, a 3 metre high barrier at the highway boundary is needed over a length of 70 metres. The barrier should be in keeping with the character of the locality.

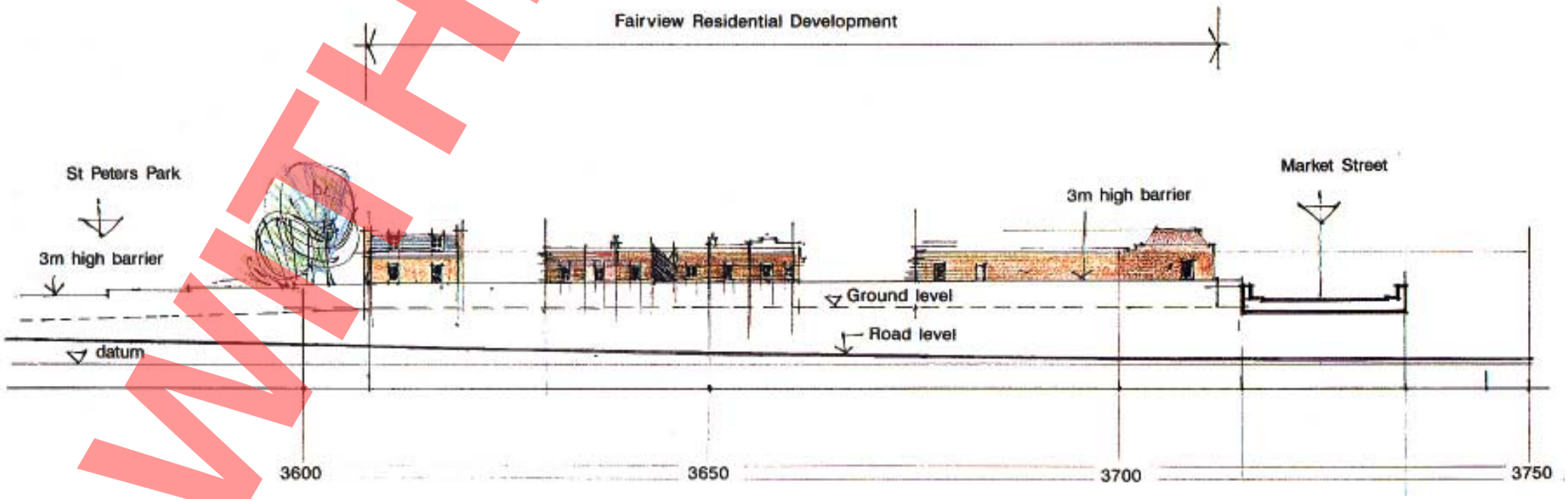


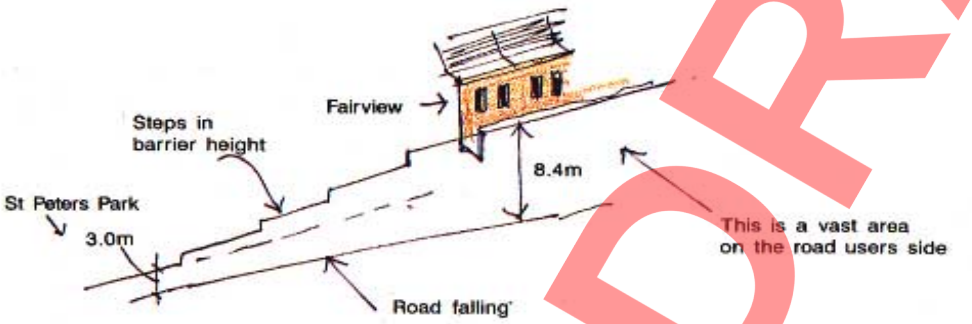
E Assess Townscape Character

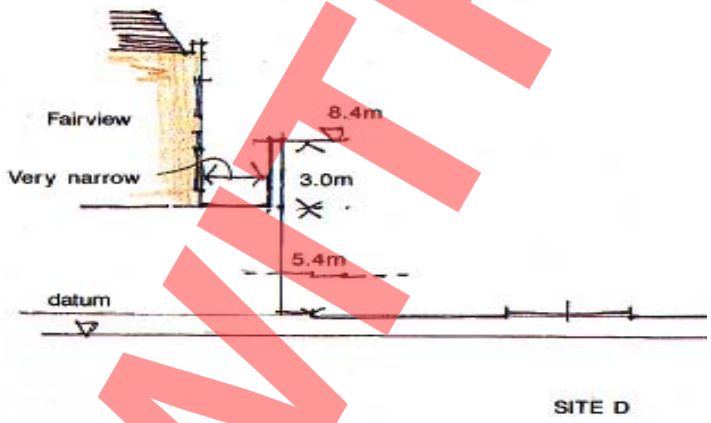
Fairview Conservation Area consists of small scale two storey terraced houses dating from the late eighteenth century or early nineteenth century. The properties are set back from the highway boundary with small front gardens often enclosed by wrought iron railings. Elevations comprise painted or brick facades, with sash window openings, and roof pitches concealed behind parapets. The railway corridor is bounded by 2 metres high iron railings which are partly covered by climbing plants. Properties adjoining the railway look towards the Athletic Stadium opposite.

F Design Barrier to Suit Local Context

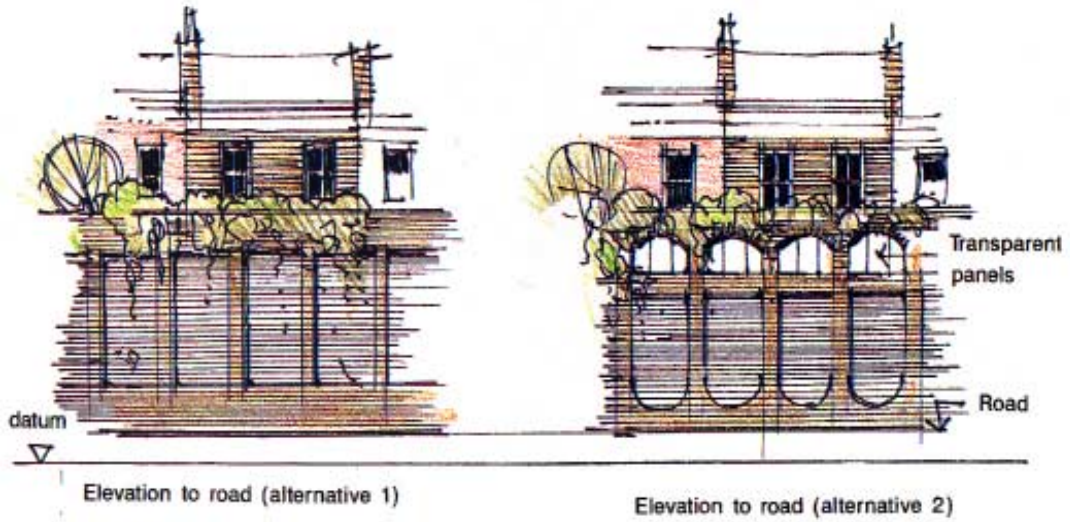
The 3 metre high barrier is only 3 metres from the front elevation of the small scale two storey houses. This deprives the ground floor rooms of the view across the sunken railway tracks towards the comparatively open land of the Athletic Stadium, although this is already partly obscured by the existing 2 metre high railings on the railway perimeter, covered by climbing plants. The 3 metre high barrier extends above the retaining wall about 4 metres high, so that the top of the barrier would be some 7 metres above road level.







SITE D



Elevation to road (alternative 1)

Elevation to road (alternative 2)

SITE D

G **Reappraise the Noise Benefits of Alternative Options**

No freedom to increase the size of barrier because of visual impact.

H **Assess the Visual Impact of Alternative Options on Protected Side and on Road User's Side**

	Option a	Option b	Option c
Type	Brick wall barrier constructed of piers and brick infill panels.	Brick arches with transparent metal infill panels.	Transparent screen supported by uprights
Impact on Protected Side	Harmonises with local vernacular architecture but would reduce light to ground floor windows and create an alleyway effect.	Harmonises with architectural detail in locality. Transparent panels would reduce enclosure effect.	Transparency would not significantly reduce visual intrusion. Glass panels would not integrate with local historic character.
Impact on Road User	70 metre long barrier would not have a significant impact on passing motorists. Barrier set on top of a 4 metre high retaining wall would appear as a 2 storey facade, helping to break down the scale	70 metre long barrier would not have a significant impact on passing motorists. Barrier set on top of a 4 metre high retaining wall would appear as a 2 storey facade, helping to break down the scale.	70 metre long barrier would not have a significant impact on passing motorists. Barrier set on top of a 4 metre high retaining wall would appear as a 2 storey facade, helping to break down the scale.
Comments	Spacing of piers would reflect scale of adjoining dwellings. Brick panels could be painted to create a trompel 'oeil effect.	Transparent panels would require regular cleaning.	Transparent panels would require regular cleaning.

I Summarise Advantages/Disadvantages

A solid brick wall would tend to enclose and dominate the narrow space in front of the houses protected by the barrier. This enclosing effect could be relieved by the use of transparent panels (Option b or c). Option b has more affinity with the character of the locality and is preferred.

J Refine Preferred Option

Consider incorporating climbing plants to soften the appearance of the barrier.

SITE - ST PETERS TOWER AND ENVIRONS

Description

Between Market Street and City Road the scheme follows the existing railway tracks. Adjoining residential developments are between 20 metres and 30 metres to the south of the route and comprises low rise local authority maisonettes and a 12 storey apartment block called St Peters Tower.

Design Process

A Consider Initial Alignment

Route determined by location study team; road in cutting, slightly lower than realigned railway.

B Identify Affected Communities and Areas

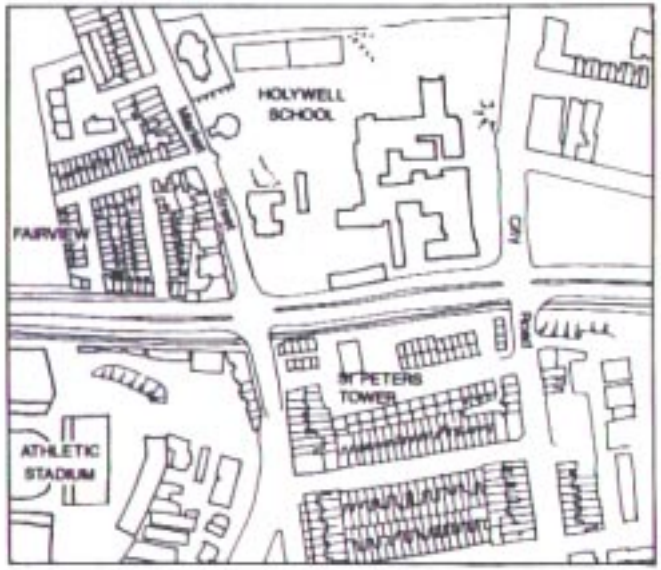
The 4 storey maisonettes and St Peters Tower overlooks the railway tracks and there are no living rooms on the railway side of the building, but the surrounding area would be seriously affected by the new road.

C Consider Route Alignment Options

No opportunity to alter route because of engineering constraints.

D Identify Noise and Visual Criteria

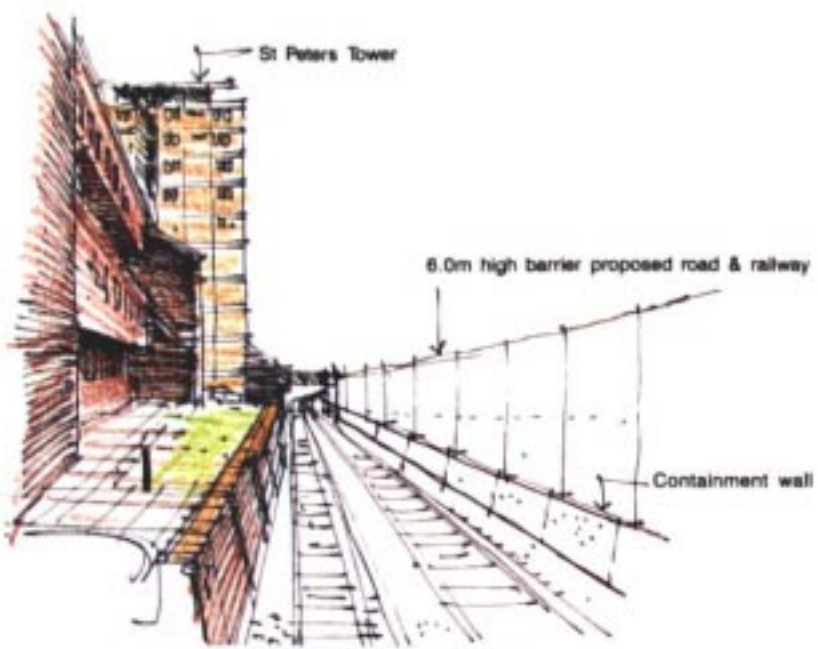
In order to reduce traffic noise levels, a 6 metre barrier is needed at the highway boundary over 160 metres. The barrier should be keeping with the character of the locality.



E Assess Townscape Character

The council residential development alongside the scheme consists of brick buildings set in concrete paved surroundings. The development is mundane in appearance, but the wider landscape encompasses the 5 storey brick residential mansions on Market Street, the distinctive structure of the Athletic Stadium, a considerable variety of brick buildings, and the Holywell School precinct to the north of the railway.

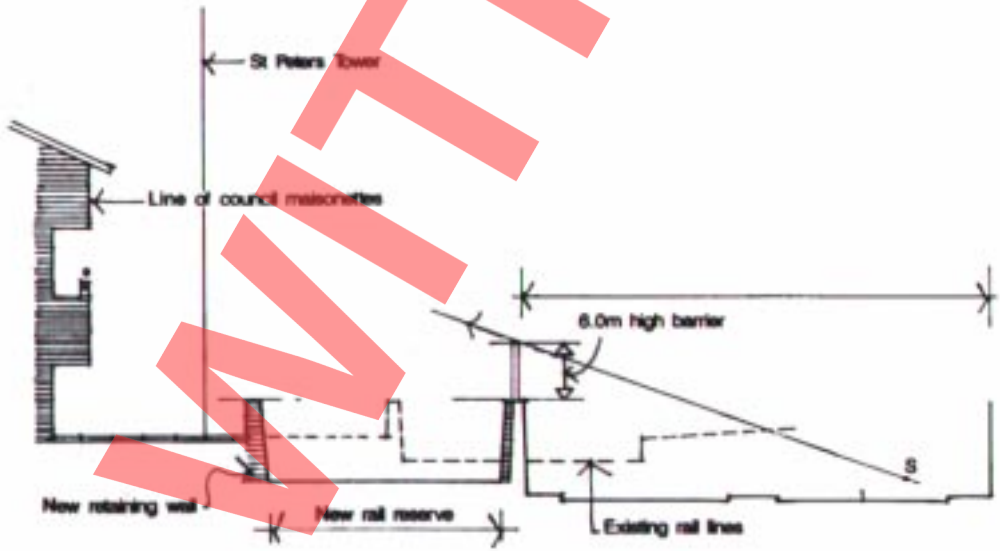
Council Housing & St Peters Tower - as existing

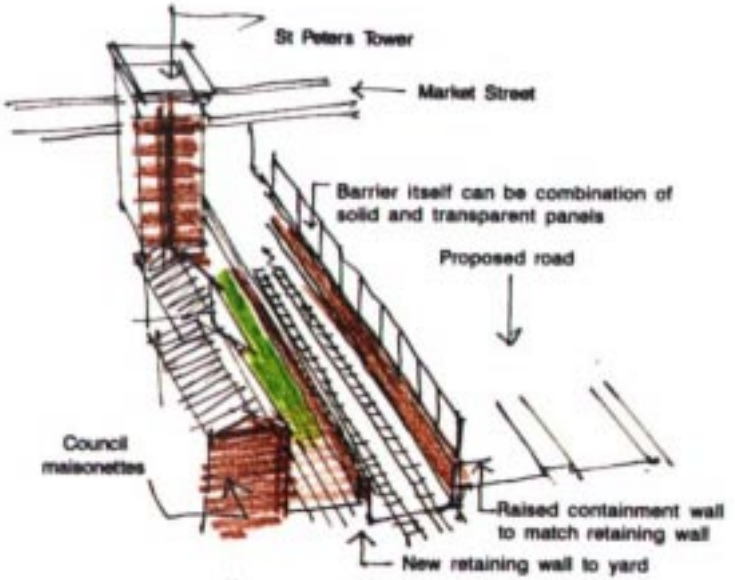


Railway moves over into housing forecourt

F Design Barrier to Suit Local Context

The new road would displace the railway, moving it some 5 metres towards St Peters Tower. This would necessitate the demolition of the existing 2 metre high boundary wall. Several trees 10 metres high would also be lost along this boundary. The 6 metre barrier would be about 17 metres from St Peters Tower, and about 20 metres from the maisonettes. It would be separated from the residential development by the intervening rail tracks. Because the road runs slightly below existing rail track level, only about 4 metres of the barrier between the road and railway would be above the ground level in the residential area. The view of the barrier from the ground would be further obscured by the reconstructed 2 metre boundary wall along the rail corridor, so that its main visual impact would be on living accommodation at first floor level and above.





G **Reappraise the Noise Benefits of Alternative Options**

No freedom to increase the size of barrier because of visual impact.

H **Assess the Visual Impact of Alternative Options on Protected Side and on Road Users' Side**

	Option a	Option b	Option c
Type	Brick wall with piers and recessed panels.	Brick wall with rendered and metallic painted infill panels.	Steel support structures and infill panels, some transparent.
Impact on Protected Side	6 metre high brick wall could impart an uncomfortable sense of enclosure due to dominance of brick elsewhere in the locality.	Painted infill panels would provide interest for residents and would break up scale of the barrier.	Steel supports and infill panels could add colour and interest to the mundane character of the locality.
Impact on Road user	The barrier could improve the view for motorists who would otherwise perceive the mundane elevation of the council development.	Brick wall barrier relieved with panels would add interest for motorists. The wall treatment could be mirrored on the opposite side of the road where the route is contained by a 5 metre high retaining wall.	Colourful steel structures would be a feature and add interest for motorists.
Comments	A brick barrier 6 metres high may lack interest unless strongly modelled.		

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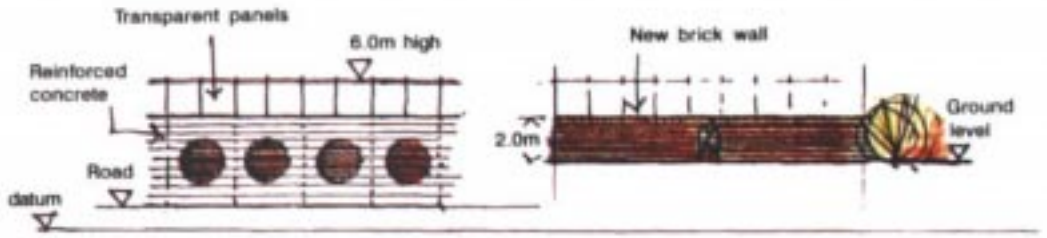
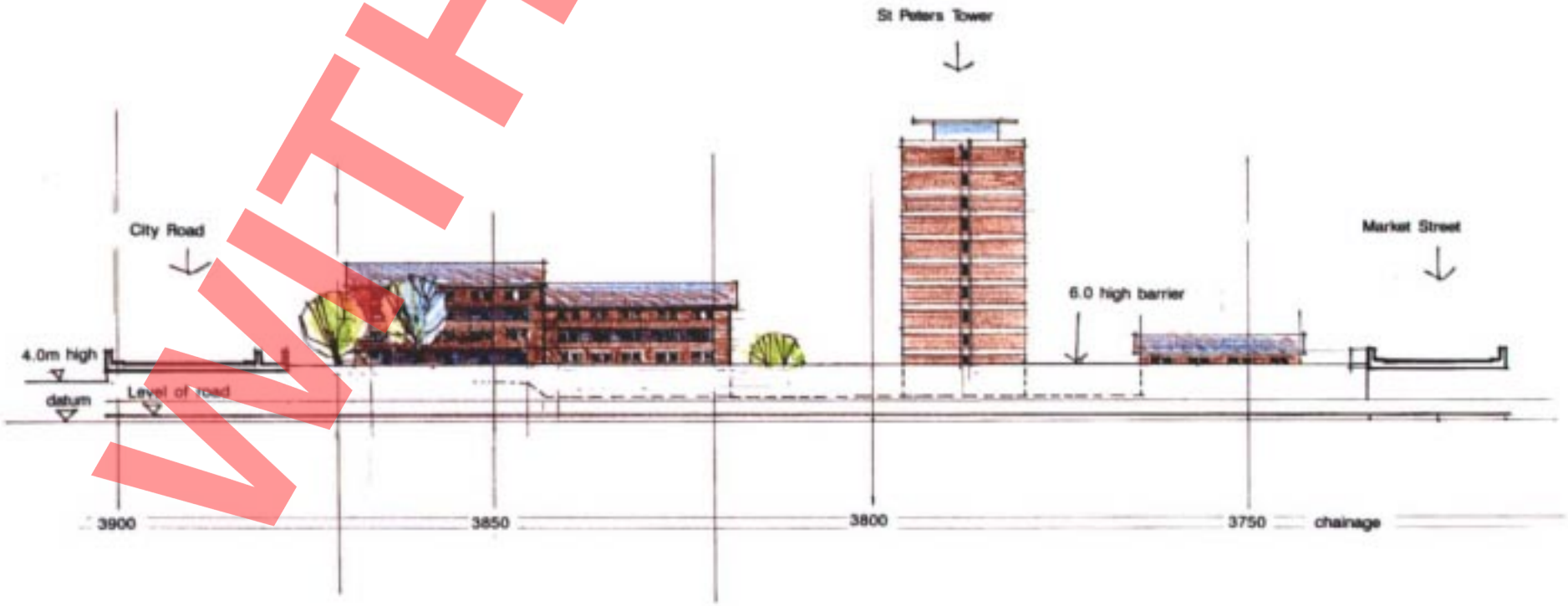


Elevation from road/rail reserve

Elevation from ground level-St Peters Tower

SITE E

St Peters Tower/maisonettes



I Consider Advantages/Disadvantages

The preponderance of brick in the locality suggest that the brick barrier alone may lack visual interest. A more varied brick barrier incorporating recessed panels (Option b) would have greater appeal and could extend on the opposite side of the road to maintain a consistent treatment along the highway corridor. The more colourful steel support and metallic panel barrier (Option c) would be a distinctive feature but would not integrate comfortably with the prevailing townscape character. Option b is preferred.

J Refine Preferred Option

Consider the appearance of the barrier in the context of road furniture (safety barrier, lighting and signs), and the new barrier 2 metres high along the rail track which is to be located immediately alongside the council development.

13. ENQUIRIES

All technical enquiries or comments on this Advice Note should be sent in writing as appropriate to:

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