Office of the
Deputy Prime Minister
Creating sustainable communities

High hedges, daylight and sunlight: final report

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CONTENTS

EXECUTIVE SUMMARY

This report has been produced as part of a contract ‘High hedges and their impact on daylight and sunlight to adjoining dwellings and gardens’ for the Tree Advice Trust (TAT) acting for DETR, now DTLR. It forms a scheduled deliverable of the above contract ‘Final report’ due in July 2001.

The aim of this project was to produce a guidance document on the impact of hedges on daylight and sunlight, and a method for calculating reasonable hedge height. BRE have completed this work, developing detailed guidance on hedge height and light loss. The guidance introduces the concept of the action hedge height, above which a hedge will block too much light.

For windows in dwellings, the action hedge height can be found using a method based on earlier guidance by BRE on obstruction by buildings. However it has been simplified and adapted for use with hedges. The method concentrates on safeguarding diffuse light on cloudy days; in most cases this will also ensure enough sunlight enters a room.

For gardens a new technique has been developed. This involves multiplying the depth of the garden by a factor which depends on the orientation of the hedge, to get the action hedge height. The method can cope with non-rectangular gardens, gardens that are sloping or stepped, and cases where the hedge is set back from the garden boundary. This report describes in detail how the method was developed.

The guidance document itself has been tested and refined through consultation and a series of site visits to real hedges.

1. INTRODUCTION

1.1 The purpose and scope of the project

High hedges can restrict the daylight and sunlight entering dwellings, and also cause a reduction in the sunlight enjoyed by neighbouring gardens. The aim of this project was to produce a guidance document on the impact of hedges on daylight and sunlight, and a method for calculating reasonable hedge height.

The idea for the project was first formulated in Autumn 2000. At the time DETR Rural Development Division (now part of DTLR) were developing legislation to tackle the problems caused by high garden hedges, such as Leyland Cypress. The intention was to set up a statutory complaints system to be administered by local authorities, who would have power to order the cutting back of the hedge if they thought it justified.

To ensure authorities adopted a consistent approach to these complaints, the Department was keen that local authority decisions should be based, as far as possible, on objective measurable factors. One of the main problems cited by sufferers of overgrown hedges is that they obstruct light to their homes and gardens.

The requirement was to have a method for:

- calculating the daylight and/or sunlight reaching habitable rooms in a home, and the main garden;
- indicating whether this is obstructed by the hedge;
- assessing whether the impact of the hedge is significant or “unreasonable”;
- estimating what size the hedge needs to be to remove any “unreasonable” obstruction.

The following additional requirements were established for the guidance document:

- The guidelines should ideally be simple enough for householders to use, to check whether there is a problem.
- They should cover loss of daylight and sunlight to buildings, and also loss of sunlight to gardens.
- They should differentiate between three types of hedge: those that are low enough not to cause problems, those that may cause problems if they grew any higher, and those that are already causing problems.
- The guidance should cover evergreen hedges, which can be assumed opaque.
- A draft document is required, which the Department or the Arboricultural Advisory and Information Service (AAIS, an information service managed by the Tree Advice Trust) would publish. The BRE guidance on daylight and sunlight would be part of a more general information pack to be produced by the Department and/or AAIS.

- The draft should be produced by March 2001, with a final version in July 2001, to fit in with the possible legislative timetable.
- The calculation procedure should be tested against a sample of problem hedges

1.2 The structure of this report

The body of this report is divided into two main parts. Section 2 describes the main stages and the project and summarises the actions taken. Sections 3-5 then give full details of the basis of the proposed guidance, explaining why the particular calculation methods were chosen.

2. PROJECT PROGRESS

2.1 Development of the initial draft guidance

The project began in February 2001 and work commenced on development of the initial draft guidance. BRE's early proposals were refined in a series of meetings with experts in the field:

Julie Richardson, Peter Annett and Steve Clark, DTLR;
Derek Patch of TAT;
Guy Barter, Colin Crosby and Paul Goacher of the Royal Horticultural Society;
Richard Nicholson of East Dorset District Council;
Alistair Redler of Delva Patman Associates and the Royal Institution of Chartered Surveyors;
Becky Hesch of the London Tree Officers' Association; Chris Colwell of the Royal Borough of Kensington and Chelsea; Barbara Milne of London Borough of Bromley;
Jim Smith of Islington London Borough Council;
Colin Grimwood and Vina Kukadia of BRE.

and telephone interviews with David Hall of Envirobods Limited, Clare Hinchliffe and Alan Bridgman of Hedgeline. Hedgeline and the National Association of Tree Officers also provided written submissions at this stage.

The draft document (ref 1) setting out the guidance was produced in March 2001. It contained the following:
1. Introduction
2. Hedge heights
3. Procedure for calculating action hedge height
4. Loss of light to windows
5. Loss of light to gardens
6. Example of full calculation procedure
7. Other relevant factors
8. Further reading
9. Acknowledgements
Annex. Explanatory notes
The document introduced the concept of 'action hedge height' above which a hedge is likely to block an excessive amount of light, and should be reduced in size. It is

advisable for reduction in hedge height to be carried out so that all the hedge is at a 'growing margin' (typically 0.5-1 metres) below the action hedge height. This allows the hedge to grow in between annual (or more frequent) trimmings, and still remain below the action hedge height.

If the hedge is already below the action hedge height minus the growing margin, or lower, it could still cause a noticeable loss of light. However it is unlikely to cause significant over shading and no action need be taken.

If the hedge is below the action hedge height, but within the growing margin, it may cause significant loss of light as it grows. In this case future trimming will be needed.

The document then gave a procedure to calculate the action hedge height both for windows to main rooms in a dwelling, and for a garden. In summary, the procedure is as follows:

a) Calculate the hedge height for loss of daylight to main house windows (Section 3).

b) Calculate the hedge height for loss of sunlight and daylight to the nearby garden (Section 4).

c) Take the lower of these 2 heights.

d) If this height is less than 2 metres, round it up to 2 metres.

e) The resulting number is the action hedge height.

The procedure was intended to be simple enough for householders to use. It involves multiplying the distance from a window to the hedge, or the depth of the garden, by a factor; for gardens this factor depends on hedge orientation. Corrections can be made for site slope or where the hedge is set back from a garden boundary.

A simple technique cannot cover every situation, and a section of the guide discussed other relevant factors which might need to be considered.

2.2 The consultation

The draft guidance was published on DETR's web site in April 2001, and BRE also sent out copies (either electronically or on paper) to the following organisations:

Royal Institution of Chartered Surveyors;
Royal Horticultural Society;
Landscape Institute;
Horticultural Trades Association;
Mediation UK;
National Association of Citizens Advice Bureaux;

Local Government Association;
Chartered Institute of Environmental Health Officers*;
Town and Country Planning Association;
Royal Town Planning Institute;
National Association of Tree Officers*;
Arboricultural Association;
Hedgeline*;
North West Tree Officers Group*;
Thames Valley Tree Officers Forum;
The London Tree Officers' Association*;
East Dorset District Council;
Royal Borough of Kensington and Chelsea;
London Borough of Bromley;
Islington London Borough Council;
Kent County Council;
Westminster City Council;
Tendring District Council;
Cornwall County Council;
Poole Borough Council*;
Elmbridge Borough Council*;
Delva Patman Associates;
Gardening Which?

Those organisations marked with an asterisk submitted detailed responses to consultation, as did a number of individuals, mainly people whose houses and gardens were overshaded by hedges. Some of these people were Hedgeline members; others became aware of the guidance through articles in the Independent (ref 2) and Daily Mail (ref 3).

2.3 Site surveys

To test out the guidance, BRE visited 16 gardens bordered by high hedges (ref 4). The gardens and hedges were measured and visually assessed. In each case the action hedge height (the height at which the earlier guidance recommended trimming) was calculated and compared with the current hedge height.

Figure 1. Site survey: measurement of hedge height with an optical clinometer.

Table 1 summarises the site visits. It gives the location of each site, and the actual height of the hedge. The third and fourth columns are the calculated action hedge heights for the windows and the garden respectively, using the draft guidelines. Normally, in the calculation, the lower of these two hedge heights would be taken as the height above which trimming would be recommended. The fifth and sixth columns give the differences between these action hedge heights and the actual hedge height. A negative value means that the hedge is higher than the action hedge height and so, according to the guidelines, trimming by this amount would be recommended.

The site visits were a valuable test of the guidance. In nearly all cases the guidelines gave reasonable results for action hedge height. However some modifications to the guidelines were identified, and there were a few areas where the guidance needed clarifying.

Finally, the site visits underlined the need for flexible guidance. It was clear that no one simple calculation method can cover every situation adequately.

Full details of the site visits, and the conclusions drawn from them, are given in reference 4.

Table 1. Summary of hedge surveys

Survey location (listed in date order)	Actual height of 'problem hedge'	Action height		Difference between Action height and Actual height.	
		Related to windows	Related to Garden	Related to windows	Related to Garden
1. Sandhurst	4 to 5	7.5	3.57	+2.5/3.5	-0.43/1.43
2. Farnham	11	8.24	3.74	-2.76	-7.26
3. Marlow	8.5	N/a	44.38	N/a	+35.88
4. Uxbridge	3	4.4/4.6	16.76	+1.4/1.6	+13.76
5. Coventry	3.8	4.5	2.1	+0.7	-1.7
6. Richmond	6.2	4.5	5.2	-1.7	-1
7. Watford	3.8	4.9	2.8	+1.1	-1
8. St. Johns Wood	7.67	8.95	8.65	+1.28	+0.98
9. Maida Vale	8.25	4.9	3.45	-3.35	-4.8
10. Sandhurst	3.75	4.57	2	+0.82	-1.75
11. Doncaster	4.5	3.55	3.56	-0.95	-0.94
12. Doncaster	2.5	2.75	2	+0.25	-0.5
13. Pratt's Bottom	10.5	10.45	41.84	-0.05	+31.34
14. Chelsfield	5.3	5.7	7.37	+0.4	-2.07
15. Keston Park	18	4.91	9.26	-13.00	-8.74
16. Beckenham	5.7 & 4.1	5.55	10.04	-0.15	+4.34

2.4 Production of revised guidance

Following the consultation process and site visits, a revised version of the guidance document was prepared early in July 2001, following a meeting on 29 June with DTLR and the Tree Advice Trust to discuss possible changes.

A number of technical changes were made to the guidance and these are described in Sections 3 to 5. Some additions were made to the guidance to make it clearer and easier to use, including production of a step by step spreadsheet to calculate action hedge height.

Since the first draft was issued in April 2001, the need for the guidance had changed. The High Hedges Bill had not been passed by Parliament, but DTLR still wanted to issue the guidance so that householders could use it as a tool to agree problem hedge cases between themselves. Consequently a number of extra changes were made to the document, removing the references to the Bill and the role of local authorities.

3. BASIS OF GUIDELINES: LOSS OF LIGHT TO WINDOWS

3.1 Introduction

High hedges can obstruct daylight to windows. Even if a window faces north, significant loss of diffuse sky light can occur. The extent of the loss of light will depend on the distance from the hedge to the window as well as the height of the hedge.

Guidance on the obstruction of light by buildings is given in the BRE Report 'Site layout planning for daylight and sunlight: a guide to good practice' (ref 5). This is widely used by local authorities to help decide planning applications for which loss of light is an issue. The guidelines can be adapted for use with hedges.

3.2 Windows and room types

The guidelines in the BRE Report are intended for use for the main rooms of a house. These include living rooms, dining rooms, kitchens and bedrooms. Loss of light to toilets, bathrooms, storerooms, circulation areas (hall, stairs and landing) and garages is deemed less important and such windows need not be analysed. This approach was adopted for the hedge guidelines.

At the initial stages of the project, following consultation with the Department, it was decided that the guidelines should only apply to dwellings, and not to outbuildings such as sheds, greenhouses, summer houses, garages or workshops. Windows to these structures need not be taken into account. Otherwise a neighbour could impose a low hedge height by building a shed or greenhouse unnecessarily close to it.

Conservatories are another problem area. They usually have side glazing which can be very close to a hedge, even though the rest of the glazing in the conservatory might be much less affected by it. In general, conservatories will be less susceptible to loss of light caused by a hedge, because the roof glazing will admit light from overhead. For these reasons it was decided that the opening between the conservatory and the house, not the front or side faces of the conservatory, should be taken as the window position.

3.3 Location of window reference point

The loss of light caused by a hedge needs to be worked out for a particular reference point related to the existing window. 'Site layout planning for daylight and sunlight: a guide to good practice' (ref 5) suggests using the centre of the existing window. Typically this will be 1.5 metres above ground, or possibly 2 metres for older homes with tall windows. However for patio doors, and where window locations are unknown, it suggests a point 2 metres above ground. For the draft hedge guidance, 2 metres above ground was chosen for several reasons:

- it makes the guidance easier to explain and apply
- there is less for the householder to measure
- the value is the same for all windows on a given facade

If the lowest affected window is at first floor height or above, ‘Site layout planning…’ (ref 5) recommends adding 2 metres to the floor level above ground. This approach was adopted in the draft hedge guidance.

However at the consultation stage there was significant opposition to the 2 metre level. A number of respondents argued for 1 metre as the reference height. They cited cases where the hedge could be quite close to the window and still be over 3 metres in height. This was backed by findings from some of the site visits which seemed to show that the action hedge heights for windows appeared slightly too high.

In the final guidance document, therefore, a 1 metre reference height was adopted. This will offer protection of daylight to most of the window, rather than just the top part. It will also ensure a better view out from the window in cases where the hedge is close to the window.

3.4 Hedge directly opposite window

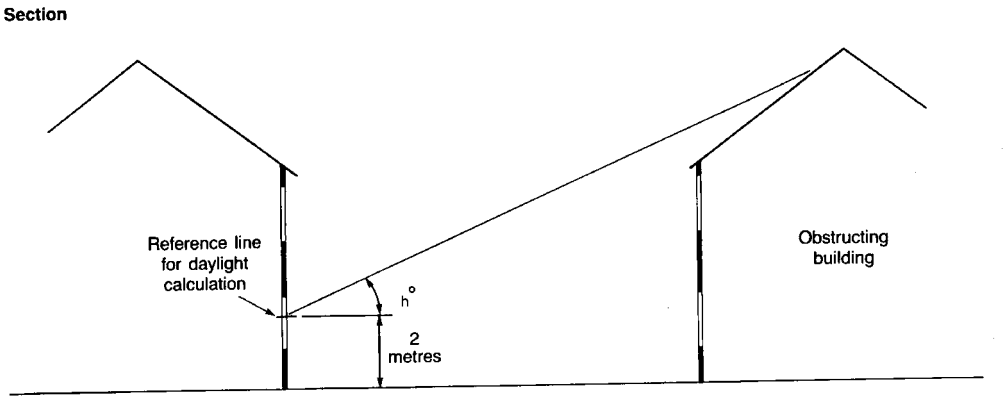

Figure 2. Building opposite a window (from refs 5,6).

This case is analogous to one of the building layouts considered in ‘Site layout planning for daylight and sunlight: a guide to good practice’ (ref 5), where a window is obstructed by a wide building opposite. It suggests a limiting obstruction angle h of 25° to the horizontal, measured from the window reference point (Figure 2). There is a more complex calculation procedure for tall narrow buildings, or where the window is already heavily obstructed.

This approach has worked well for typical UK house layouts, particularly in low density housing with gardens or roads between the windows. The 25° angle ensures reasonable daylighting of most common room shapes, provided window areas are adequate.

The aim here has been to concentrate on daylight provision on cloudy days. Where a building of this size is opposite a window that faces within 90° of due south, it can be shown that there is little obstruction to sunlight if the obstruction angle is less than 25°.

Accordingly one approach to the case where the line of the hedge is parallel to the window wall would be to require the hedge to subtend no more than 25° at the window reference point. This would be the same as replacing the building in figure 2 by a hedge.

An angular approach like this is easy to use for buildings, where the architect will normally have drawn a section through the proposed development. For gardens with hedges no such drawing will exist. So a spacing to height ratio approach would be more convenient.

A 25° obstruction angle corresponds to a ratio (Height of obstruction above reference point) / (distance of obstruction) of 0.4663. This is close to 0.5. So the householder should measure the horizontal distance between the outside window wall and the hedge, halve it and add 1 metre. This gives the action hedge height (Figure 3).

If the land slopes or is stepped from window wall to hedge, the action hedge height needs to be modified to take account of this. If the base of the hedge (where the trunks meet the ground) is higher than the base of the window wall, subtract this height difference from the calculated action hedge height. If the base of the hedge is lower, add the height difference to the calculated action hedge height.

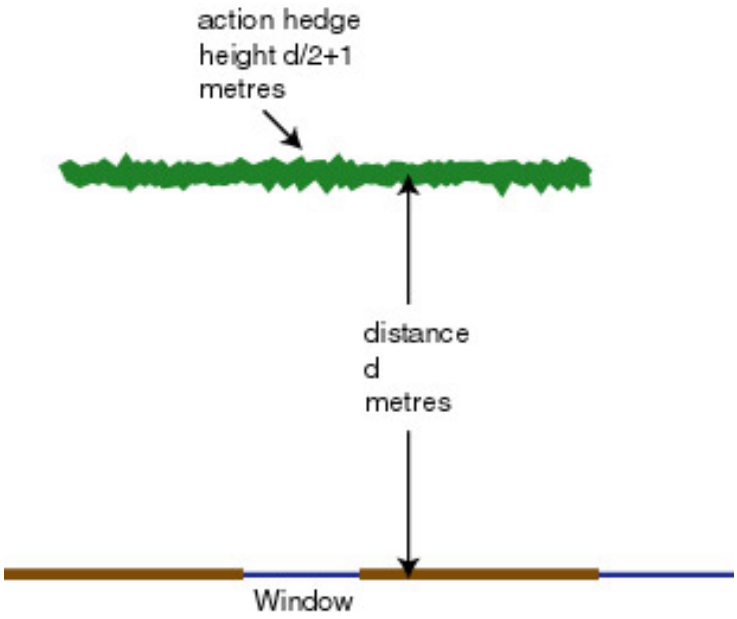

Figure 3. Hedge opposite a window.

One issue that was discussed in detail during the project was from which part of the hedge to measure the distance. The centre of the hedge was chosen because in its untrimmed state this will be the tallest part. Also the trunk location is relatively easy to establish. If the nearest part of the hedge had been chosen, a neighbour could

allow hedge branches to grow towards his window to reduce the action hedge height.

3.5 Hedge to one side of window

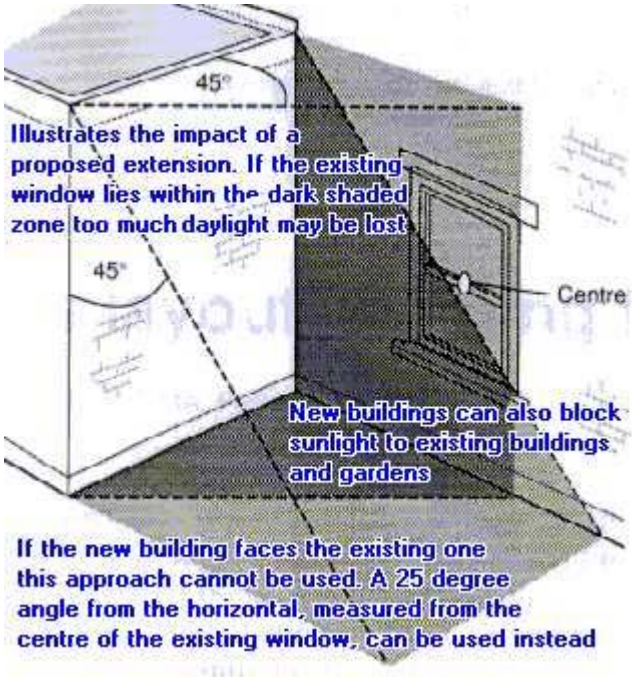

Figure 4. Loss of light due to an extension.

This is normally the case if the hedge separates the gardens of two adjoining houses. Here the analogy is an extension to the rear of an adjoining house. 'Site layout planning for daylight and sunlight: a guide to good practice' (ref 5) suggests a 45° approach. If the top of the end of the extension subtends angles of more than 45° in both plan and elevation from the window reference point (figure 4), then there is likely to be a significant loss of light.

A hedge will normally go some distance out into the garden, so the angle on plan will almost always exceed 45°. The key issue therefore is whether the hedge subtends more than 45° in elevation. This corresponds to a hedge height above the reference point greater than its horizontal distance away.

Accordingly the householder should measure the horizontal distance between the centre of the window and the centre of the hedge line, then add one metre to get the action hedge height (figure 5).

Most of the light loss to the window will be caused by the portion of the hedge nearest to it (figure 5). Only this part need be reduced in height to deal with the obstruction. To find the length of hedge that needs trimming, the approach for a hedge opposite the window was adapted. To get the length of hedge that needs trimming, take the current height of the hedge, subtract 1 metre and then double this number.

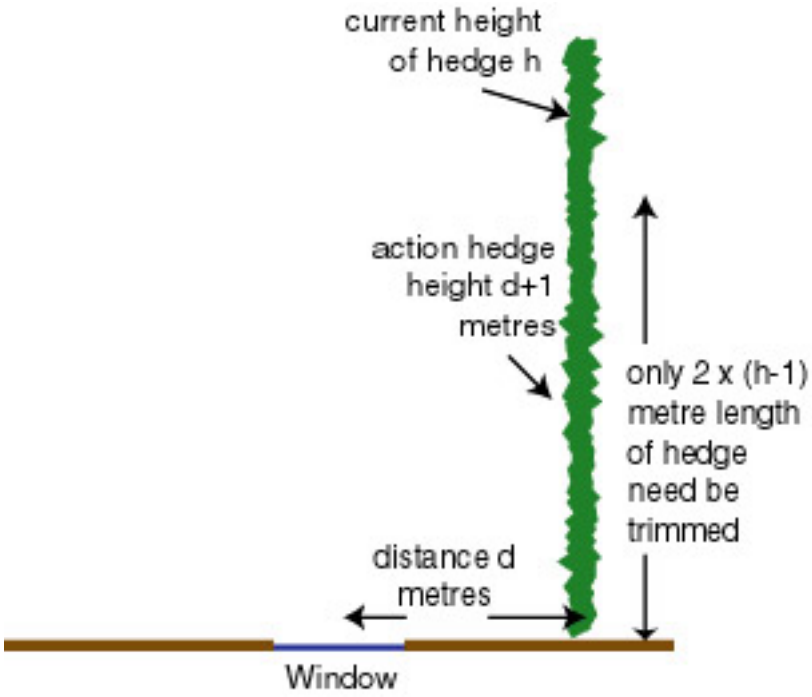

Figure 5. Hedge to one side of window

3.6 Hedge is at 45° to window

This can sometimes happen if the hedge is on a corner plot (figure 6). The action hedge height will be proportional to the closest distance d from the centre of the hedge to the centre of the window (this will be measured along a line at right angles to the hedge and 45° to the window). 'Site layout planning for daylight and sunlight: a guide to good practice' (ref 5) does not give an analogy to this situation, but does contain a calculation method to assess the impact. This involves finding the vertical sky component at the window reference point. The vertical sky component is the direct sky illuminance reaching the reference point, divided by the simultaneously occurring horizontal unobstructed illuminance. It is a good measure of the light entering the window. For the situation in Figure 2, with an obstruction angle of 25°, the vertical sky component is 27%. 'Site layout planning…' therefore uses this as a general guideline for complex obstructions.

With the hedge as shown in Figure 6, a vertical sky component of 27% is realised at the window reference point if the hedge height above that reference point is 0.637 times (or almost two thirds) the distance d. So to get the action hedge height, the householder should multiply this distance by two, divide it by three and add one metre.

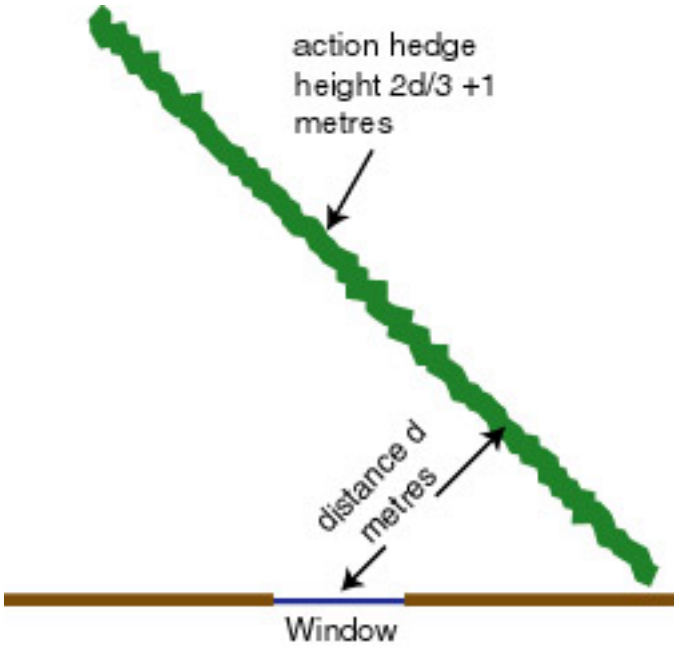

Figure 6. Hedge at 45° to window.

4. BASIS OF GUIDELINES: LOSS OF LIGHT TO GARDENS

4.1 Introduction

A high hedge will create an area of shade next to it. The extent of this area of shade will depend on the orientation of the hedge (whether it is north or south of the obstructed garden). The impact on the amenity value of the garden will depend on its size, relative to the size of the shaded patch.

The guidelines are intended to apply to any type of garden, even small back yards with no lawn. One of the issues raised during consultation was the need to protect small gardens.

The guidelines are intended to protect light to the garden as a whole rather than particular features within it. This was also discussed in detail at the consultation stage. The conclusion was that it was up to the owner of the garden to site features within it so they would not be too close to tall hedges.

4.2 Development of basic guidance; hedge height and garden size

The BRE Report 'Site layout planning for daylight and sunlight: a guide to good practice' contains recommendations for sunlight in gardens and other open spaces. These are based on the area of the garden that can receive some sunlight on March 21. Areas that cannot receive sunlight on March 21 will normally be in shade all winter. At an early stage in the project it was decided not to base the hedge height calculations on this method, for the following reasons:

- this part of the BRE Report is targeted at worst case overshadowing where a space is surrounded by buildings;

- in particular, an infinitely high hedge could be allowed if some sunlight reached the garden from other directions;
- the method requires a complicated calculation involving the heights of all the surrounding buildings as well as the hedge itself.

So as part of the project a simpler procedure was developed to assess the impact of hedges.

A key issue is the nature of light as an amenity in gardens. Is it only sunlight that is important, or is access to diffuse sky light valued in gardens too? The initial consultation (particularly discussions with local authority tree officers) suggested that sunlight was the overriding factor. So the initial draft guidance was based solely on safeguarding sunlight. This has particular repercussions for where the hedge is to the north of the garden. A hedge to the north will block little sunlight, however high it is. Thus the initial guidance allowed very high hedges to the north.

Figure 7. A hedge to the north does not cast deep shade (note the flowers growing underneath it), but it can have an overbearing effect on a garden.

This was underlined during one of the site visits (figure 7). Our inspection showed that 7-8 metres would be a reasonable maximum height for this hedge (at the time of inspection it was 5.3 metres high). In fact the draft guidance suggested it could be 105.2 metres high before it blocked too much sunlight.

This, and the comments received from some of the consultees, showed that diffuse light, and the general overbearing effect of a hedge, are important as well as sunlight.

BRE had carried out some previous work in this area, evaluating growth of grass in football stadia and wild plants under road bridges. Growth of plants depends on the total amount of light, both daylight and sunlight, they receive.

This has been calculated for a range of garden layouts. The data are calculated in terms of kilolux hours per year as a percentage of the corresponding values for unobstructed ground. The values include both direct sunlight and diffuse sky light, and light reflected from the hedge itself. This assumes an average hedge reflection factor of 4%, based on measurements of yew and cypress hedges at BRE. The calculation uses a monthly and hourly time step, and allows for the average luminance distribution of the sky, which is brighter nearer the sun.

In interpreting the figures, some comparisons might be helpful. Beside an east or west facing wall, a yearly average illuminance exposure of around 170 kilolux hours per day (or 55% of the unobstructed value) would be expected. Nearly all plants will grow under these conditions, but there will be a significant loss of sunlight amenity.

Beside a north facing wall, a yearly average illuminance exposure of around 100 kilolux hours per day (or 32% of the unobstructed value) would be expected. In this situation plants which require regular sunlight would find it hard to grow, but there is a wide range of shade loving plants which would thrive. For outdoor activities there is a serious loss of amenity.

By a south facing wall, an illuminance exposure of around 75% of the unobstructed value would be expected. Here there is no significant loss of sunlight amenity and all common plants would grow.

Figures 8-10 give simulated results for three different garden geometries. In each case it is assumed that the hedge is 5 metres high, the same height as the eaves of the house, and that hedge and house each cover the whole of one side of the (square) garden. On the other two sides of the garden are 2 metre high fences. In figures 8-10 the hedge and house are at opposite sides of the garden.

Square garden, width 4 times hedge height

N house

	52	64	70	74	75	76	76	77	77	77	77	76	76	76	76	75	74	70	63	51	
	55	68	75	79	80	81	82	82	82	82	82	82	82	82	81	80	79	75	67	54	
	57	71	79	82	84	85	85	86	86	86	86	86	86	85	85	84	82	79	71	57	
	59	73	81	85	87	88	88	88	89	89	88	88	88	88	88	86	85	81	73	59	
	60	75	82	86	88	89	90	90	91	90	90	90	90	90	89	88	86	82	74	60	
	61	76	83	88	89	91	91	91	92	92	92	91	91	91	91	89	88	83	75	60	
	61	76	84	88	90	91	92	92	92	92	92	92	92	92	91	90	88	84	75	61	
	61	76	84	88	90	91	92	92	92	92	92	92	92	92	91	90	89	84	75	61	
	61	76	84	88	90	91	92	92	92	92	92	92	92	92	91	90	89	84	75	61	
W	61	76	84	88	90	91	91	91	92	92	91	91	91	91	91	89	88	84	75	60	E
fence	61	75	83	87	89	90	91	91	91	91	91	91	91	91	90	89	87	83	75	60	fence
	60	75	83	87	88	89	89	90	90	90	90	90	90	90	89	88	87	83	74	59	
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	31	38	41	43	43	43	43	43	44	44	43	43	43	43	43	43	42	42	37	30	
	25	30	32	34	35	35	36	36	36	36	36	36	36	35	35	34	34	32	30	25	

S hedge

3.75 % of garden 35% or less daylit
17.25 % of garden 55% or less daylit
37.75 % of garden 75% or less daylit

Figure 8. % annual daylight received in different parts of a 20 metre garden (hedge to south).

With this garden size, there is an area of shade right next to the hedge, but most of the garden still has more than enough daylight. 62% of its area has the high daylight levels you would expect near a south facing wall. Only just under a fifth of the garden receives less daylight than the ground next to an unobstructed east or west facing wall.

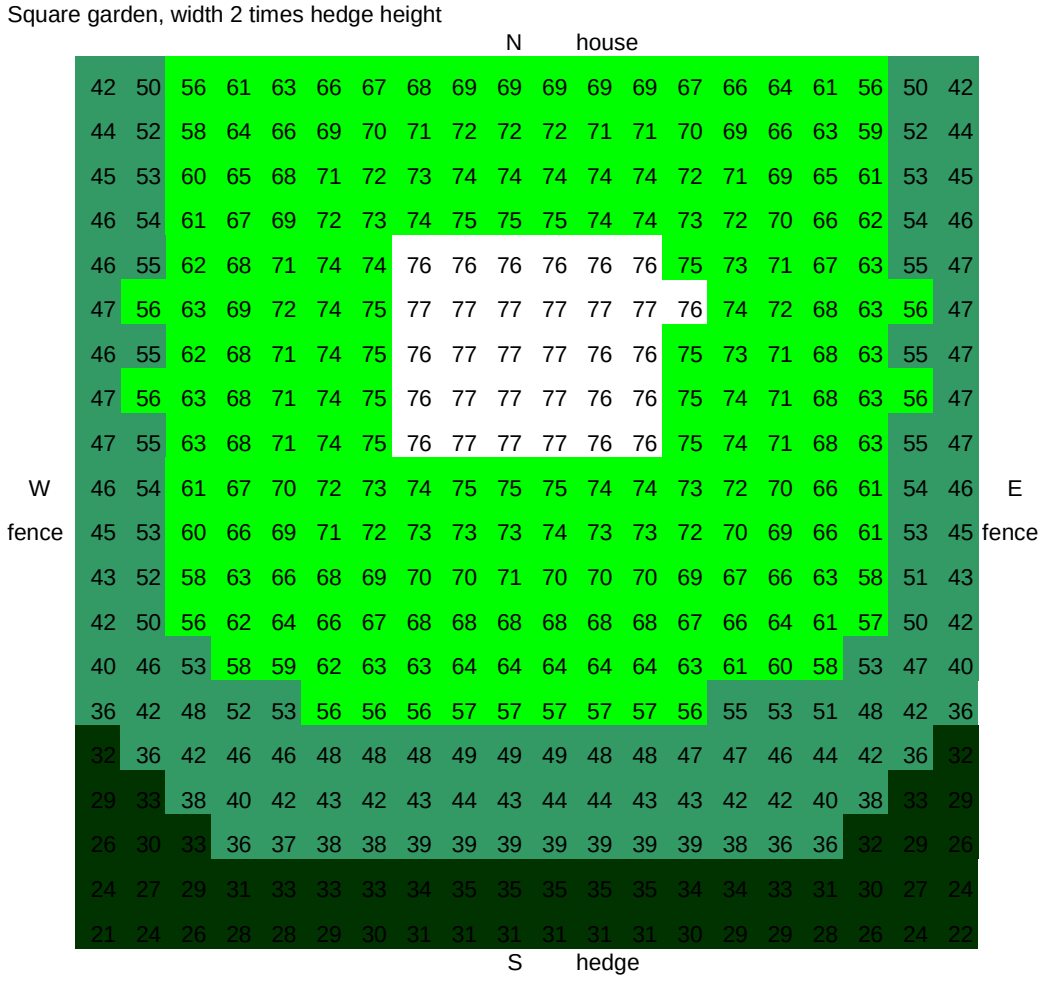

Figure 9. % annual daylight received in different parts of a 10 metre garden (hedge to south).

In this smaller garden, though, there are definite problems. There is a large area of deep shade at the south of the garden, covering around one eighth of it. In around half the garden there is a big loss of sunlight amenity.

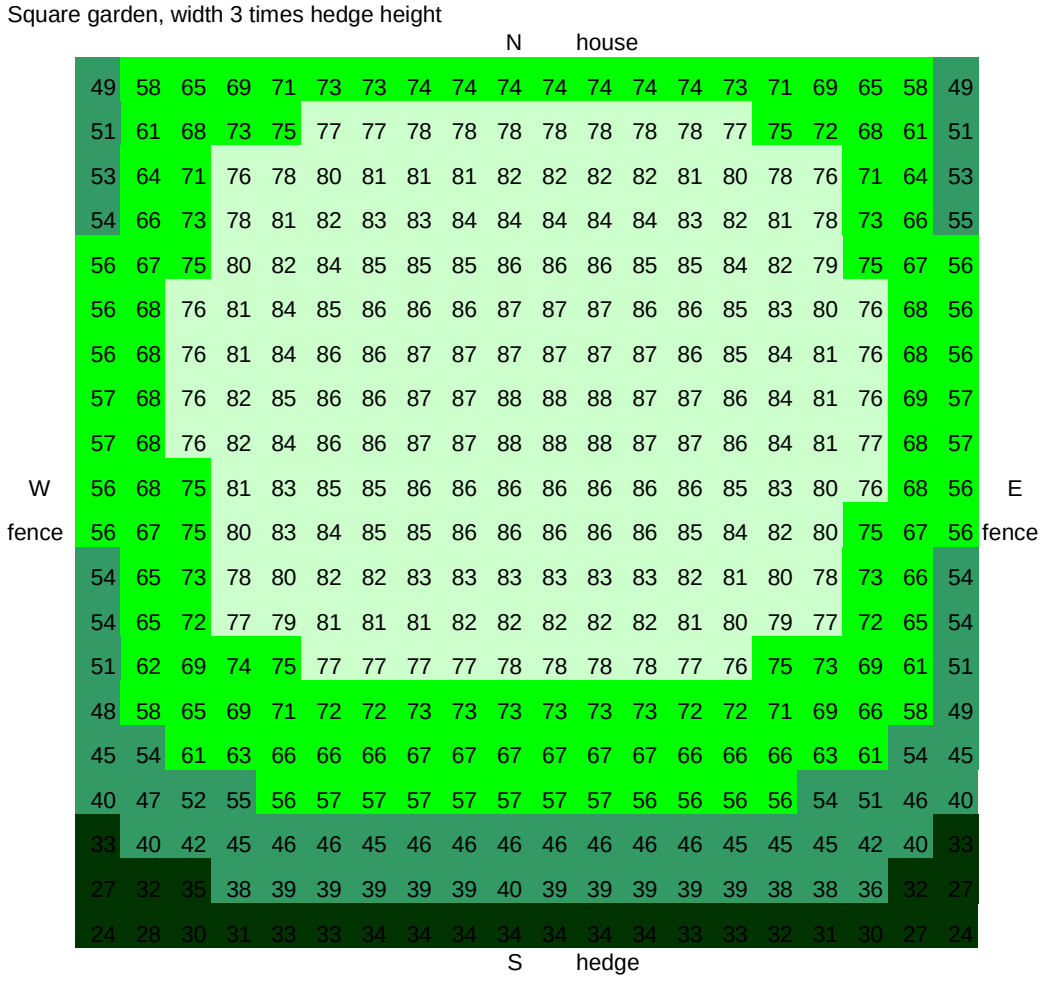

Figure 10. % annual daylight received in different parts of a 15 metre garden (hedge to south).

This represents an intermediate condition where the hedge height is one third the size of the garden. This level of overshadowing is probably just acceptable. Only 7% of the garden is in deep shade and most of it has more than the 55% daylight you would get near an unobstructed east or west facing wall.

The above analysis was repeated for a range of garden geometries and orientations. Overall, it appeared that the overshadowing was just acceptable if the height of a hedge to the south was around a third of the garden depth; and if the height of a hedge to the west was around half this depth.

4.3 Hedge orientation

The different amounts of daylight and sunlight blocked by hedges of different orientations can be readily calculated using an adaptation of the 'daylight exposure' technique described above. The light intercepted by the hedge over the whole year was calculated for eight different orientations. The corrections for orientation are based on light blocked by the hedge between 0900 (clock time) and sunset, which is why the values for east and west are not the same. It was felt that early morning sunlight was not as crucial for enjoyment of a garden as light after 0900, when people are more likely to be outside.

Table 2. Orientation factors for hedges

Orientation	**Factor**
North	0.95
North East	0.8
East	0.55
South East	0.4
South	0.35
South West	0.4
West	0.5
North West	0.7

The depth of the garden is multiplied by the relevant factor in Table 2 to get the basic action hedge height. Factors for other orientations may be obtained by interpolation. The orientation in Table 2 is the direction faced when looking from the obstructed garden to the hedge.

4.4 Non-rectangular gardens

The depth of a rectangular garden is easy to establish; it is the distance between the boundary containing the hedge and the far end of the garden. However for an oddly shaped garden, for example an L shaped garden, the depth is less easy to work out.

For a garden of the general type shown in Figure 11, the average depth is given by

$$\text{Effective depth} = \frac{\int_0^w y\,dx}{\int_0^w dx} = \frac{\text{Area of garden}}{\text{Length of hedge}}$$

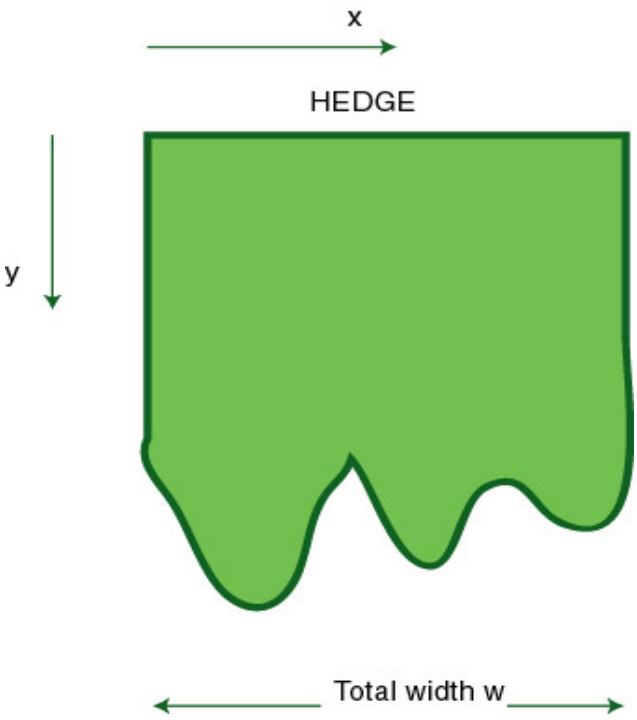

Figure 11. An oddly shaped garden.

This formulation also works where the hedge does not cover the whole of the boundary. The effective depth of the garden is increased so that a hedge which only obstructs part of the garden can be higher.

4.5 Hedge set back from boundary

Sometimes the hedge may not be immediately adjacent to the boundary of the affected garden, but some distance away from it. For example, there may be a driveway between the hedge and the boundary. Or the hedge might be at the far side of the hedge owner's garden.

Moving the hedge back results in significantly increased light to the garden. So you can have a higher hedge that, on average, blocks the same amount of light. However the relative impact of the two hedges will vary with distance, as Figure 12 shows. A hedge on the boundary will block more light to the areas immediately adjacent to it. Further away, a taller hedge set back from the boundary will cause the greater loss of light. The problem is therefore one of choosing the point, corresponding to where the dashed line in Figure 12 meets the ground, where we want the impact of the two hedges to be the same.

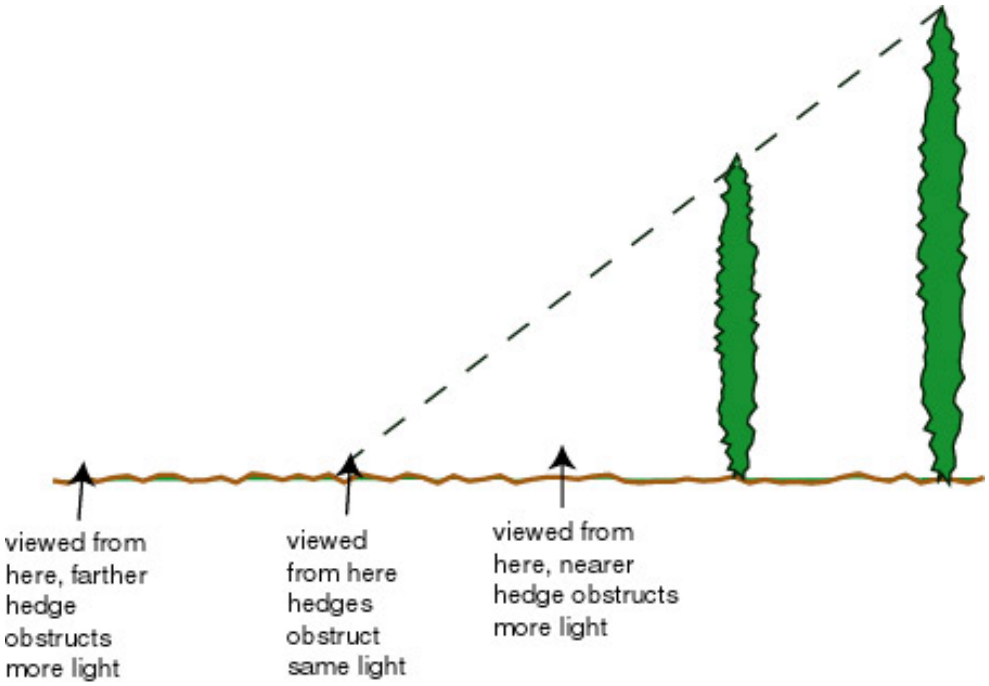

Figure 12. Comparison of a hedge on the boundary with a higher hedge set back from it.

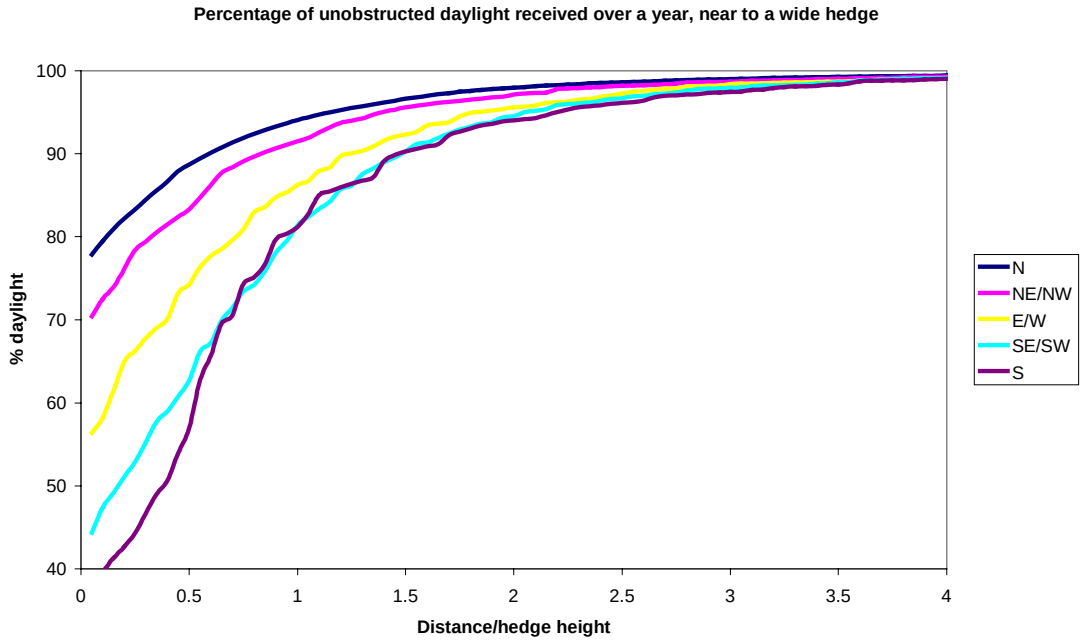

Figure 13. % annual daylight received at different distances from a wide hedge

Figure 13 shows that the impact of a hedge is most significant for a horizontal distance equal to the hedge height or less. So the key point in Figure 12 would be situated at this distance (the dotted line would then be at 45° to the horizontal). By similar triangles, this means that the difference between the two hedge heights is

equal to the distance between them. So where a hedge is set back from the boundary, the distance between it and the boundary should be added to the action hedge height.

4.6 Site sloping or stepped

Where the base of the hedge is above or below the level of the obstructed garden, or the obstructed garden is sloping or terraced, the action hedge height needs to be corrected.

This applies only if the level of the obstructed garden changes as you walk away from the hedge, at right angles to it (see for example figure 14). Where the slope is along the line of the hedge, so that the hedge runs up or down the slope, no correction need be made.

The correction needs to be equal to the height difference between the garden and the base of the hedge. But this height difference will tend to vary as you go away from the hedge.

Section 4.5 above showed that a key point is situated at a distance from the hedge equal to the action hedge height. For a south facing hedge this will be approximately one third of the effective depth of the garden.

The procedure is therefore as follows:

a. Measure the effective depth of the garden in metres.

b. Divide by 3

c. Take a point this distance away from the boundary nearest the hedge (this is point P in figure 14).

d. Estimate the vertical height difference between this point and the base of the hedge opposite it.

e. If the base of the hedge is higher, subtract this height difference from the action hedge height. If the base of the hedge is lower than the point in the garden, add this height difference to the action hedge height.

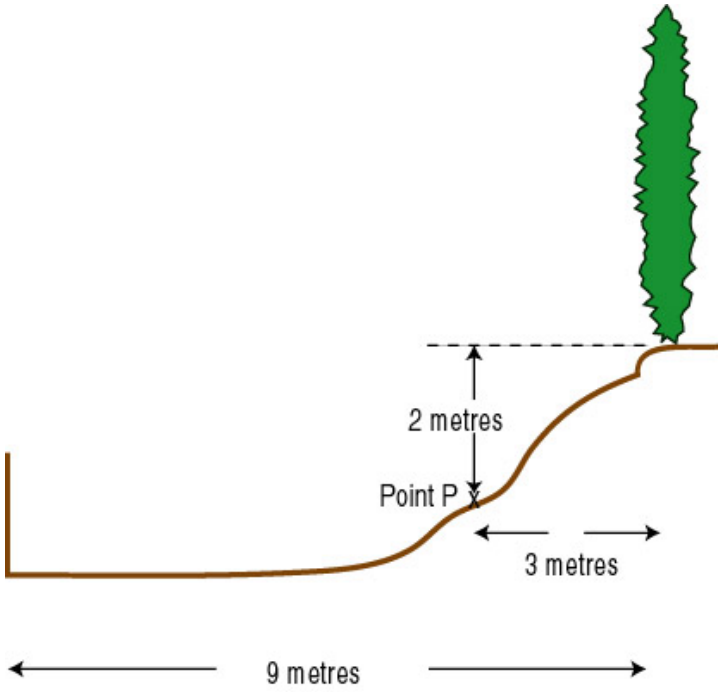

Figure 14. A hedge in a sloping garden.

5. OTHER ISSUES

5.1 Privacy

People like to have privacy inside their homes and gardens. Various types of privacy can be identified (ref 6), but visual privacy is the most relevant here.

Some local authorities use privacy distances here. Design guides (ref 7) suggest distances up to 35 metres or more (Figure 15). These can act as a major constraint on layout design.

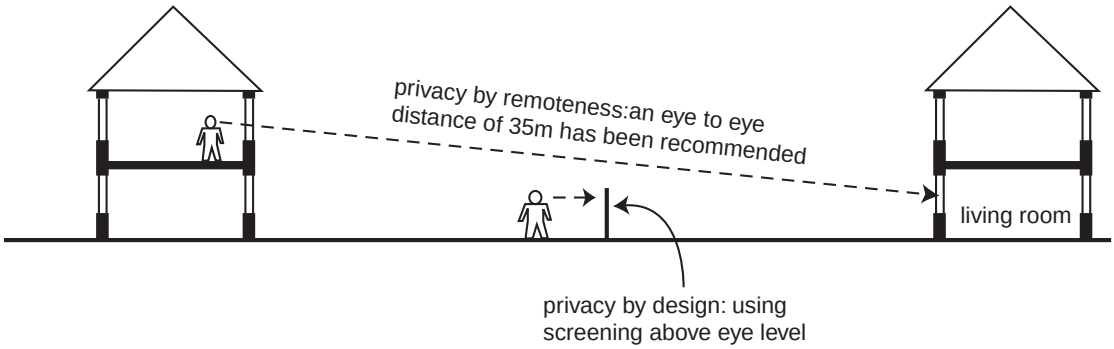

Figure 15. Achieving privacy

Distance helps promote visual privacy but does not guarantee it. An early study (ref 8) suggests complete visual privacy indoors is only achieved at distances of 90

metres or more. For outdoor activities like sunbathing the required distances will be even greater.

External screens such as hedges can therefore enhance privacy. On a level site a basic height of 2 metres will usually provide privacy from ground floor to ground floor and from garden to garden. 3.5-4 metres is usually enough to prevent overlooking from first floor to ground floor or garden, although this depends on whether the hedge is an equal distance from both properties. 5-5.5 metres is required to stop a view from first floor to first floor.

In general, the first level of privacy, with a 2 metre high screen, is what could reasonably be expected in urban and suburban areas.

An exception could arise where there is inequality of overlooking. Planning authorities sometimes use this concept. It can arise where one of the gardens is steeply terraced, or the neighbour has a balcony or roof garden and the hedge owner does not. In these special cases a higher hedge height might be justified to prevent overlooking.

Where external protection cannot provide visual privacy, windows may need to be screened in some way, usually with blinds or curtains.

5.2 Wind shelter

A hedge can be an effective windbreak. The area of land that is protected by the hedge will depend on its height.

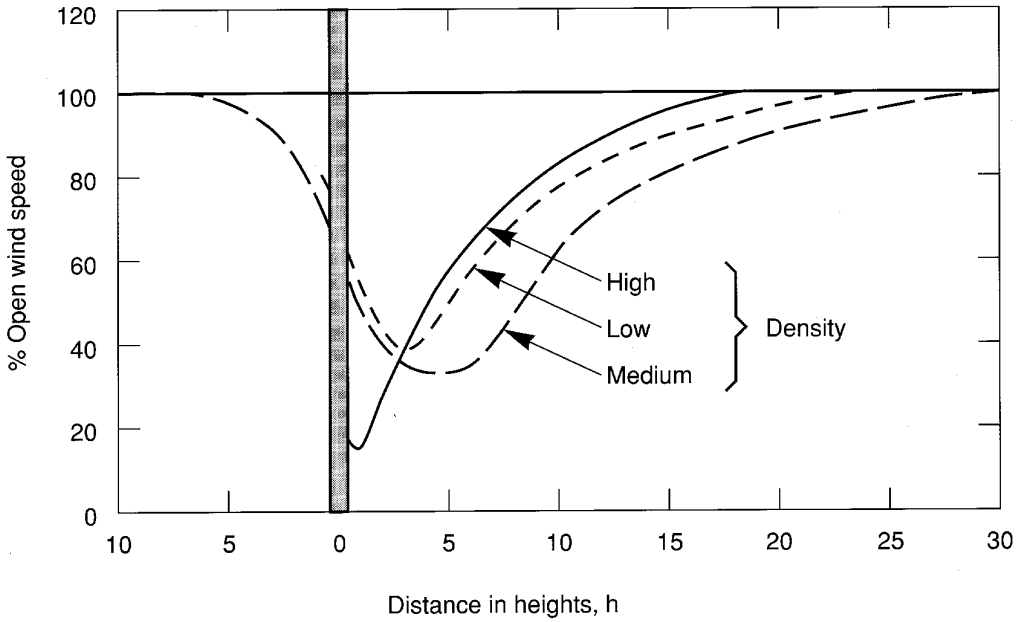

Figure 16. Wind speed reduction near shelterbelts with different densities. Data from Oke (ref 9). A hedge corresponds to a medium density obstruction.

Figure 16 shows that a hedge provides good shelter from the wind for a distance up to 8-10 times its height. According to the guidance in sections 4.2 and 4.3, the garden depth will typically be 1-3 times the action hedge height. So a hedge of this height ought to provide good shelter throughout a garden of this size.

The only problems could occur if the hedge owner's garden is much larger than the neighbour's. A hedge of reduced height might not offer wind protection to the whole of the large garden. However in this case the hedge owner could plant additional trees and shrubs in his or her own garden to provide extra wind shelter.

5.3 Noise

Protection from noisy neighbours has been cited as a benefit by hedge owners. However, measurements have shown that this is largely psychological. Normal hedges are acoustically porous. It is possible to design a hedge as an acoustic screen, usually incorporating a special type of fence as well as planting. However, this is relatively rare.

5.4 Spread of pollutants

Hedge owners also sometimes claim that their hedges stop smells and smoke coming from neighbours. However hedges are largely ineffective in this respect. Airborne pollutants can easily make their way over or through a hedge. An exception could be large particulate matter such as sawdust or paint shavings.

6. CONCLUSIONS

BRE has developed detailed guidance on hedge height and light loss. The guidance includes a method to calculate the action hedge height, above which a hedge will block too much light.

For windows in dwellings, the method is based on earlier guidance by BRE (ref 5) on obstruction by buildings. However it has been simplified and adapted for use with hedges. The method concentrates on safeguarding diffuse light on cloudy days; in most cases this will also ensure enough sunlight enters a room.

For gardens a new technique has been developed. This involves multiplying the depth of the garden by a factor which depends on the orientation of the hedge, to get the action hedge height. The method can cope with non-rectangular gardens, gardens that are sloping or stepped, and cases where the hedge is set back from the garden boundary.

The guidance has been tested and refined through consultation and a series of site visits to real hedges.

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