

# Flood Defence Levels of Service - Stage 2

Annex B: Land Use Assessment

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R&D Note 127



**NRA**

*National Rivers Authority*

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## **1. INTRODUCTION**

This Annex is one of five Annexes which, together, provide a description of a method for applying a flood defence levels of service strategy. The overall system is described in the main report, which contains references to the other Annexes where appropriate.

This particular Annex deals with the method for assessing land use within areas at risk from flooding and how these might be categorised in a manner which facilitates the setting of appropriate target levels of service for flood defence.

## 2. KEY PRINCIPLES

A number of key principles have guided the development of land use assessment techniques.

- (i) The actual land use should be the fundamental basis rather than potential. This view has been taken because it is less subjective to record what uses are actually present, as opposed to making predictions about what might evolve under certain conditions. It is also assumed that the NRA's role is to mainly provide flood defence in response to changes rather than to create conditions which may lead to change (ie: to avoid disbenefits rather than create benefits).
- (ii) It is not inappropriate to have regard for the generality of land use in an area at risk rather than specific features within it. In effect, this means that targets should not be set for individual properties as a matter of course. This is not a major shift from current practice where applying standards for specific types of property are subject to the outcome of benefit:cost analysis.
- (iii) The levels of service are limited to flood defence only. In some cases it is recognised that conservation, fisheries, navigation etc may all influence the level of flood defence service provision. However, it is considered that generally, these factors influence how a particular level of service is achieved, not what level of service should be achieved.
- (iv) Only land use factors which are significantly affected financially by flooding are to be considered.
- (v) The level of detail should not be so great as to impose unreasonable demands on resources for data collection and is appropriate to the ultimate use of the data.
- (vi) Procedures to be used should allow objective and consistent methods to be applied across the ten regional components of the NRA.

### 3. FACTORS TO BE INCLUDED

A wide range of land uses and other features occur within the areas at risk from flooding and it is appropriate to consider which ones should and should not be included in a process which helps determine what LOS to apply. In reaching this decision, the significance of flooding in financial terms has been the guiding principle, together with the realities of what features are commonly found in these areas.

The factors included are:

- Property
  - Houses
  - Gardens
  - Non-residential properties
- Roads and Railways
  - Railways
  - 'C' Roads
  - 'B' Roads
  - 'A' Roads
  - Motorways
- Agriculture
- Amenity
  - Parks
  - Golf Courses
  - Playing Fields
  - Special Parks

There is likely to be little debate on the inclusion of the first three general categories. Within these categories, the inclusion of gardens could be challenged. The consultants believe that many members of the public consider the flooding of their garden as flooding of their premises, despite the limited financial damage incurred. It may be appropriate to recognise this by applying an intangible value to the cost of damage to a flooded garden. This approach has been adopted, and therefore its inclusion is recommended.

Amenity use of areas at risk from flooding, particularly in urban areas but increasingly in rural areas also, leads to the proposed inclusion of amenity interests. Only those adversely affected by flooding are included. Watersports and fishing are excluded. Although there may be some arguments in favour of their inclusion, the difficulty of recording the level of activity is considered sufficient to justify their rejection. The loss of informal recreation, such as riverside walks, is not sufficient to justify their inclusion; in fact there may be some positive effects with people emerging to see 'a big flood'.

Table B.1 House Equivalents for Customers Interests  
- NRA Thames Approach

Land Use Factor	Unit	House Equivalents HE/Unit
House	Total Number	1.0
Garden/Allotments	Total Number	0.2
NRP - Distribution	Total Number	40.2
NRP - Manufacturing	Total Number	64.6
NRP - Other	Total Number	5.3
C Roads	Total Number	2.4
B Roads	Total Number	5.7
A Roads (Non Trunk)	Total Number	14.3
A Roads (Trunk)	Total Number	28.6
M. Way	Total Number	57.3
Railway	Total Number	57.3
Forestry and Scrub	100 Ha	0
Extensive Pasture	100 Ha	1.3
Intensive Pasture	100 Ha	3.0
Extensive Arable	100 Ha	6.9
Intensive Arable	100 Ha	40.2
Formal Parks	Total Number	0.6
Golf Courses	Total Number	0.6
Playing Fields	Total Number	0.1
Special Parks	Total Number	8.5

## **4. METHODS OF ASSESSMENT**

### **4.1 INTRODUCTION**

Two methods have been proposed as appropriate for assessing current land use and thus guiding the application of target levels of service for particular lengths of river and coastline. The two methods proposed are as developed by Laurence Gould Consultants in association with NRA Thames Region and as developed by NRA Anglian Region, to implement the findings in the W.A.A report of the land drainage levels of service working group.

This Annex will compare the two techniques by highlighting particular situations that have arisen in the study, identifying any problems and where possible identifying the solutions. Full results of the land use assessment for the most appropriate technique will be given.

Reach definition in both methods is very similar and will not be commented on in this Annex. For the purposes of comparison the reach definition technique as described in Annex A will be used as it adapts readily to both methods. Adaptations which follow on from selection of the most appropriate assessment method are highlighted in the main report which details fully the techniques for reach definition.

### **4.2 EXPLANATION OF TECHNIQUES**

Both techniques consider the presence, within the area at risk from flooding, of the same broad types of customer interests. These are:

- properties;
- road and rail links;
- agricultural land use;
- amenity interests.

The two techniques however differ in the way they apply these divisions to the classification of land use in areas at risk from flooding.

The method applied by NRA Thames ascribes a weighted value to each incidence of the particular customer interest in the area at risk of flooding in a defined reach. The weighted values of the interests are expressed in terms of a House Equivalent (HE), one house equivalent being the average damage to an average house when flooded.

Weighted averages of damage data for the range of customer interests assessed have been calculated from Middlesex Polytechnic Flood Hazard Research Centre (MPFHRC) data. This gives the relative values for the various customer interests as shown in Table B.1 opposite.

Table B.2.

Assessment Summary Sheet

Assessor's Name .....

River Name .....

River Number .....

LOS Reach Number,  
(specify left or  
right bank) .....

Catchment Number .....

Regional Identifier (NRA .....  
region, responsible office) .....

Landranger Map Number .....

Floodplain extent Map Number .....

From .....  
(Downstream,  
Name & Grid  
reference)To .....  
(Upstream, Name &  
Grid reference) .....Agricultural  
Floodplain Area (Ha) .....

Reach length (km) .....

Effective Reach  
length (km) .....


Land Use Factor	Unit	Number (x)	House Equivalents HE/Unit (y)	Total HE (x x y)
House	Total Number		1.0	
Garden/Allotments	Total Number		0.2	
NRP - Distribution	Total Number		40.2	
NRP - Manufacturing	Total Number		64.6	
NRP - Other	Total Number		5.3	
C Roads	Total Number		2.4	
B Roads	Total Number		5.7	
A Roads (Non Trunk)	Total Number		14.3	
A Roads (Trunk)	Total Number		28.6	
M. Way	Total Number		57.3	
Railway	Total Number		57.3	
Forestry and Scrub	100 Ha		0	
Extensive Pasture	100 Ha		1.3	
Intensive Pasture	100 Ha		3.0	
Extensive Arable	100 Ha		6.9	
Intensive Arable	100 Ha		40.2	
Formal Parks	Total Number		0.6	
Golf Courses	Total Number		0.6	
Playing Fields	Total Number		0.1	
Special Parks	Total Number		8.5	
Total HE (a)				
Effective Reach Length (b)				
HE/Km (a ÷ b)				



The incidence in a given floodplain area of the factors is identified by site visits and the total incidence of HEs in any reach is calculated. To compare reaches of different length the total HEs in any reach is expressed in terms of HE/km with simple division by reach length (km). The summary sheet completed for the land use of each reach is included as Table B.2 opposite. River reaches of similar land use can be expected to have similar HE scores per km. Five broad land use bands have been identified ranging from land use band A, highly urbanised areas, to band E - very rural areas with lower grade agricultural land. A sixth category X has also been identified for those areas where no floodplain is defined.

The range of HEs/km thought appropriate for the land use bands by NRA Thames is included in Table B.3 below.

**Table B.3 NRA Thames Range of HE's per km by Land Use Band**

Land Use Band	Broad Description	Range of HE's/Km as used by NRA Thames region for both banks together	Range of HE's/Km for one bank only
A	Urban	100.01 and over	50+
B		50.01 - 100	25.01 - 50
C		10.01 - 50	5.01 - 25
D		2.51 - 10	1.25 - 5
E	Rural	0.01 - 2.5	0.01 - 1.25
Category X	No flood plain recorded	0	0

In contrast the W.A.A method is a more desk based exercise, with only limited site visits, in which areas of similar land use within a reach are divided into parcels. This approach relies more on a descriptive means of assessing the particular land use band to ascribe similar uses.

The broad descriptions of land use by band are:

band A Areas of dense conurbations where widespread flooding would cause serious infrastructure failure and endanger life. Major trunk roads, motorways, railways.

- band B Predominantly urban areas, including housing, industry and commerce. Little agricultural land is likely to be present. 'A' and 'B' roads.
- band C High grade agricultural land suitable for cereal and cash crops. Residential and industrial property, as well as roads, amenity or navigation interests may also be prominent.
- band D Typical land use incorporating average gross margin crops and permanent pasture. Little residential or industrial property will be present. Conservation and water ecology interests may significantly influence the standard of service to be applied.
- band E This covers areas which are generally of low grade land use. Residential or industrial property is unlikely to be present. Agricultural use is likely to be limited to horse paddocks, forestry and scrubby grazing land. Land within this category may have a high conservation value requiring a lower standard of service than would be expected otherwise. Flood storage washlands or land which is deliberately allowed to flood may fall into this band.

Additional guidance is also suggested for classification of some items. For agricultural land Ministry of Agriculture, Fisheries and Food Agricultural Land Classification maps are used to allocate agricultural land as follows:

MAFF Grade	LOS Band
i	C
ii	C
iii	D
iv	D
v	E

One hectare is suggested as the minimum consideration of a land use type.

When the consultants attempted to apply this method some additional rules had to be developed to assist classification of land use type. Amenity interests such as parks, golf courses and sports pitches were assigned to land use band C. There was also practical difficulty in distinguishing the appropriate land use band for properties, this is discussed in greater detail in a later section of this document.

#### 4.3 COMPARISON OF TECHNIQUES

The following examples highlight the differences between the two techniques in their recording of different situations that are encountered. Solutions to problems due to inadequacies of a particular technique are identified if possible, however in some cases this was not possible and the deficiencies of the particular technique remain. These examples serve to highlight the reasons for the consultants choice of recommended technique for land use assessments.

Figure B.1. Illustration of Floodplain of R. Waveney near Bungay.

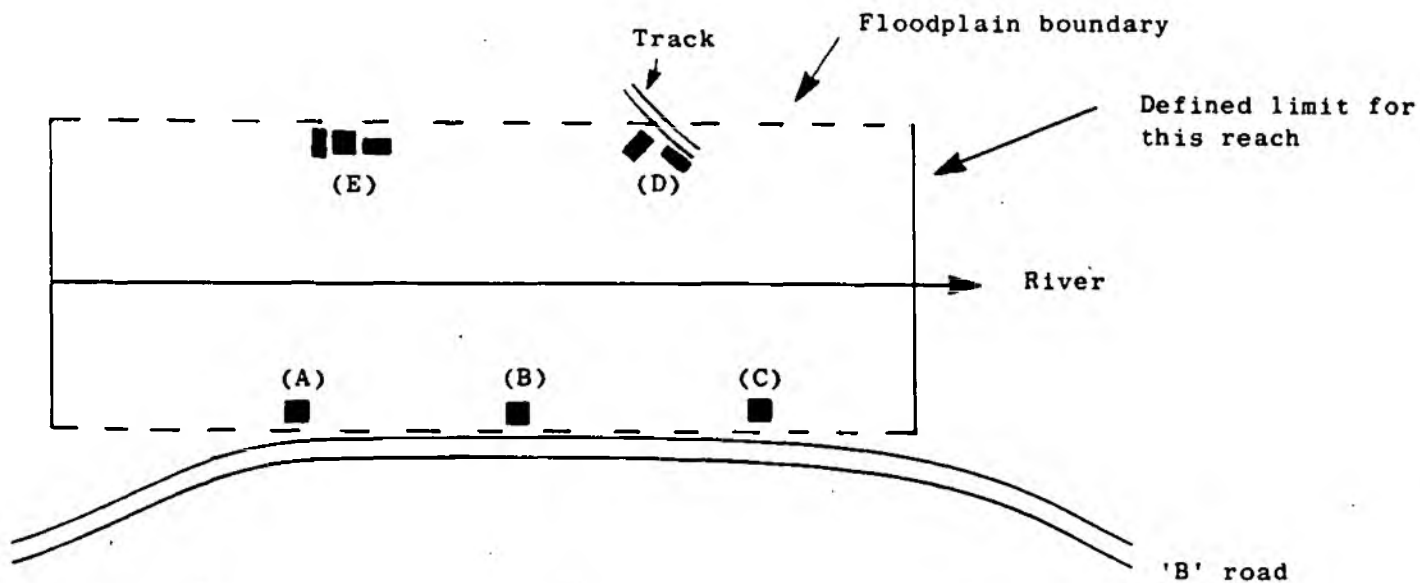
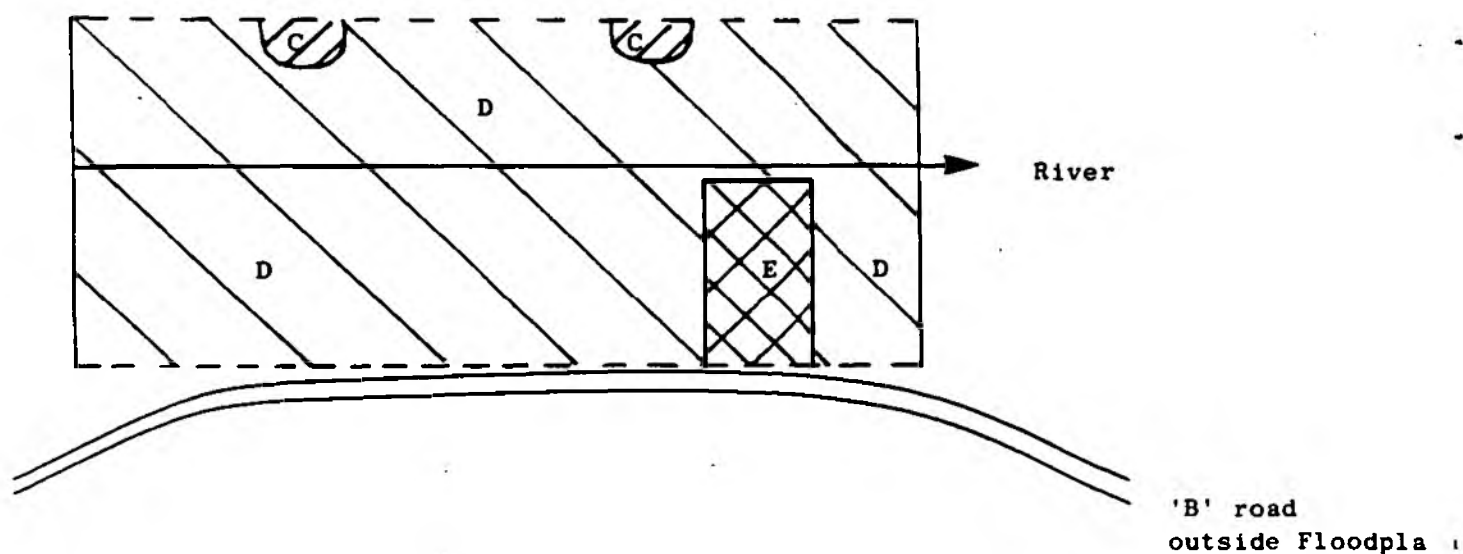


Figure B.2. Land use band classification using the W.A.A. method for the situation shown in Figure B.1.



#### 4.3.1 Inclusion of all Relevant Interests

One hectare has been taken as the minimum area for consideration of a separate land use type in the W.A.A. method. In this way the NRA avoids the need to provide flood defence for all individual interests to the standard deemed suitable for that interest. By contrast the Thames method records the separate incidence of each interest, no matter its size, accumulating the scores within a given reach, and thus identifying the standard of flood defence to protect the average level of interests.

In the more rural areas the one hectare criteria could result in a significant number of interests being ignored when identifying the current land use. For example on the River Waveney upstream of Bungay the situation illustrated by Figure B.1 opposite exists.

By application of the one hectare minimum area requirement none of the properties indicated on the map at locations (A), (B) and (C) are included. Groups of properties located at (D) and (E) satisfy the one hectare requirement and are included as areas of land use Band C. The remaining land is classified according to agricultural land classification. Figure B2 opposite illustrates the land use band map produced by the W.A.A. method.

The Thames method however takes into account all those factors which are present in the floodplain no matter what the area they occupy and produces the following results:

			HEs
Left Bank	Property at (D)	1 house and garden and non residential property (NRP) other	6.5
	Property at (E)	4 houses and gardens plus NRP distribution	45.0
	Agricultural Land	150 ha of extensive pasture	1.95
		<b>TOTAL</b>	<b>53.45</b>

If we assume the reach is the average length of 5.5km then  $HE/km = 53.45$  divided by  $5.5 = 9.7$  HE/km which equates using NRA Thames bands to land use band C.

Similarly for the right bank:

Property at (A)	1 house and garden plus NRP (other)	6.5
(B)	1 house and garden plus NRP (other)	6.5
(C)	1 house and garden plus NRP (other)	6.5
Agricultural land	150ha extensive pasture	1.95
	<b>TOTAL</b>	<b>21.45</b>

$21.45$  divided by  $5.5 = 3.9$  HE/km = land use band D.

Figure B3

## Agricultural land use classification.

## Thames Approach

R. Waveney @ Billingham  
NRA Anglian

## Example 1.

110 Ha of Extensive Pasture

$1.1 \times 1.3 = 1.43$  HE's.

over 6.7 km = 0.21

Land use band E

## Modified W.A.A Approach

R. Waveney @ Billingham  
NRA Anglian

MAFF Classification (iv)

= Land Use Band band D

## Example 2.

River Yeo - NRA Wessex

350 Ha of Intensive  
Pasture

=  $3.5 \times 3.0 = 10.5$  HE's

Over 5.8 km = 1.8 HE/KM

= Land Use band D

River Yeo - NRA Wessex

MAFF Classification (iv)

= Land Use band D

Use of a lower cut off point, say half of one hectare, as the minimum would mean some of the larger farmsteads being included and an area of separate land use band being delineated. However this starts to cause problems in measuring the size of farmsteads on 1:25,000 scale. Use of 1:10,000 scale maps would make this measuring easier but begins to introduce spurious accuracy in measuring building areas to the very last square metre.

Indeed the area of a building is only one component in determining the damage resulting from flooding of that building, of more importance is the use of that building and the potential loss of stocks, working materials or production. Non distinction between types of property is discussed more fully later in this section.

#### 4.3.2 Accuracy of Assessing Agricultural Land Use

There are two aspects in assessing agricultural land use in areas at risk from flooding. Firstly, the nature of the use, ie: type of cropping and secondly the physical area of agricultural land that is at risk from flooding and thus the potential scale of the damage.

The methodology used by the NRA Thames approach is to carry out a visual assessment of the cropping in the floodplain and identify the predominant current land use. Provision of flood defence to agricultural land is not field specific and so it is unnecessary to know what the cropping in every field is. This itself would be an almost impossible task requiring annual updating due to the often rotational nature of cropping in any one field.

The average damage to a particular class of agricultural cropping when flooded has been calculated and is expressed in HEs for each 100 hectares of such land in a reach. The agricultural HEs at risk from flooding can thus be calculated for each reach and combined with scores for the other interests to give an overall measure of the damage likely to occur in that reach when flooded.

Under the Thames method the contribution to the land use band designation made by agriculture is both dependent on the particular cropping and on the area of land that is at risk.

The W.A.A approach involves definition of agricultural land use band by individuals broadly familiar with the area under consideration with reference to the MAFF land classification. Figure B.3, illustrates the two methods and highlight the limitations of not accounting for area. The examples chosen are from the River Waveney upstream at Billingford and from some earlier study work on the River Yeo for NRA Wessex region.

The W.A.A. method works relatively well for reaches where the area of land at risk from flooding is relatively constant with cropping being the only variable. This is inappropriate in the national context where areas at risk of flooding in any reach range from 10's to 100's of hectares. A system taking note of both cropping type and area is more appropriate.

Table B.4

Examples of the Crop Types Within the Agriculture Classification

No Agricultural Use i.e. discount from this section	Forestry and Scrub	Extensive Pasture *	Intensive Pasture *	Extensive Arable	Intensive Arable
Housing	Woodland	Permanent grassland	Improved grassland	Crops cut by combine harvester	High value crops
Leisure/recreation	Commercial forestry	Used for extensive grazing of beef, sheep and horses	Cut for hay or silage	- wheat - barley - oats - peas - beans - oilseed rape - linseed	- potatoes - sugar beet - soft fruit - vegetables - market garden - turf - horticultural crops - nursery crops - vines
Conservation	Scrubby ground such as heathland, gorse	Generally unimproved by draining or reseeding	Possibly drained  Possibly reseeded within last 5 years		
Commercial Properties	Unmanaged agricultural ground	Agro-forestry	Grazing by dairy cows		
Allotments	Coppiced trees  Top Fruit		Forage crops e.g. kale, stubble turnips, rye maize etc.		

\*Note - These should be used as indications only. Dairy cows grazing does not necessarily mean the grass is intensive pasture. Similarly sheep grazing does not necessarily mean extensive pasture.

### 4.3.3 Methods for Gathering Agricultural Information

Differing techniques are used to classify agricultural land. The Thames approach relies on visual observation of current land use to identify the predominant use in a particular reach. Such an approach requires the surveyor to have some agricultural knowledge to apply the identification guides in Table 4 opposite. The alternative approach requires individuals familiar with the area to decide in conjunction with MAFF agricultural land classification maps, the existing land use. The deficiencies of modified W.A.A. method in so far as not accounting for the area of agricultural land have been explained, however there is merit in investigating whether this map approach can accurately identify cropping type thus reducing the need for on site survey.

Comparison of land grades shown on the map with observed cropping patterns highlights various problems associated with using the maps.

Firstly the land grades are based on the potential cropping for a particular area taking into account, soil type, topographical details and climate conditions. However actual land use varies with economic conditions, nature of the farming business and other local factors. There were found to be close agreement between MAFF land grades and observed land use for land grades 4 and 5 equating to extensive pasture and forestry or scrub respectively. However, as land grade improved through 3, 2 and 1 the correlation between actual land use and land grade was very variable. Grades 2 and 3 for instance could be cropped with intensive grass or may be arable, there was no clear distinction. Grades 1 or 2 could have intensive arable crops but again the precise level varied greatly.

In addition the use of potential land use to determine flood defence levels of service is contrary to the NRA's current moves to discourage development in areas at risk from flooding. Adoption of flood defence levels of service set from potential land use would involve considerable resource requirements to provide high standards of protection for areas that may currently be poor scrubland or low grade agriculture. Similarly providing protection to agricultural land based on its potential use is inappropriate in the current economic climate of agricultural surplus and moves to limit production.

Secondly the level of detail available on the land grade maps makes it inappropriate to assume that relatively narrow risk areas are necessarily of the land grade indicated on the map. Notes with the map indicate that where characteristics vary over a relatively short distance an average grade has been assumed. Such a situation is likely to have been encountered across the narrower river valleys. In addition areas of less than 80 hectares have not been separately delineated.

The modified W.A.A. approach requires individuals to remember current land use in flood risk areas from some earlier visit. Individuals will inevitably be more familiar with some areas than others and are also unlikely to remember the more subtle differences between intensity of pasture use and proportion of extensive arable cultivations.



Table B.5 Effect of Increased Agricultural Scores on Total HE/km

	Current Values HE/Km Band		+ 50% increase HE/Km Band		+ 100% increase HE/Km Band		+ 200% increase HE/Km Band		+ 400% increase HE/Km Band	
Reach 1 left	3.4	D	3.47	D	3.53	D	3.66	D	3.9	D
1 right	2.3	D	2.37	D	2.42	D	2.51	D	2.7	D
2 left	0.42	E	0.47	E	0.53	E	0.65	E	0.88	E
2 right	0.08	E	0.11	E	0.15	E	0.23	E	0.38	E

#### 4.3.4 Identification of Cropping Type

On several occasions in both this study and in earlier LOS pilot studies undertaken by the consultants, NRA personnel have stressed the need to take account of local social factors when assessing the damage consequent on agricultural flooding. This is particularly the case in the more upland areas where the terrain is relatively steep except for the floor of the river valleys. It has been suggested that the viability of the whole holding depends on the relatively small proportion of the holding which is found in these flatter areas and that just assessing the area at risk from flooding will under value the damage consequent on flooding of this area. On a strictly local basis there is some justification for modifying the value used for such agricultural land. However in the consultants experience the values have to be adjusted very considerably before there is any significant change to the calculated land use band. Table B.5 opposite shows various changes in the house equivalent for the agricultural land and its effect on land use banding for reaches 1 and 2 of the River Elwy in Wales. In only a minority of cases will there be any change in land use banding as a result of increasing HEs for agricultural land. Relative changes between the scores for reaches within a land use band may however be of importance locally when attempting to programme and prioritise river or coast works though again this is likely to be on a very limited number of reaches. Changes to HE scores are therefore not recommended.

#### 4.3.5 Accuracy of Assessing Types and Intensity of Property

In broad descriptive terms it is possible to define the nature of properties within each of the land use band as follows:

**Table B.6 General Property Description for Various Land Use Bands**

Land Use Band	Summary description for properties
A	Dense Conurbations
B	Principally Urban Areas
C	Limited numbers of property, eg rural communities or urban fringe
D	Isolated, but limited numbers of property
E	Properties unlikely to be present.
Category X	No flood risk area identified.

Trying to classify urban land use into bands using these descriptions on their own is particularly difficult. The extremes such as dense conurbation are readily identifiable however making the distinction between a principally urban area and a dense conurbation is more difficult.

The Thames assessment method attempts to overcome such problems by scoring the incidence of particular types of property, relating this to an average damage when flooded. The accumulated score is added to scores from other interests and this identifies the land use band for the reach as a whole.

The W.A.A. report however indicates that by appropriate choice of parcels of land, the majority of areas can be assigned to a land use band by inspection. As indicated above this can be particularly difficult. For example the most urbanised area within the pilot study was the land around the River Spen in Yorkshire region. The river flows through the outskirts of Dewsbury, through Heckmondwike and Liversidge and along the edge of Checkheaton. Whilst the area surrounding the flood risk area has the appearance of dense conurbation the flood risk area itself is relatively open. There are a large number of properties present, both residential and commercial, but these are interspersed with significant areas of amenity use, parks, pitches etc and areas of scrubland and poor agricultural use. With this type of situation, the categorisation between land use bands A, B or C is open to subjectivity. To overcome this the W.A.A. report suggests a number of scoring systems. Their application in the method suggested is considered inappropriate for classification of land use for a number of reasons:

- i) They should not just be applied to areas where there is perceived to be doubt over classification as this introduces a subjective element into deciding where there is or is not doubt.
- ii) The methods proposed make no distinction between the types of non residential property that may be found MPFHRC data indicates that a large variation in damage occurs between the different types of property that may be found within flood prone areas.

Further, the scoring systems are only appropriate when making an assessment of comparable units of land, ie reaches of similar length. The W.A.A. approach seeks on occasions to separately classify parcels of land within each reach, this poses a number of problems. Not only when should a particular area be separately classified from its surrounding land use, ie qualitative distinctions, but how big or small should this area be, a quantitative distinction.

In extreme cases this may lead the NRA region to protection of individual properties.

The Thames methodology overcomes this problem by scoring all interests over a length of river rather than their particular density of distribution within a reach. To an extent this means an averaging of interests suffering high degrees of damage with those affected to a lower degree but does ensure that all interests contribute cumulatively to the land use band classification and thus the average standard of protection. It also ensures that the region is not committed to protecting each individual interests to an absolute standard.

#### 4.4 SPECIFIC ADVANTAGES OF THE THAMES METHOD

The modified W.A.A. method developed by Anglian region has been chosen to keep the resource input as low as possible. It is therefore principally a desk based map exercise undertaken by individuals familiar with the area, with only limited site visits. The Thames method by contrast involves site visits to more specifically identify interests within the areas at risk from flooding. Both approaches incorporate varying degrees of precision and accuracy. The modified W.A.A. method is very precise in attempting to classify land use banding for small parcels of land within a reach. By contrast the Thames method accepts a degree of imprecision by classifying land use on the basis of the reach as a whole. The Thames method is more accurate being based on actual land use recorded by site visits whereas the modified W.A.A. method is less accurate being reliant on maps and knowledge of individuals familiar with the area. To overcome this inaccuracy of the W.A.A. method it is suggested approximately 20% of the area be validated by survey.

This however can lead to more inconsistency than if no cross checking were carried out. It is likely that some errors and inconsistencies will be identified even in the limited cross referencing. For example floodplain areas may be marked incorrectly or there may be new development taking place. Such inconsistencies can be resolved and the data corrected for this cross checked area, however this data could now be inconsistent with the remaining 80%. This can be avoided by either not cross referencing any of the data or cross referencing it all. Under a strict W.A.A. approach it would probably be more appropriate not to cross check any of the data so that there was at least a commonality of inaccuracy. This is likely to mean that the assessment is not strictly based on current land use.

The Thames method involving site visits does offer several advantages.

Firstly, even relatively inexperienced surveyors with limited experience of flooding can identify inconsistencies in mapping of flood areas, highlighting those interests which may not in fact be at risk of flooding. Such areas can be checked with local flood defence staff.

Secondly, visual inspection of virtually all the area at risk from flooding can very accurately record the customer interests present with additional detail allowing a more comprehensive analysis to be undertaken.

Thirdly, visual inspection identifies the actual current land use rather than any perceived or historic record of land use shown on maps.

#### 4.5 CONCLUSION

The methodologies have been compared with reference to situations encountered in the pilot study areas as well as in the consultants earlier work for various NRA regions. Whilst it appears that most of the deficiencies encountered are with the modified W.A.A. method it must be noted that many of these problems are precisely the reason why the Thames method has developed to its present form. Several new situations have been encountered in the pilot study and various modifications to the land use assessment technique have been made.

In essence the land use assessment technique recommended by the consultants is that developed by them for Thames. This method combines both a qualitative and quantitative assessment of interests within a flood prone area compared with the W.A.A. method which is principally a qualitative assessment with a quantitative assessment of only a few selected items. The problems detailed earlier with the W.A.A. technique and how these have been overcome by the Thames method are summarised as follows.

#### 4.5.1 Precision and Accuracy

It is recognised that the levels of service system should provide a robust yet quick and simple assessment of current levels of service provision. The technique devised must recognise this and whilst being accurate in distinguishing between levels of service for different areas must balance the need for precision against the increased resource need to improve the level of precision.

The proposed W.A.A. method however attempts to be very precise in identifying the level of service to almost individual interests but loses accuracy in the compilation of the background data. By contrast the Thames method recognises the need for accuracy but maintains a degree of precision considered appropriate for the eventual use of the system by considering the level of service by reach not individual interest.

#### 4.5.2 Quantitative and Qualitative Assessment

The NRA regions are providing a flood defence level of service through provision of capital works, maintenance programmes and the operation of river structures. Under a limited budget it is important that money is spent where it is most needed, ie: where there is the greatest benefit to the nation. Such benefit depends not only on the quality of the interest at risk from flooding, but also the quantity of the interests that are present.

The Thames method accounts for all incidences of the various interests, no matter what area they cover and also recognises the difference in damage between different interests. In this way all interests are recorded qualitatively and quantitatively, although at the cost of greater resource input than the W.A.A. method.

The proposed W.A.A. method does not fully or accurately record the quantity. For agriculture the W.A.A. method only records quality with no allowance made for extent ie quantum of agricultural land use. Use of land classification and knowledge of individuals familiar with the area to identify land use is in addition moving away from assessing service requirement on the basis of current land use. For urban interests such as properties, neither the quality of the interest nor the quantity of the interests are fully assessed in the W.A.A. method. Scoring systems, such as counting numbers of properties could be used to introduce a quantitative element with recognition of the differing damage levels for industrial as opposed to residential providing a qualitative input. Such scoring systems would be prone to variations in distribution of properties particularly as a minimum level must be used to avoid the need to protect all individual, isolated properties.

Figure B4 Method of classifying Floodplains which may be affected by more than one source.  
Example: Little Ouse River - NRA Anglian.

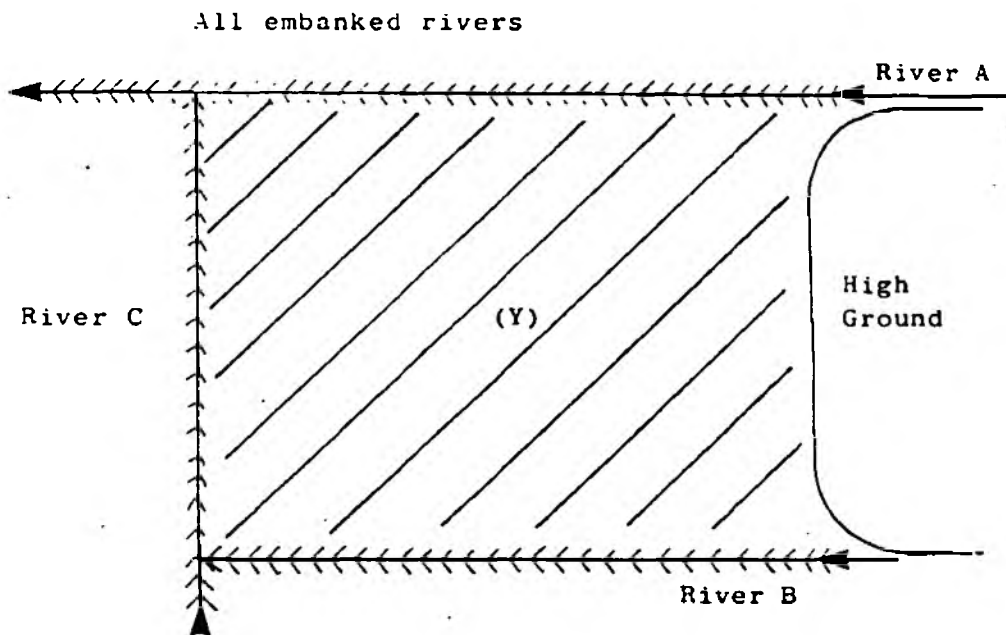
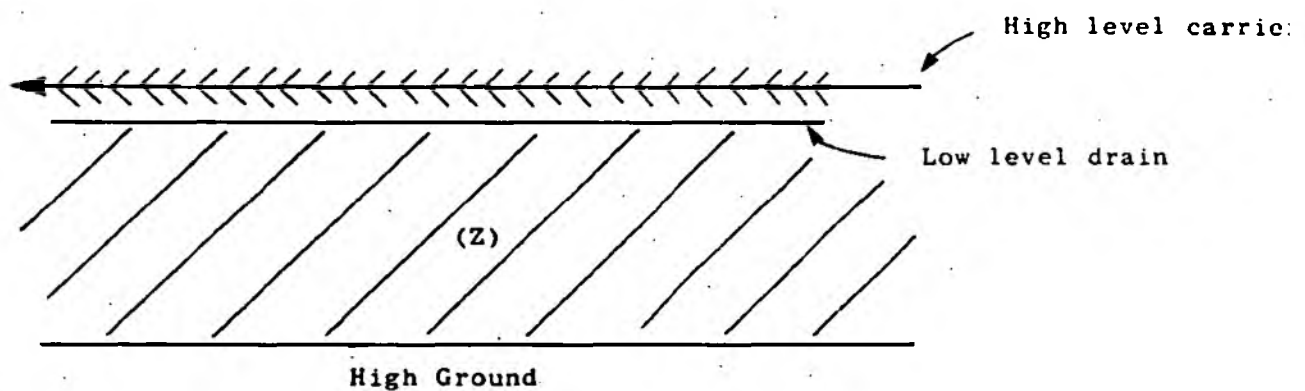
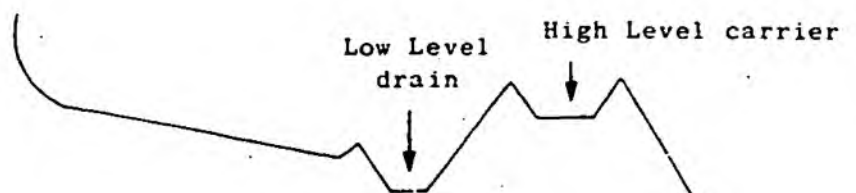


Figure B5 As above but example from Maltreath Marshes - NRA welsh.



Cross section of Maltreath Marsh



### 4.5.3 Current Land Use

With its reliance on a number of individuals to remember details of land use in different areas, the principally desk based W.A.A. method will be subject to greater variability of data than the Thames method. The recommended Thames method includes site visits to all properties present in the flood risk areas and an assessment of agricultural land use between such properties. The land use assessment can thus be based on a constant level of detail no matter where undertaken.

Full details of the recommended method and how it is applied to complete the land use assessment follow in Section 4.7 of this Annex. The results of applying this technique to the pilot study areas are summarised in Appendix B1. Some modifications to this which have become necessary as a result of new problems highlighted by the pilot areas are first detailed in the following Section 4.6.

### 4.6 MODIFICATION TO THAMES METHOD FOLLOWING APPLICATION OF TECHNIQUE TO PILOT AREAS

The pilot study included several areas which posed the same problem for the assessment techniques. Areas of land that could be affected by flooding from more than one river source. Figures B4 and B5 opposite illustrate this situation for the Little Ouse river and that encountered on the Maltreath Marshes.

This is in fact an extension of the situation encountered at confluences where an area could be affected by flooding from more than one source.

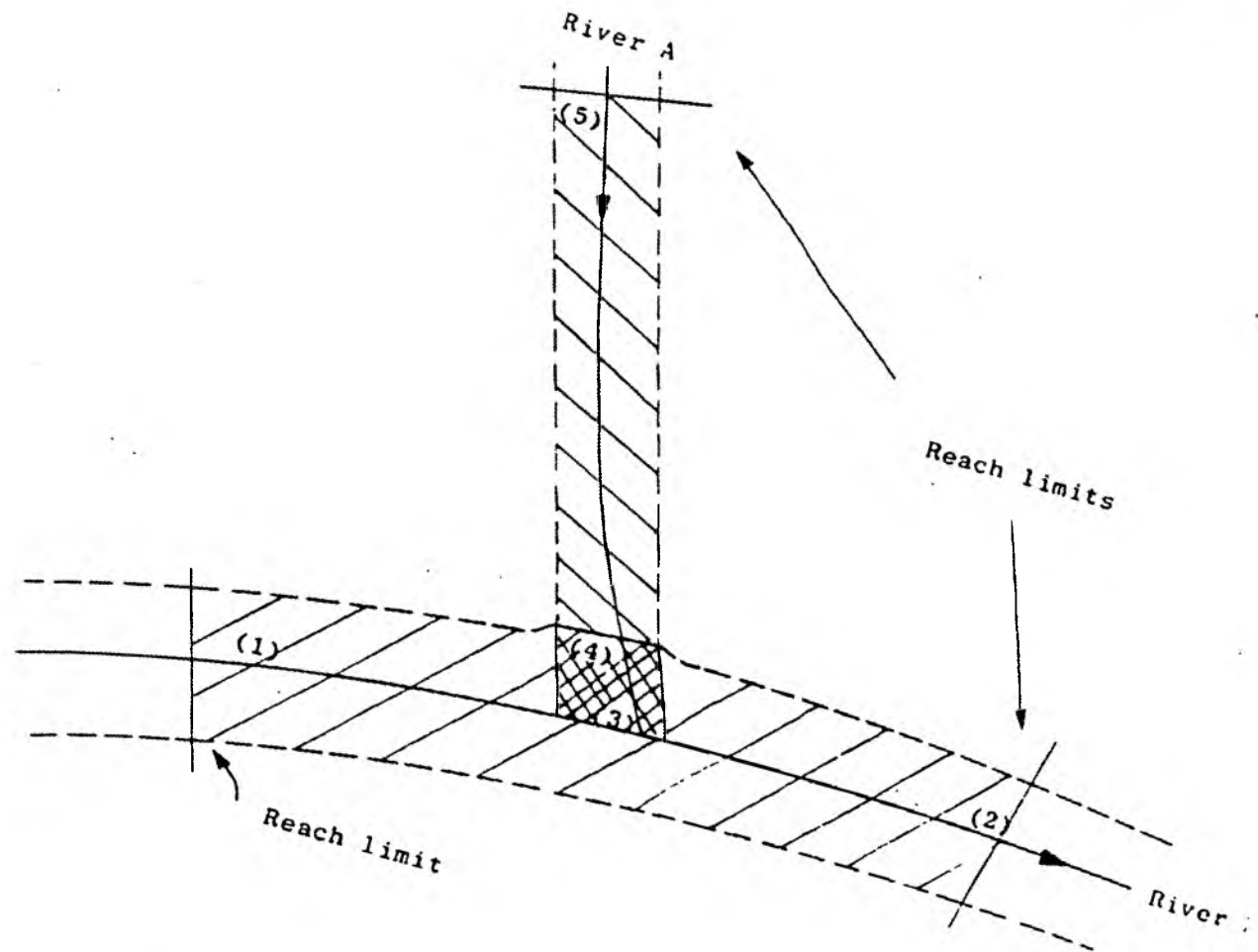
In its simplest form the approach is as follows. For Figure B.4 the land use in area Y is allocated to the assessment of each of the Rivers A, B and C assuming each could flood the whole area. So if there were interests totalling 120 House Equivalents in area Y and each of the reaches of rivers A, B and C for this area were 5km long then land use bands and targets would be as follows:

River	HE/km	Land Use Band	Target (for example only)
A	24	C	1 : 10 or better
B	24	C	1 : 10 or better
C	24	C	1 : 10 or better

So to protect the land in area Y to a standard appropriate for the interests present, rivers A, B and C must provide defence from flooding in events up to at least a 10 year return period. Such an approach assumes that flooding of all three rivers is coincidental. Without coincidence of flooding it would be possible that the rivers could have events exceeding the 1 in 10 year event out of synchronisation and thus provide only an approximate 1:3 1/3 year standard of protection from flooding to area Y.




Similarly for Figure B.5 interests in area Z would be allocated to both the low level drain and the high level carrier.

Figure B6 Assessment of areas at risk from Flooding - confluences.





Hydrologists at Halcrows agree with the theory of this approach and the independence or otherwise of rivers does have a bearing on the level of protection afforded by the particular banks. However the degree of independence in UK rivers is considered to be of little significance principally due to the size of catchments and normal weather patterns in the UK. For the purposes of the LOS system it is reasonable to assume that flooding at confluences and the situation highlighted in Figures B.4 and B.5 will be due to the combined effects of the two or more rivers and not due to one river alone.

The suggested approach in Figures B.4 and B.5 modifies the treatment of confluences that was used in the Thames method. In this old method a simple extrapolation of the floodplain of the major river was made to define which reaches the particular interests were allocated to. See Figure B.6 opposite. In Figure B.6 interests in the area  were included in the assessment of the reach on river B. Interests in the area shaded  would be allocated to the reach on river A and calculated to HE/km on the basis only of the river length between (4) and (5). To be consistent with the modifications required for the situation in Figure B.4 and B.5 and to ensure that the assessment is based on all interests that are affected by a stretch of river the area shown in Figure B.6  as is to be included in the land use assessment of both the reach on river A and the reach on river B. Whilst this appears to be a double counting of interests it is only single counting of interests against the lengths of river that could affect them. The method recommended refines this further with sub division of this overlap area between left and right banks as detailed in Annex A.

## 4.7 PROPOSED METHOD OF LAND USE ASSESSMENT

### 4.7.1 Introduction

The interests that are included in the assessment are those which on average suffer significant damage when flooded. Table B.1 indicated those proposed. Each of these interests suffers damage from flooding to a greater or lesser extent. To assess them on a common basis a unit known as the House Equivalent (HE) has been developed. This represents the average financial damage to the average house when flooded. Calculation of these figures from Middlesex Polytechnic Flood Hazard Research Centre (MPFHRC) data has taken into account the differing effects of duration and depth of flooding though for agriculture the effects of duration and timing are separately accounted for in the monitoring phase. All other interests have been assessed on a similar basis and expressed in terms of HEs. The full range of values for the interests assessed is indicated in Table B.2, with the units of assessment also detailed.

It was considered inappropriate to include environmental interests as part of the land use assessment rather they should be concerned with how a particular flood defence level of service is achieved rather than what level of service should be provided.

A blank copy of the land use assessment summary form is included as Appendix B.2. This will need to be completed for each bank of each LOS reach identified within a region using the additional guidance notes detailed at 4.7.2 below.

The effect of saline flooding is not reflected in calculation of land use bands; this is discussed in the scoring methodology detailed in Annex C.



The number of allotments should be counted. If exact numbers cannot be identified, a best approximation can be devised by dividing the area of allotments by 180 sq. metres. (The area of a standard scheduled allotment).

#### 4.7.2.3 Non Residential Property (NRP)

Not all NRPs within the area at risk are sufficiently important to be included in the assessment and their eligibility must firstly be assessed before they are allocated to a specific category. The list below indicates some qualifying and non qualifying structures.

Qualifying	Non Qualifying
Dutch barn (hay barn)	Redundant, dilapidated buildings
Livestock sheds	Tents and Marquees
Fully enclosed stables	Portaloos
Sheds/barns used for storage	Partially enclosed single stables
Electrical sub station	Concreted areas which are not curtilages
Water pumping station	or associated with other buildings
Airfields	Garden/allotment sheds
Car parks, where there is a fee payable	Garages for domestic use
	Small structures of less than 10 sq.m.

Where there is some doubt about a building's significance, the relative damage from a flood in comparison to the above can be used as a guide. For example an isolated stone barn used by stock only for shelter in poor weather cannot really be classed as a livestock shed but would fall under the remit of redundant buildings and be classed as ineligible.

Groups of buildings devoted to one business for example a group of farm buildings is combined as one NRP only. However a building used by a farm whose main set of buildings had been classed as one NRP would be included as a separate NRP if it was found in isolation, some distance from the controlling businesses centre of operation.

Properties whose curtilage only are at risk are included as one NRP, only if the area at risk is used as a storage area for goods or properties or is the main area for customer parking and there is no alternative available.

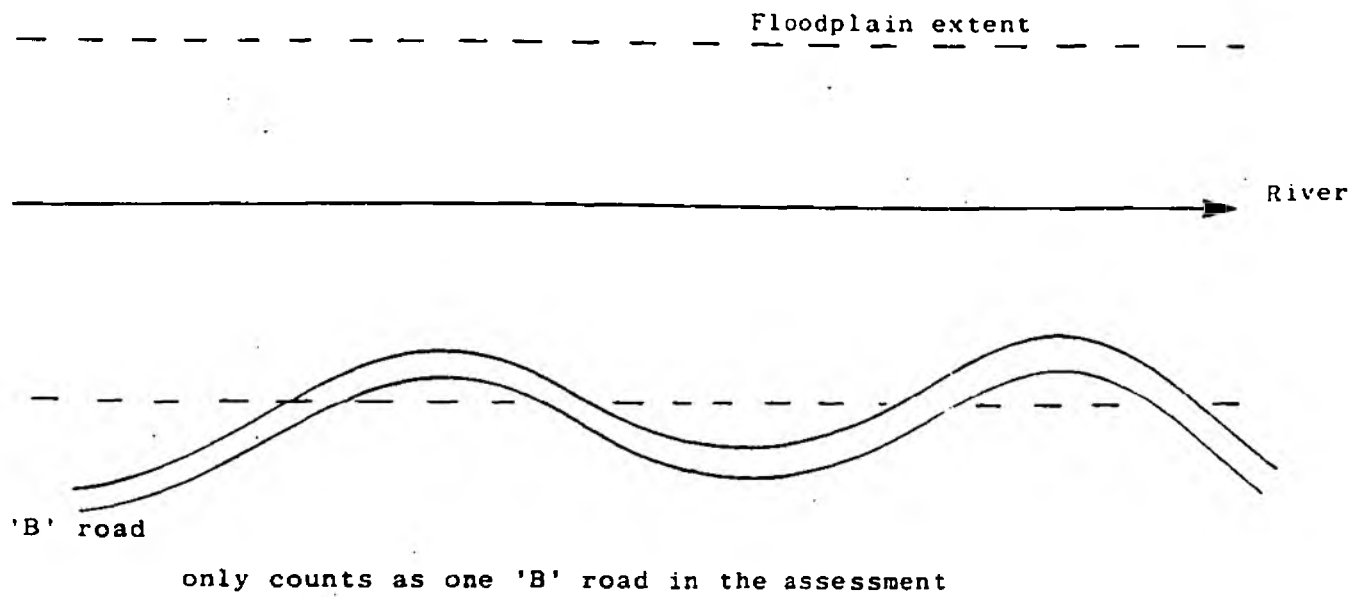
Where a building is used by an outdoor amenity, eg: boats for hire, sports clubhouse etc it is recorded as an NRP only if the building or clubhouse is at risk, it would not also be included as an amenity. If the clubhouse or associated building is outside the floodplain and the interest falls within the amenity category it is recorded as such.

Once a building has been identified as qualifying for inclusion in the assessment as an NRP, further classification is necessary into one of three categories:

- distribution;
- manufacturing;
- other (including retail) businesses.

Appendix B.3 lists the types of business in each category.

Figure B7      Note to classification of roads in the land use assessment.



#### 4.7.2.4 Roads and Railways

Road classification is as per ordnance survey 1:50,000 sheets. It should be noted that motorways and railways are normally raised above ground level and are therefore unlikely to suffer flooding. If they are marked on the maps as liable to flood then ground truthing or consultation with local NRA personnel will be required to confirm their inclusion or otherwise. Where a single road runs roughly parallel to the boundary of the flood risk area but is within it at several points it should only be counted once. See Figure B.7 opposite.

#### 4.7.2.5 Agriculture

Site visits are necessary to record the current predominant agricultural land use. It should not be necessary to visit every field within the area at risk, but at least half will need to be visited to identify the predominant cropping. In most cases the agricultural land can be rapidly assessed whilst driving between the various urban interests that need to be assessed.

The total area of agricultural land in any particular reach is measured from the maps. Computer graphics packages to assist in this measuring are available, alternatively a simple dot planimetre is sufficient. This area is then recorded against the crop identified as being predominant.

When it proves impossible to identify a predominant cropping type, the proportions of each type are recorded on the assessment summary sheets and the area of agricultural land split accordingly.

A predominant agricultural crop is assumed to be one covering at least 50% of the agricultural area in the area at risk from flooding in a particular reach.

It is unlikely that intensive arable crops will be predominant in this area, indeed because of rotational constraints they are unlikely to exceed 25% of the risk area. Where intensive crops comprise 10% or more of the land use within the area at risk of flooding in a reach, the intensive arable area should be recorded separately on the assessment summary form with the remaining land being assessed on the basis of predominant cropping. To distinguish between the types of agricultural land uses the notes in table B8 below are used in conjunction with the summary of likely crop types shown in table B4 repeated overleaf.

Table B.4

Examples of the Crop Types Within the Agriculture Classification

No Agricultural Use i.e. discount from this section	Forestry and Scrub	Extensive Pasture *	Intensive Pasture *	Extensive Arable	Intensive Arable
Housing	Woodland	Permanent grassland	Improved grassland	Crops cut by combine harvester	High value crops
Leisure/recreation	Commercial forestry	Used for extensive grazing of beef, sheep and horses	Cut for hay or silage	- wheat - barley - oats - peas - beans - oilseed rape - linseed	- potatoes - sugar beet - soft fruit - vegetables - market garden - turf - horticultural crops - nursery crops - vines
Conservation	Scrubby ground such as heathland, gorse	Generally unimproved by draining or reseeding	Possibly drained  Possibly reseeded within last 5 years		
Commercial Properties	Unmanaged agricultural ground	Agro-forestry	Grazing by dairy cows		
Allotments	Coppiced trees  Top Fruit		Forage crops e.g. kale, stubble turnips, rye maize etc.		

\*Note - These should be used as indications only. Dairy cows grazing does not necessarily mean the grass is intensive pasture. Similarly sheep grazing does not necessarily mean extensive pasture.

**Table B.8 : Explanatory Notes for Agricultural Land Classification**

**Forestry or Scrub:** Any types of trees should be considered as forestry. Scrub is intended to include derelict or vacant land not obviously used for any agricultural purpose.

**Extensive Pasture:** is generally permanent grassland, which is not improved by drainage or recent reseeded. The presence of weeds, flowers or clover would tend to indicate this. It can be used for grazing any livestock, but usually for sheep, beef cattle and horses. The grass may have a brownish appearance, and be thickly matted, through which bare soil cannot normally be seen. The presence of shrubs or trees (e.g. parkland) within the field would also indicate extensive pasture.

**Intensive Pasture:** is grassland which is generally improved by reseeded (probably within last five years) and/or drainage and/or intensive use of fertilisers. Due to this reseeded the grass is more open and bare soil may be visible, through the sward. It will have a more lush, dark green colour than extensive pasture, and an absence of weeds and clover, trees and shrubs. It is likely that this grass will be cut for hay or silage, and a 'mown look' would indicate this. As part of grassland management, electric fences may be erected to control grazing.

**Note:** Not all intensive pasture is grass - kale, stubble turnips, rye and maize can all be grown for the same purpose - as a forage crop.

**Extensive Arable:** Includes all combinable crops such as cereals, rape, beans, peas, linseed, etc. After planting in the autumn and throughout the winter months there are very clear lines of plants, with soil visible in between, and wheel markings where machinery has been used. Spring sown crops will have this appearance in spring and early summer. Oilseed rape, linseed, peas and beans will become more leafy in the spring, closing up the spaces between the plants, giving the appearance of random planting. Oilseed rape has distinctive yellow flowers, normally sometime in April, May or June. As the cereal crops (wheat, barley and oats) mature they will take on a brownish colour. At all times, the tractor wheel marks should still be visible.

**Intensive Arable:** This classification contains a wide variety of plant types but are unlikely to be commonly found in floodplains. Crops include those listed in table B4. Depending on the time of assessment the nature of cropping may only be discernible from post harvest remains e.g. potato haulm, sugarbeet tops. Crops grown under glass or plastic structures should be excluded here, but the buildings should be included as non-residential properties. Crops grown on field scale, covered in plastic sheeting such as lettuce, should be included in the intensive arable category.

#### 4.7.2.6 Amenity

Amenity interests are identified by site visits and are then allocated to one of four categories as follows:

Categories	Notes
Playing Fields	E.g cricket, hockey, rugby, football, polo or non specific playing field. Record the number of pitches.
Formal Parks	Formal ornamental parks, bowling greens, tennis courts.
Special Parks	Special sites. For example theme park with rides.
Golf/Race Courses	Not including pitch and putt or crazy golf which would be classed as NRP (others).

**Note:** If any of these amenities are associated with buildings or club houses, they would be scored as an NRP (other) if the building was within the floodplain and would not be scored under amenity. If no building is present or all buildings are outside the floodplain then score as amenity only.

Boating and sailing areas are not included under amenity assessments though their club houses could be scored as NRP other if at risk of flooding.

School sports facilities or industrial sports facilities are not counted unless they are located at a separate site away from the main premises in which case the same rules as for other amenity interests would apply.

#### 4.8 INTERESTS OCCURRING AT REACH LIMITS

Any interests which are used as the reach limit and to divide the floodplain between reaches should be included in the assessment of the upstream reach only if the interest is at risk from flooding. This is likely to involve roads and railways which form many of the reach limits.

#### 4.9 SCORE CALCULATION

After completing the assessment and identifying all the interests within the floodplain attributed to a reach the total score for each LOS reach can be calculated. The total House Equivalents in a reach is then divided by the reach length to allow comparison, on a common basis, of reaches of varying lengths.



#### 4.10 LAND USE BANDS

Reaches of broadly similar land use can be expected to have similar HE/km scores. Five broad land use bands have been identified reflecting these uses. In addition a sixth category band X had been identified to separate all those LOS reaches which have no identified or separate floodplain area. The range of HEs/km thought appropriate for each land use band is indicated in Table B.9 below.

Table B.9

Land Use Band	Broad Description	Range of HE's/Km for one bank only
A	Urban ↑ ↓ Rural No Floodplain	50 +
B		25 - 49.99
C		5 - 24.99
D		1.25 - 4.99
E		0.01 - 1.24
Category X	No Floodplain	0

\*These scores are for the assessment of one bank only.

Each land use band, with the exception of band X, can be related to an acceptable degree of flooding occurrence or a desired standard of flood protection.

#### 4.11 BAND X

Band X was defined as a means of separating from band E those reaches recorded with an assessment score of 0 because there was no floodplain separately identified. This separate banding allows these reaches to be treated separately when utilising LOS information to influence maintenance works and capital programmes.

A reach may be classified as band X either because there is insufficient information to identify a floodplain or the natural topography of the stream may be such that there would never be any flooding. As regards programming and prioritisation it could be argued that there should be no works undertaken on band X reaches as there is nothing at risk.

## **Appendix B.1**

### **Land Use Assessment**

#### **Summarised Results of Applying Recommended Approach to Pilot Study Rivers**

Land Use Assessment. Results Summary

River Name D/S grid ref.	Reach	Left Bank		Right Bank	
		HE/Km	Land Use Band	HE/Km	Land Use Band
Afon Elwy SH 927 703	1	3.40	D	2.3	D
Afon Elwy SH 886 698	2	0.42	E	0.08	E
Afon Elwy SH 877 674	3	0.04	E	0.40	E
Afon Elwy SH 888 635	4	0.23	E	0.04	E
Afon Gallen SH 878 673	1	0.02	E	0.05	E
Afon Dysynni SH 566 029	1	0.62	E	0	E
Afon Dysynni SH 599 038	2	0.21	E	0.39	E
Afon Dysynni SH 612 052	3	0.87	E	0.24	E
Afon Erch SH 383 354	1	5.26	C	0.05	E
Afon Erch SH 403 381	2	0	X	0	X
Left Low level drain SH 407 687	1	10.05	C	/	/
Maltreath Marshes SH 451 719	2	2.0	D	/	/

Land Use Assessment. Results Summary

River Name D/S grid ref.	Reach	Left Bank		Right Bank	
		HE/Km	Land Use Band	HE/Km	Land Use Band
Little Ouse TL 608 919	1	/	/	/	/
Little Ouse TL 644 873	2	/	/	/	/
Little Ouse TL 676 856	3	1.05	E	1.05	E
Little Ouse TL 724 868	4	6.10	C	4.40	D
Little Ouse TL 784 869	5	6.80	C	7.70	C
Little Ouse TL 817 879	6	0.35	E	9.90	C
Little Ouse TL 851 844	7	1.20	E	0.14	E
Little Ouse TL 874 822	8	0.07	E	0.11	E
Little Ouse TL 893 802	9	0.70	E	0.70	E
Little Ouse TL 925 812	10	1.40	D	1.30	D
Little Ouse TL 973 806	11	1.90	D	2.00	D
Little Ouse TM 012 792	12	2.66	D	2.70	D
Stream @ Botany Bay TL 670 856					
Wharfe SE 077 522	1	0.53	E	0.53	E
Wharfe SE 057 593	2	0.09	E	6.10	C
Wharfe SE 025 623	3	0.07	E	0.17	E
Wharfe SD 998 638	4	0.61	E	0.64	E
Wharfe SD 979 675	5	0.08	E	0.76	E
Wharfe SD 972 710	6	17.39	C	0.12	E
Wharfe SD 951 745	7	0.54	E	0.60	E
Spen SE 232 205	1	119.73	A	65.2	A
Spen SE 213 234	2	239.76	A	80.3	A

Land Use Assessment. Results Summary

River Name D/S grid ref.	Reach	Left Bank		Right Bank	
		HE/Km	Land Use Band	HE/Km	Land Use Band
Waveney TM 521 927	1	3.37	D	1.80	D
Waveney TM 489 926	2	1.02	E	1.00	E
Waveney TM 451 915	3	4.40	D	8.60	C
Waveney TM 421 914	4	5.75	C	12.96	C
Waveney TM 389 908	5	14.50	C	3.80	D
Waveney TM 348 901	6	22.50	C	4.80	D
Waveney TM 328 898	7	11.25	C	10.30	C
Waveney TM 307 872	8	3.50	D	1.10	E
Waveney TM 282 845	9	4.80	D	13.90	C
Waveney TM 246 822	10	2.25	D	2.30	D
Waveney TM 213 792	11	0.90	E	13.30	C
Waveney TM 168 782	12	3.00	D	0.76	E
Waveney TM 130 789	13	9.90	C	5.20	C
Waveney TM 089 800	14	4.80	D	3.00	D
Streams at Alburgh TM 297 868	1	0.02	E	0.02	E
Streams at Worlingham TM 459 912	1	0	X	0	X
Hundred drain TM 482 919	1	0	X	0	X
Stream at Oulton broad TM 522 927	1	0	X	0	X
Stream at Ringfield TM 405 908	1	0.06	E	0.06	E
The Beck TM 277 837	1	0.03	E	0.03	E
The Beck TM 328 845	2	0	X	0	X
The Beck TM 355 833	3	0	X	0	X
Flixton Stream TM 309 878	1	0	X	0	X
Denton Stream TM 289 874	1	0	X	0	X
Stream at Bungay TM 345 898	1	0	X	0	X
Stream at Beccles TM 421 912	NO	ASSESS	MENT		
Stream at Geldeston TM 394 912	NO	ASSESS	MENT		

Note: No assessment is given for either the steeping river or for the coastal units because of difficulties in defining Floodplain areas. For the coastal units it is understood that under the continuing study undertaking Halcrows areas at risk from flooding from breach of sea defences will be identified.

## **Appendix B.2**

### **Land Use Assessment Summary Sheets**

## Land Use Assessment Summary Sheet

Assessor Name : ..... Catchment Reference : .....  
 River Name : ..... Regional Identifier (NRA,  
 local office etc): .....  
 LOS Reach Number : ..... Landranger Map Number: .....  
 Specify Left (L),  
 Right (R) or Coastal (C) : ..... Floodplain Extent Map Number: .....  
 From - Downstream Name: ..... To - upstream Name: .....  
 Grid Reference : ..... Grid Reference : .....  
 Reach Length of: ..... Coding Number : .....  
 main watercourse (km)

Other Watercourses allocated to this LOS reach

Name	Grid reference From (downstream)	Grid reference To (upstream)	Length (km)
i)			
ii)			
iii)			
iv)			
v)			
vi)			
vii)			
viii)			
ix)			
x)			
Sub Total: Length of watercourses allocated to this LOS Reach (km)			
Total Watercourse length this reach (km)			

## Summary Assessment

Total HE =  
 Reach Length =  
 HE/KM =

River: .....

Reach No. ....

## Summary incidence of customer interests.

Land Use Factor	Unit	Number (x)	House Equivalents HE/Unit (y)	Total HE (x x y)
House	Total Number		1.0	
Garden/Allotments	Total Number		0.2	
NRP - Distribution	Total Number		40.2	
NRP - Manufacturing	Total Number		64.6	
NRP - Other	Total Number		5.3	
C Roads	Total Number		2.4	
B Roads	Total Number		5.7	
A Roads (Non Trunk)	Total Number		14.3	
A Roads (Trunk)	Total Number		28.6	
M. Way	Total Number		57.3	
Railway	Total Number		57.3	
Forestry and Scrub	100 Ha		0	
Extensive Pasture	100 Ha		1.3	
Intensive Pasture	100 Ha		3.0	
Extensive Arable	100 Ha		6.9	
Intensive Arable	100 Ha		40.2	
Formal Parks	Total Number		0.6	
Golf / Race Courses	Total Number		0.6	
Playing Fields	Total Number		0.1	
Special Parks	Total Number		8.5	
Total HE (a)				
Reach Length (b)				
HE/Km (a ÷ b)				

Additional detail on attached working notes.



River: ..... Reach No.: .....

HOUSES/CARAVANS

Sources of data: .....

Grid Reference	Street Name/Location	Number Within Floodplain
----------------	----------------------	--------------------------

GARDENS/ALLOTMENTS

Sources of data: .....

A. Gardens (other than those attached to houses recorded above)

Grid Reference	Location	Number Within Floodplain
----------------	----------	--------------------------

Sub-Total

Plus - Number of houses in Floodplain (as above)

TOTAL

B. Allotments

Grid Reference	Location	Number Within Floodplain
----------------	----------	--------------------------

River: ..... Reach No.: .....

NON-RESIDENTIAL PROPERTY

Sources of data: .....

A. Distribution

Grid Reference	Proprietor/Location	Nature of Activity/building
----------------	---------------------	-----------------------------

B. Manufacturing

Grid Reference	Proprietor/Location	Nature of Activity/building
----------------	---------------------	-----------------------------

C. Other

Grid Reference	Proprietor/Location	Nature of Activity/building
----------------	---------------------	-----------------------------

River: ..... Reach No.: .....

NON-RESIDENTIAL PROPERTY

Sources of data: .....

C. Other (continued)

Grid Reference	Proprietor/Location	Nature of Activity/building
----------------	---------------------	-----------------------------

Working Notes

Quer

River: ..... Reach No.: .....

ROADS/RAILWAYS

A. Road Details

Grid Reference of  
Central point/crossing point

Road Classification

B. Railway Details

Grid Reference of  
Central point/crossing point

River: ..... Reach No.: .....

AGRICULTURE

Sources of data: .....

Predominant type of cropping within the floodplain

Forestry/scrub

Extensive Pasture

Intensive Pasture

Extensive Arable

Intensive Arable


Tick as appropriate or  
if unable to decide  
list the % of each

If proportion of intensive crops 10% (see Practical Guidelines, Stage 8)

AMENITY INTERESTS

Sources of data: .....

A. Formal Parks

Grid Reference	Location	Brief Description
----------------	----------	-------------------

B. Golf / Race Courses

Grid Reference	Location	Brief Description
----------------	----------	-------------------

C. Special Parks

Grid Reference	Location	Brief Description
----------------	----------	-------------------

D. Playing Fields

Grid Reference	Location	Brief Description
----------------	----------	-------------------

## **Appendix B.3**

### **Categorisation of Non Residential Property to**

- **Distribution**
- **Manufacturing**
- **Other**

**Note: The classifications shown above and detailed on the following pages have been taken from the modified hierarchical land use classification in "Urban Flood Protection Benefits" - D Parker, C Green and P Thompson.**

**Non-Residential Property****- Distribution****Storage and wholesale  
establishments**

Establishments engaged  
in the wholesale  
distribution of food  
products

Establishments engaged  
in the wholesale  
distribution of non-food  
products

Transit warehouses  
(including cash and carry  
depositories)

Bonded warehouses

Post office depots

Furniture and book  
depositories

Fuel storage tanks

Establishments which  
do not suitably fit  
into any other category

## - Manufacturing

## Sector 8 Manufacturing and extractive industries

A.

## Energy and extractive industry

## 1 Energy and extractive industry

Deep coal mines  
Open cast coal mines  
Solid fuel manufacture  
Coke ovens  
Oil and gas extraction  
Mineral oil processing  
Other oil products  
Nuclear fuel production  
Extraction metalliferous  
ores  
Extraction stone, clay, sand  
etc.  
Extraction of salt & refining  
Other mineral extraction

## Metal and mineral manufacture

## 2 Metal manufacture

Iron and steel manufacture  
Steel tubes  
Steel wire manufacture  
Other drawing and cold  
rolling of steel  
Aluminium manufacture  
(basic refining and semi-  
manufacture only)  
Copper, brass and other  
copper alloys  
(manufacture and semi  
processing)  
Other non-ferrous metal

## 3 Other mineral manufacture

Structural clay products  
(e.g. tiles)  
Cement, lime, plaster  
ready mixed concrete  
Other concrete, cement,  
plaster, asbestos cement  
building products  
Asbestos goods (except for  
cement and automotive  
gasket sets)  
Stone, slate and other non-  
metallic mineral products  
Abrasives (other than  
natural stone)  
Flat glass  
Glass containers  
All other glass and glass  
fibre products (not  
optical glass or completed  
items with glass fibre  
parts)  
Refractory goods (heat  
resistant blocks linings  
etc.)  
Ceramic goods

## Chemicals and derivatives

## 4 Chemicals and derivatives

Inorganic chemical  
manufacture (excluding  
gases and finished  
products)  
Basic organic chemicals  
(excluding  
pharmaceutical chemicals  
& finished products)  
Artificial fertilizers  
Synthetic resins and plastic  
materials  
Synthetic rubber  
Dyestuffs and pigments  
Paints, varnishes and  
painters' fillings (not  
sealants)  
Printing ink  
Formulated adhesives &  
sealants  
Chemical treatment of oils  
and fats  
Essential oils and  
flavourings (not  
turpentine)  
Explosives, fireworks and  
matches (not  
ammunition)  
Miscellaneous industrial  
chemicals (industrial  
gases, tanning agents,  
waxes etc.)  
Formulated pesticides  
Adhesive film, cloth and foil  
(not paper)  
Pharmaceutical products  
Soaps and detergents  
Perfumes, cosmetics and  
toilet preparations  
Photographic materials and  
chemicals  
Chemical products not  
elsewhere specified  
(includes candles, waxes,  
food preservative and  
unrecorded magnetic  
tape)  
Production of man-made  
fibres



*Metal and electrical engineering etc.*

5 Other metal goods

Ferrous metal foundries  
Non-ferrous metal foundries  
Forging, pressing and stamping  
Bolts, nuts, washers, springs, non-precision chains  
Heat and surface treatment of metals  
Metal doors, windows etc.  
Hard tools and implements  
Cullery, similar tableware and knives etc.  
Non-industrial metal storage vessels (e.g. cisterns, dustbins)  
All metal packaging (e.g. cans, drums, foil)  
Non-electrical domestic heaters and cookers (not central heating systems)  
Metal furniture and safes  
Domestic metal utensils (e.g. kettles, cookware)  
Other finished metal products (locks, needles, pins, metal fastenings)

6 Mechanical engineering

Fabricated constructional steelwork  
Boilers, process plant fabrications and other heavy steel fabrications (e.g. silos, bunkers etc. over 3mm thick)  
Agricultural machinery  
Wheeled tractors (agricultural)  
Metal-working machine tools (includes numerically controlled machine manufacture, e.g. milling, bending etc. machines)  
Engineer's small tools (metal cutting tools and press tools e.g. dies, drills)  
Textile machinery  
Food, drink and tobacco machinery (processing, packaging and bottling)  
Chemical industry machinery; furnaces, kilns; gas water and waste treatment plant  
Process engineering contractors (combining design, construction, assembly and commissioning of process industry plant)  
Mining machinery manufacture

6 continued

Construction and earth moving equipment  
Mechanical lifting and handling equipment (e.g. cranes, escalators, forklifts)  
Precision chains, plain bearings, gears, gearboxes and other mechanical power transmission equipment  
Ball, needle and roller bearings  
Machines working: wood, rubber, plastic, leather, footwear, paper, glass, brick, ceramics; and laundry and dry cleaning  
Printing, bookbinding and paper goods machinery  
Internal combustion engines (not for road vehicles, agricultural tractors or aircraft) includes steam and gas turbines for any other prime movers, including ships  
Compressors and fluid power equipment (e.g. hydraulics and pneumatic control equipment)  
Refrigerating, air conditioning, ventilating and space heating equipment (not domestic gas or electric heaters)  
Scales, weighing machinery and portable power tools  
Other industrial and commercial machinery (includes non-electronic test equipment, lawn mowers, machinery for foundries and rolling mills, other machines not specified elsewhere)  
Pumping manufacture (not for hydraulics or internal combustion engines)  
Industrial valve manufacture  
Mechanical, marine and precision engineering not elsewhere specified (includes components common to a wide range of engines and machines, gas welding machinery, general subcontractors, establishments with very mixed engineering products, auxiliary marine machinery)  
Ordnance, small arms, ammunition and tracked military vehicles

7 Office machinery

Office machinery (not copiers, dictating machines)  
Electronic data processing equipment (computers, subassemblies and specialised computer peripherals)

8 Electrical and electronic engineering

Insulated wires and cables  
Basic electrical equipment (generators, power transmission switch and control gear, electric motors and overhauling of electrical machinery)  
Batteries and accumulators  
Alarms and signalling equipment  
Electrical equipment for motor vehicles, cycles and aircraft (not railways or marine = 8472)  
Industrial electrical equipment not specified elsewhere (e.g. electric welding equipment)  
Telegraph and telephone equipment  
Electrical instruments and control systems  
Radio and electronic capital goods (e.g. transmitters, TV cameras, radar, aerials, X-ray machines, electro-medical apparatus)  
Non-active electronic equipment components (e.g. resistors, capacitors, transformers, printed circuits)  
Gramophone records and prerecorded tapes  
Active components and electronic subassemblies (e.g. valves, transistors, integrated circuits, domestic aerials, loudspeakers, microphones, record playing parts, tape decks, tuners, any subassemblies not specified elsewhere)

8 continued

Electronic consumer goods (e.g. domestic radios, TVs, record players, tape recorders; public address systems etc.; other electronic equipment not specified elsewhere)  
Domestic electric appliances (e.g. electric cookers, washing machines, refrigerators, toasters, space heaters)  
Electric lamp bulbs and tubes and other electric lighting equipment (not for vehicles)  
Electrical equipment installation (by specialist non-manufacturers not wiring of buildings)

Transport and instrument engineering

9 Motor vehicles

Manufacture of passenger cars, commercial vehicles and motor vehicle engines  
Motor vehicle body manufacture  
Trailers and semi-trailers  
Caravans  
Motor vehicle parts wholly or mostly of metal

10 Other transport equipment

Shipbuilding and repairing (includes inland and pleasure vessels)  
Railway and tramway vehicles, rolling stock, parts and repairs  
Motor cycle manufacture (includes metal components not elsewhere specified)  
Pedal cycles and parts  
Aerospace equipment and repair (includes gliders, helicopters, guided weapons, launch vehicles, aero engines and power plants, hovercraft, balloons, parts but not instruments and electrical-electronic parts)  
Other vehicles (baby carriages, wheelchairs,

invalid carriages, animal drawn carts etc.)

# 11 Instrument engineering

Measuring, checking and precision instruments (e.g. balances, thermometers, pressure gauges, laboratory apparatus, *not* electrical-electronic or optical)  
 Medical, surgical and orthopaedic equipment (e.g. surgical cutlery, respirators, anaesthetic equipment, dental instruments, artificial parts)  
 Spectacles and unmounted lenses  
 Optical precision instruments (e.g. microscopes, lasers; *not* cameras)  
 Photographic and cinematographic equipment (cameras, photocopiers, mounted lenses)  
 Clocks, watches and timing devices

## Food, drink and tobacco manufacture

### 12 Food, drink and tobacco manufacture

Margarine and compound cooking fats  
 Processing organic oils and fats (not crude animal fats)  
 Slaughterhouses (includes preparing fresh meat and freezing but *not* poultry)  
 Bacon curing and meat processing (includes prepared meat products e.g. pies, sausages etc.)  
 Poultry slaughter and processing  
 Animal by-product processing (including slaughter and processing for non-human consumption)  
 Preparation of milk and milk products  
 Processing of fruit and vegetables (includes freezing, canning, pickling and jams etc.)  
 Fish processing (includes shellfish, all means of preserving etc.)  
 Grain milling (includes splitting and grinding pulses and producing *uncooked* breakfast cereals)  
 Manufacture of starch

Bread and flour confectionery manufacture  
 Biscuit and crispbread manufacture  
 Sugar and sugar by-products  
 Ice-cream manufacture  
 Cocoa, chocolate and sugar confectionery  
 Compound animal feeds (includes protein concentrates)  
 Pet foods and non-compound animal feeds and supplements  
 Miscellaneous foods (coffee, tea; crisps, snack products; infant and diabetic foods; starch and malt extracts; puddings, yeast; soups, sauces etc.; pasta; ready-to-eat breakfast cereals; any foods not elsewhere specified)  
 Spirit distilling and compounding (includes producing raw ethyl alcohol and fermentation etc. of potable spirits)  
 Production of: wines based on concentrates, cider, perry, fruit wines (including from fresh grapes, but *not* on agricultural holdings)  
 Brewing and malting  
 Soft drinks, mineral waters and fruit juices  
 Tobacco industry

## Textile and clothing industries

### 13 Textile industry

Woollen and worsted industry (preparation of wool and hair fibres, spinning and weaving, includes blankets but *not* carpets)  
 Spinning and doubling on the cotton system (includes cotton, silk and man-made if done using cotton system; production of yarns and finished thread)  
 Weaving of cotton, silk and man-made fibre (of all sorts excluding for carpets, includes establishments both weaving and finishing)  
 Throwing, texturing, crimping etc. continuous filament yarn (not where man-made fibres manufactured)

13 continued

Spinning and weaving of flax, hemp and ramie (includes establishments both weaving and finishing)  
 Spinning, weaving and production of jute, fibrillated yarn and polypropylene fabric (not extrusion of man-made fibres or tapes)  
 Hosiery and other knit goods and fabrics (includes knitting and pile fabrics)  
 Warp knitted goods (includes elastic fabrics, not making-up garments from purchased fabric)  
 Textile finishing (includes bleaching, dyeing, printing etc. of all items listed above (8701-8); if carried out by manufacturer assign to manufacturing)  
 Pile carpets, carpeting and rugs (both woven and tufted)  
 Needle and bonded carpets, rugs etc. and hard fibre matting (not jute)  
 Lace (except for bleaching, dyeing etc. on commission = 8709)  
 Rope, twine and net  
 Narrow fabrics (elastics and elastomers under 30 cm wide, labels, ribbons, tapes etc.)  
 Miscellaneous textiles (felt, textiles not elsewhere specified, kapok and hair fibre fillings)  
 Leather tanning and dressing and fell mongery  
 Leather goods (travel goods, belts, saddlery etc. and industrial leather goods)

14 Clothing and footwear

Footwear manufacture (not wooden, plastic or rubber component manufacture)  
 Weatherproof outerwear  
 Men's and boys' tailored outerwear (not jeans)  
 Women's and girls' tailored outerwear (not jeans)  
 Work clothing and men's and boys' jeans  
 Men's and boys' shirts, underwear and nightwear (except for hosiery and knitted goods)  
 Women's and girls' light outerwear, lingerie and

14 continued

infants' wear (includes jeans, dresses)  
 Hats, caps and millinery (felt and other non-fur materials)  
 Gloves (excludes knitted, rubber and plastic gloves and sportswear)  
 Other dress industries (includes swimwear, foundation garments, umbrellas, handkerchiefs, neckties, scarves etc.)  
 Soft furnishings (covered cushions, pillows etc.)  
 Canvas goods, sacks, other made-up textile products  
 Household textiles (e.g. quilts, sheets, towels)  
 Fur goods (not sheepskin rugs etc.)

Wood and paper industries

15 Timber and wooden furniture

Sawmilling, planing etc. (includes pit props, railway sleepers etc. skirting boards and flooring, but not parquet floors = 8803)  
 Semi-finished wood products, preservation and treatment of wood (e.g. veneers, plywoods, boards)  
 Builders' carpentry and joinery  
 Wooden containers  
 Other wooden articles (not furniture, e.g. beading, handles, wood for textile, footwear, agricultural industries, wooden utensils)  
 Brushes and brooms  
 Cork and cork articles, basketware, wickerware etc. (except for furniture)  
 Wooden and upholstered furniture (both domestic and non-domestic, including cabinet work, wooden furniture components, beds & mattresses)  
 Shop and office fitting

16 Paper, printing and publishing

Manufacture of pulp, paper and board of all sorts (includes newsprint; coating and surface treatment by manufacturers)  
 Wall coverings (wallpaper, paper backed vinyl and fabric wall coverings)  
 Household and personal

hygiene paper products  
based on paper (wrapping  
and toilet papers  
etc. = 8831)  
Stationery (paper and  
binders)  
Paper packaging products  
Board packaging products  
(fibre board, cartons etc.)  
Other paper and board  
products not specified  
elsewhere (not toys,  
playing cards or sensitised  
photographic paper)  
Printing and publishing of  
newspapers  
Printing and publishing of  
periodicals  
Printing and publishing of  
books  
Other printing and  
publishing (includes  
security printing, cards,  
music, transfers, book  
binding and repairing,  
making printing plates,  
printing on metal,  
unspecialised printing  
works)

Toys and games (not of  
rubber)  
Sports goods  
Miscellaneous stationers'  
goods (pens, pencils,  
crayons etc., inks,  
duplicating materials,  
staplers etc.)  
Other manufacturers not  
elsewhere specified (e.g.  
taxidermists,  
manufacturers of  
devotional ivory, bone  
etc. articles)

*Rubber, plastics and miscellaneous manufacturing*

17 Rubber and Plastics

Rubber tyres and inner  
tubes (not retreading)  
Other rubber products not  
elsewhere specified  
(includes rubber and  
plastic hose, tubing and  
belting; not complete  
rubber footwear = 8731  
or adhesives)  
Retreading and specialist  
repair of rubber tyres  
Plastic coated textile fabric  
(not floorcoverings)  
Plastics semi-manufactures  
(e.g. film, sheet, tubes)  
Plastic floorcoverings (also  
linoleum, felt base and  
woven plastic matting)  
Plastic building products  
Plastic packaging products  
Plastics products not  
elsewhere specified (not  
complete items of  
footwear or clothing,  
brushes, mattresses, toys,  
sports goods, leather  
substitutes, fibre glass  
boats or mouldings for  
vehicles)

18 Miscellaneous manufacturing

Jewellery and coins  
Musical instruments  
Photographic and  
cinematographic  
processing laboratories

Non-Residential Property

- Other

**Sector 2 Agricultural buildings**

Arable farm

Livestock farm

Dairy farm

Mixed farm

Agricultural buildings are not coded individually but collectively by broad farm type classification if known.

**Sector 3 Non-built up land (non-agricultural)**

Recreational

Playing fields

Golf courses

Parks

Stadia, race tracks, and courses

Children's playgrounds

Zoos and botanical gardens

Picnic sites (designated)

Lidos and open air swimming pools

Other non-specified public and private open spaces

Cemeteries, crematoria etc.

Cemeteries and burial grounds

Crematoria

Memorial grounds

(detached from parks)

**Sector 4 Non-domestic residential**

Accommodation ancillary

to educational establishments

Halls of residence

Student hostel

(non-purpose built)

School boarding house

Accommodation of health/welfare establishments

Nurses homes, staff hostels, etc.

Old people's homes

Children's homes

Family group homes

Homes for mentally subnormal adults

Homes for the blind

Other special residential accommodation

Convents, monasteries, etc. Residential conference centres

Showman's winter quarters

Itinerants' caravan sites

**Sector 4 continued**

Government residential establishments

Royal navy barracks

Army barracks

Royal Air Force barracks

Prisons, approved schools, borstals etc. Other government establishments

Hotel accommodation

Hotels and motels

Guest houses

Residential clubs

Other hotels including YMCA and YWCA

Holiday establishments

Holiday camps

Camping sites

Holiday caravan sites

Holiday bungalow and chalets

Youth hostels

Comments in section 5.1 have some application to properties in sector 4.

**Sector 5 Retail trading and related services**

Shops

Food

Grocers and provisions-dealers

Dairymen

Butchers

Fishmongers, poultryer

Greengrocer

Fruiters

Bread and flour confectionery

Off licences

Confectioners, tobacconists and newsagents

Clothing and footwear

Boots and shoes

Men's and boys' wear

Women's and girls' wear

Household goods

Furniture and allied

Sector 5 continued

Vehicle services

Services

Other non-food  
retailers

General stores

Major garages with  
showrooms, repair  
depots and petrol  
filling facilities  
Petrol filling stations  
with or without  
service bay  
Tyre sales and  
servicing  
Car wash plant  
Motor bike repairs  
and sales  
Motor vehicle repairs

Public houses

Cafes and restaurants  
Laundries, laundrettes  
and dry cleaning  
plants (including  
linen hire)  
Design studios,  
photographers'  
studios, picture  
framing  
Take-away food  
establishments  
Repair establishments  
(e.g. TV/electrical  
goods)  
Auction sales and  
markets  
Livestock sales and  
markets  
Other services

Sector 5 continued

Radio and  
electrical goods  
Radio and T.V.  
hire  
Cycles and  
perambulators  
Hardware and  
china, wallpaper  
and paint  
Electricity board  
showrooms  
Gas board  
showrooms

Books, stationers  
Chemists, photo-  
graphic dealers  
Jewellery, leather  
and sports  
Other non-food

Department stores  
Variety and other  
general

Public houses  
without cellars  
Public houses  
with cellars

Travel agencies  
Betting offices  
Opticians and  
chiropodists  
Funeral services

- Other

Hairdressers,  
beauty parlours  
and slimming  
clinics  
Car and taxi hire  
offices  
Coach booking  
offices  
Driving school  
offices  
Printing shops

**Sector 5 continued**

**Contractors and  
other merchants  
and dealers**

Builders' merchants,  
contractors (electricians  
painters, plumbers, etc.)  
Coal merchants and coal  
yards  
Scrap metal and rag and  
bone merchants  
Timber merchants  
Dealers in sand, gravel,  
bricks and tiles  
Construction (civil  
engineers, scaffolders  
and concrete contractors)  
Plant and crane hire  
Waste rubber dealers and  
waste clearance and  
disposal merchants  
Miscellaneous

**Sector 6 Professional and offices**

**Central government  
offices (including  
labour exchanges)**

**Local government  
offices (including  
rate and rent offices)**

**Embassies, consulates  
etc.**

**Banks**

**Commercial offices**

Architects  
Building societies  
Estate agents



**Sector 6 continued**

	Insurance brokers/ loss adjusters Surveyors/valuers Solicitors/accountants Other commercial offices, e.g. secretarial, duplicating services, etc.
<b>Surgeries</b>	Dentists Doctors Osteopaths, etc. Physiotherapists Veterinary
<b>Institutional offices</b>	Hospital offices University offices Trade union offices Other
<b>Research establishments</b>	Research establishments Observatories Laboratories

**Sector 7 Public buildings and community services**

**Central and local  
government  
establishments  
and public  
corporations**

Post offices  
GPO sorting offices  
Telephone exchanges  
Police stations  
Fire and ambulance  
stations  
Radar and radio  
communications  
establishments  
Law courts  
Telecommunications and  
GPO depots  
Armed forces offices

**Schools, colleges, etc.**

Nursery and  
kindergartens  
Primary  
Secondary  
Technical, art, teacher  
training and FE  
colleges  
Universities and  
polytechnics  
Adult education centres  
Schools for physically  
and mentally  
handicapped  
Industrial training centres

**Health establishments**

General and psychiatric  
hospitals  
Convalescent and  
nursing homes  
Clinics  
Health centres  
Rehabilitation centres

**Sector 7 continued**

**Education and  
recreation centres**

Major entertainment  
centres containing  
at least 2 of those  
listed below:  
Cinemas, theatres,  
concert halls  
Dance halls  
Amusement parks and  
permanent fun fairs  
Swimming baths  
Sports halls and  
gymnasias  
Skating rinks  
Indoor games and  
amusements including  
bingo halls, billiard  
saloons, amusement  
arcades, casinos  
and night clubs

**Places of assembly**

Public halls  
Private halls (including  
church halls)  
Community centres  
Clubs (non-residential)  
and societies  
Youth clubs and scout  
halls

**Places of culture  
and worship**

Libraries  
Museums  
Art galleries  
Exhibition halls  
Ancient monuments  
Historical buildings  
Churches

**Other**

Public conveniences  
Public baths and  
wash houses  
Turkish, foam and  
sauna baths

## Sector 9 Public utility and transportation

## Transportation

## Roads

## Bus and coach

Road transport  
stationsBus and coach  
depotsRoad haulage  
depots

Transport garages

Taxi garages

## Car parks and garages

Multistorey car  
parksLock-up garages  
(not attached to  
other property)

## Rail transport

British rail track  
and operational  
buildingsBritish rail  
stationsLiner and goods  
depotsLocomotive works  
and maintenance  
shedsNational carriers  
etc.

## Air transport

Civil and commercial  
airports

Private airfields

Air terminals

Heliports

## Water transport

Docks and other  
harbour  
installationsOcean passenger  
terminalsOcean freight  
terminals  
including  
transport  
warehouses

Sector 9 continued

Utilities

Local authority  
establishments

Inland waterways  
and associated  
installations  
Boat hire  
installations  
Car ferry  
terminals  
Hovercraft  
terminals

Sewage works  
Sewage pumping  
stations  
Local authority  
depots

Central Electricity  
Generating Board  
and Area Electricity  
Board establishment

Power stations  
Transformer  
stations and  
substations

Gas boards

Gas works, gas  
holder stations  
Control stations  
and governors

Water undertakings

Storage reservoirs  
Intakes and wells  
Waterworks and  
treatment plants  
Pumping stations

Telecommunication  
services and other  
public utilities

Telephone link  
boxes, cabinets  
and pillars  
Public call boxes  
Letter boxes  
(isolated)

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