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(NATURAL ENVIRONMENT RESEARCH COUNCIL)

FIRST INTERIM REPORT TO THE NATURE CONSERVANCY COUNCIL ON BRITISH RAIL LAND - BIOLOGICAL SURVEY

(NCC/NERC CONTRACT NO F3/03/80 : ITE PROJECT NO 466)

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I. Wyllie and I.C. Bolt (Bath University) contributed greatly to the project both in the field and in the laboratory. Sally Oakes (Luton College of Higher Education) prepared the maps and diagrams and Valerie Burton did all the typing.

PRESENTATION

For reasons of production of this interim report the number of copies including all the site data, maps and photographs has been restricted to six. Complete sets can be seen at:

NCC, Chief Scientist Team, George House, Huntingdon
NCC, Library, 19 Belgrave Square, London
ITE, Monks Wood Experimental Station, Abbots Ripton, Huntingdon

BRITISH RAIL LAND - BIOLOGICAL SURVEY

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SUMMARY

The management of land associated with active railways is the responsibility of the Chief Civil Engineer at British Rail Headquarters. This is further delegated in the five Regions of BR in the UK through the varying Divisional, District and Area structures. The point of contact for NCC Regional staff is most likely to be at Divisional or Area level.

The route mileage of railways has decreased from a peak of 23,400 miles in 1914 to 11,300 miles in 1975. The acreage of land associated with the 1975 mileage is estimated in the report as (75,000) - 185,000 - (300,000) acres. Most of the main line routes date from the 1830-1850 period, with a subsequent wave of building towards the end of the century. However, there has been considerable reworking of the formations in many areas so that the age of the vegetation cannot always be calculated from the date of original construction. Management of vegetation has been traditionally by hand cutting and by burning, but since the 1960's with the reorganisation of track maintenance work, the traditional methods have been replaced by a general policy of minimum management and no regular programmes of work. As a consequence considerable areas have not been managed for some years, and this is giving rise to problems of development of scrub and woody growth. Contemporary forms of management, including the use of herbicides, are being considered. It is feared that much conservation interest in terms of herb rich grassland may be affected by the development of coarser vegetation and scrub in the absence of regular management, followed by the subsequent effects of any herbicides that might be used.

Descriptions are given in the report of the physical and vegetation characteristics of four 12-15 mile sections of railway route in different parts of the country. 401 species of plants were recorded; approximately 240 species were recorded at each section. It was evident that the vegetation on the often highly disturbed embankments was generally composed of ruderals, coarse grass and herb species, bramble and scrub. Whilst these elements were also present on cutting slopes, there was a better chance of finding finer herb rich swards, and generally of older undisturbed vegetation complexes in cuttings.

It is proposed over the next four years that more detailed studies should be made in the four individual regions of BR in England and Wales. Detailed proposals are given for work in 1977 in the Eastern Region, comprising some 1650 route miles of rural track. These proposals revolve around a restatement of the objectives:

a) Surveys to estimate physical and botanical resources on BR land.

b) A standardised file of entries on visits to selected sites of known or suspected conservation importance.

c) Information on sites of known or suspected conservation importance not visited.

d) Desk studies on historical, geographical and management aspects of railway land.

e) Collation of up-to-date information on contemporary, and possible future, management techniques.

INTRODUCTION

The probability of NCC commissioning work on the ecology of railway land was forecast in Appendix A (Item 5) of contract number F3/03/27 (ITE Project Number 184) in 1975. In January 1976 a preliminary meeting was held between N.W. Moore (NCC) and C. Beagley (BR) to establish a link with the British Rail management, and seek their co-operation. This meeting was followed by a meeting between J.M. Way (ITE) and Mr. Beagley on 11 March to discuss in more detail the interests of the three parties (NCC, ITE and BR) concerned, to seek BR's formal approval for entry of ITE staff onto their land, and to make general arrangements for the work to be done in 1976.

Notification of BR's approval was received on 31 March 1976. After further discussions and administrative arrangements, field work was begun on 7 June.

The concept of the work to be done in 1976 was that it should be a reconnaissance, and it was arguable how this might be approached. On the one hand there was the possibility of making a number of assumptions about what might be found, on the other hand there was the philosophy of making no assumptions. Taking the first case, an objective plan might be made, stratified on the basis of the assumptions with random sampling. This would be appropriate in a situation (such as woodland or upland surveys) where there was already a body of information on which to base the assumptions. However, no previous general descriptive account existed of the ecological characteristics of railway land (although records of individual species of plants and animals had been made), and thus the criteria on which to base a stratification were lacking. Previous work on roadside verges might have been thought to have provided experience for an objective approach de novo to railway land. It is relevant to note that attempts to apply a modified form of the roadside recording card and sampling techniques failed early in the programme and were abandoned.

As a result it was decided to make a general reconnaissance, looking at a number of areas of railway land in different parts of the country to assess the problems of recording, and to attempt to identify those criteria on which subsequent objective surveys could be based, bearing in mind the aims of the work, summarised below:

1. To assess the ecological and conservation importance of railway land in the countryside.
2. To record in some detail the vegetation of four sites, with the intention of gaining experience of the physical and biological structures of the land.
3. To study archival material that might be of ecological interest.
4. To consider the present day management problems and practices of BR with reference both to conservation and to user requirements.

The account that follows is an interim report on the work that was done within this framework in 1976.

PART 1 - DESK STUDY

THE MANAGERIAL HIERARCHY AND ORGANISATION OF BRITISH RAIL (as at March 1977)

Paragraphs 1-10 below are intended to help the reader identify the parts of British Rail most closely concerned with the management of vegetation on banks and cuttings. Detailed information is therefore given for only those parts of the management hierarchy which relate to the construction and management of the Permanent Way Civil Engineering formations.

1 Railway activities form the largest responsibility of the British Rail Board. Their relationship to the other activities of the Board, and the structure of management, are indicated in Figure 1.

2 Other corporate parts of British Rail Board include British Rail Property Board, British Rail Engineering Ltd., British Rail Hovercraft Ltd. and British Transport Hotels Ltd. The British Rail Property Board undertake the duties of land agent for British Rail and assume responsibility for any British Rail Property which ceases to be operational.

3 The corporate needs of the British Rail Board are looked after by the Chief Solicitor; Chief Internal Auditor; Controller of Corporate Finance; Research and Development Division (see below); and others.

4 British Rail HQ at 22 Marylebone Road, London (01 262 3232) is the office of the Chief Executive (Railways).

5 There are a number of Executive Directors responsible to the Chief Executive (Railways) (Figure 1), including:

a) Executive Director, Finance
Freight
Passenger
Personnel
System and Operations

b) of whom, the Executive Director, System and Operations has a:
Chief Operations Manager
Chief Architect
Chief Civil Engineer
Chief Mechanical and Electrical Engineer
Chief Signal and Telecommunications Engineer

c) of whom, the Chief Civil Engineer has a:
Permanent Way Engineer, who covers track work and fencing, track drainage, grass cutting, &c
Works Engineer, who covers station buildings, bridges, tunnels, sea defences, &c, and all proposals for new works

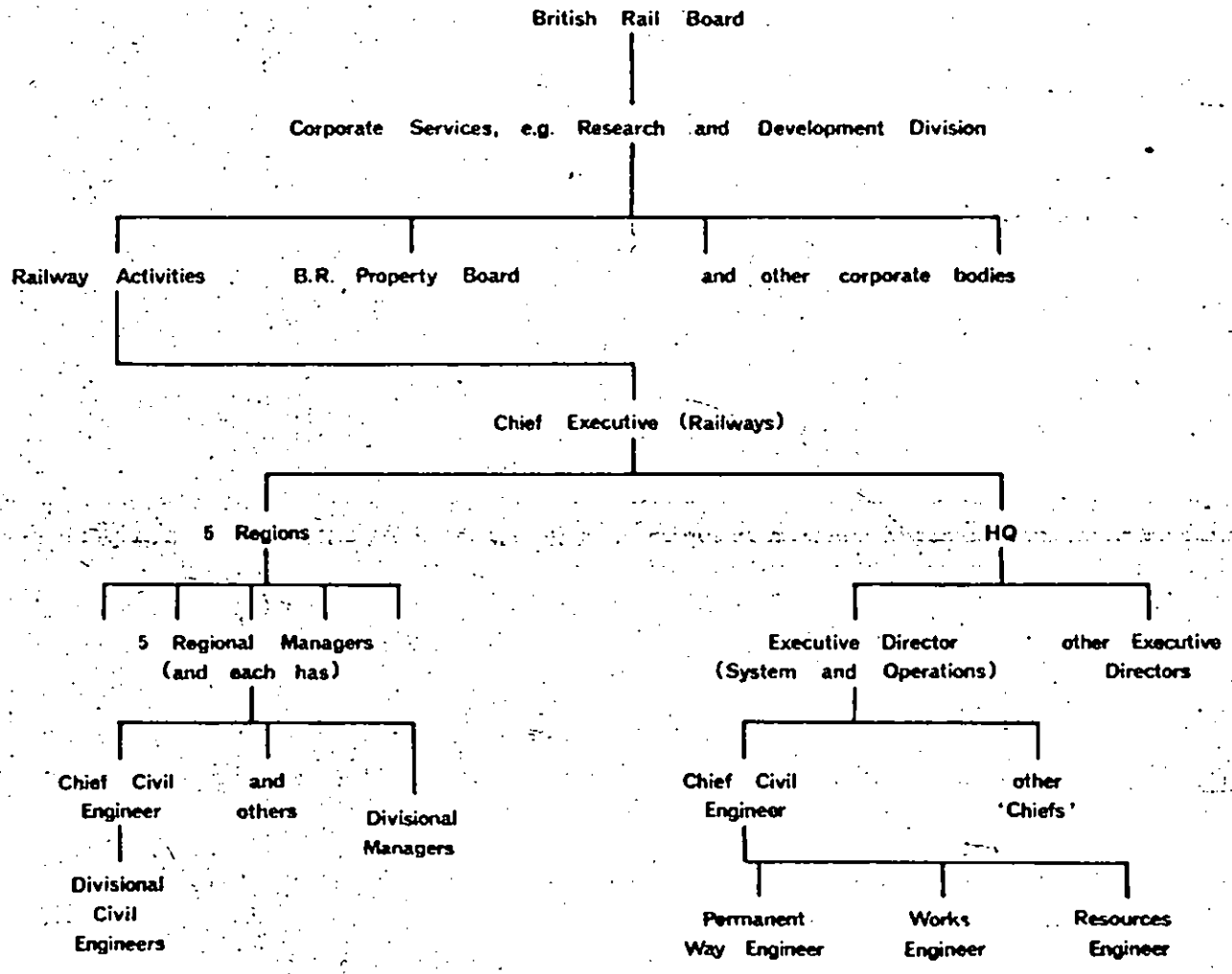

Fig. 1 Organisational Hierarchy

Resources Engineer, who covers materials and labour needs, Method Studies, Civil Engineering School; &c

and these four officers are based at Melbury House, Melbury Terrace, London NW1 6JU (01 262 3232).

6 British Rail divides the country into five Regions, and each has a Chief Civil Engineer:

Eastern Region (E.R.) : Chief Civil Engineer's Office, Hudson House, York (0904 53022)

London Midland Region (L.M.R.) : Chief Civil Engineer's Office, Stephenson House, Hampstead Road, London NW1 2PP (01 387 9400)

Scottish Region (Sc.R.) : Chief Civil Engineer's Office, Buchanan House, 58 Port Dundas Road, Glasgow G4 OHG (041 332 9811)

Southern Region (S.R.) : Chief Civil Engineer's Office, Southern House, East Croydon, CR9 1DY (01 686 3422)

Western Region (W.R.) : Chief Civil Engineer's Office, Paddington Station, London W2 1HA (01 723 7000)

The functional chain of command between the Chief Civil Engineer at British Rail HQ and the Chief Civil Engineer in the Regions is either through the Executive Director (System and Operations), together with the appropriate Regional General Manager on major issues, or direct on other matters. The organisational structure of the Chief Civil Engineer's office varies between regions (Figure 2).

7 Each of the five regions is subdivided into Divisions:

a) Eastern Region comprises 6 Divisions:

Doncaster
Kings Cross
Liverpool Street
Newcastle
Norwich
Sheffield
and 2 Districts
West Riding
York

The Divisions and Districts are further subdivided into 32 Areas.

b) London Midland Region comprises 7 Divisions:

Birmingham
Crewe
Liverpool
Manchester

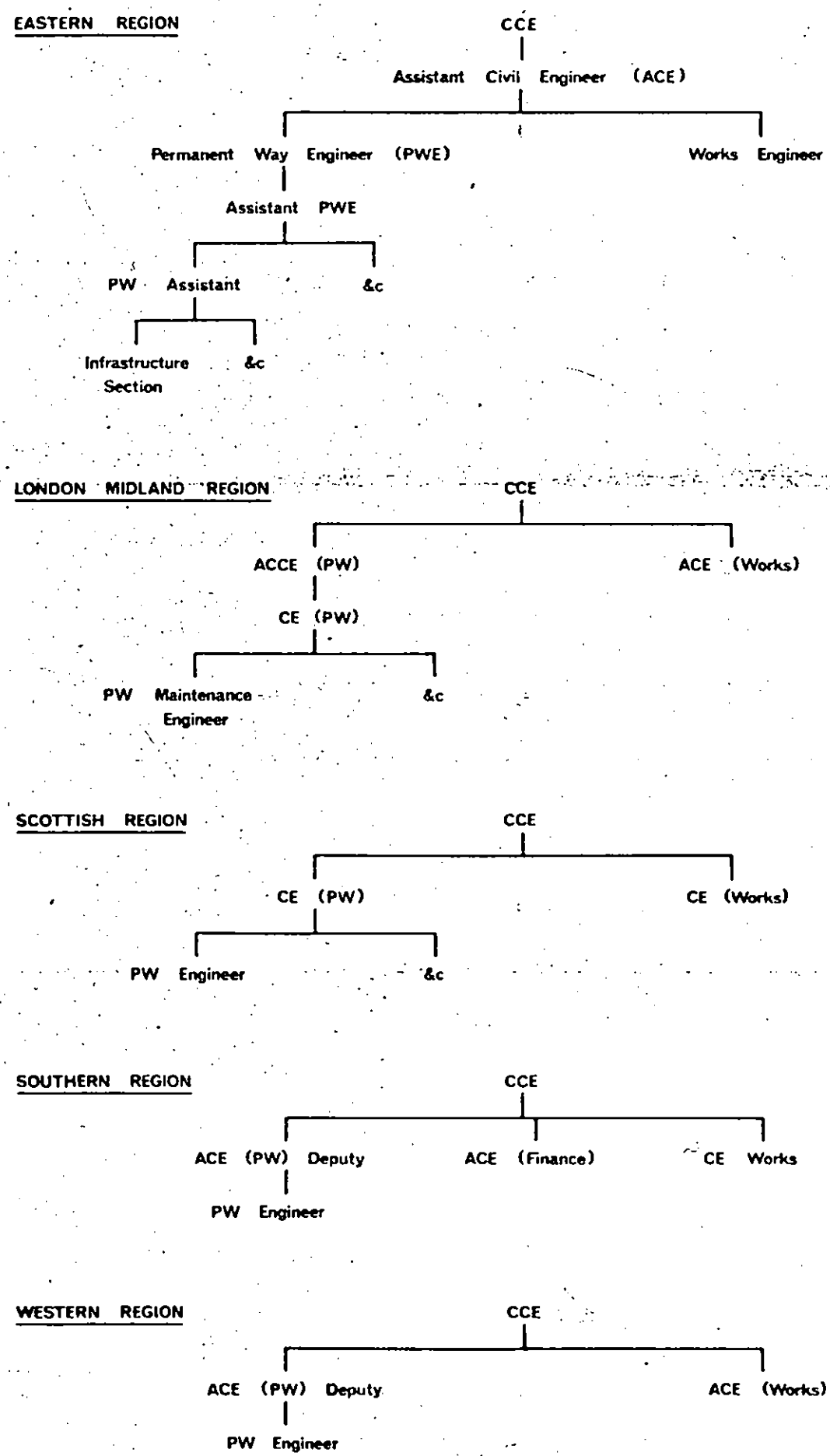

Fig. 2 Regional Hierarchy

Nottingham

Preston

Watford

There is no further subdivision of authority in this Region.

c) Scottish Region comprises 4 Divisions:

South West based on Glasgow, subdivided into 3 Areas:

West

South

Irvine

South East based on Edinburgh, subdivided into 3 Areas:

East

North

West

North West based on Glasgow, subdivided into 3 Areas:

West

East

West Highlands

North East based on Perth, subdivided into 3 Areas:

South

Inverness

Aberdeen

d) Southern Region comprises 3 Divisions:

South Eastern, based on Beckenham

Central, based on Southern House, Croydon

South Western, based on Wimbledon

The Divisions are further subdivided into Areas.

e) Western Region comprises 3 Divisions:

London

South Wales, based on Newport, which includes 2 Districts:

Newport

Swansea

West of England, which includes 4 Districts:

Bristol

Gloucester

Plymouth

Taunton

There is a further subdivision into Areas, but these are of a generally lower status than, for example, those on Southern Region.

8 Each Division has a Divisional Civil Engineer, but the organisation of his office varies between regions (Figure 3).

9 Regional and Divisional boundaries are shown in Map 1. This is based on information provided by the Offices of the five Regional Chief Civil Engineers, and on a map of the British Rail Passenger Network, published in 1976. The map excludes lines used for freight purposes only, of which there may be a considerable local mileage.

Copies of the large-scale regional maps may be obtained from the offices of the Regional Chief Civil Engineers (para 6). These maps cover both passenger and freight lines.

10 Scientific Services of the Research and Development Division of British Rail operate from a centre at Derby, with specialised offices and laboratories at Doncaster, Manchester, Muswell Hill and Swindon. An officer at the Railway Technical Centre, Derby DE2 8UP (0332 42442) provides advice on chemicals for use in the control of vegetation, and he is advised by a specialist officer in the British Rail Disinfestation Service at Rail House, Store Street, Manchester M60 9AJ (061 228 2141). Historically, the Disinfestation Service has dealt with problems arising from pests in goods being carried or stored by the railway. It is now concerned more generally with pest control, bird control and scrub control (in relation to rabbit and vermin control).

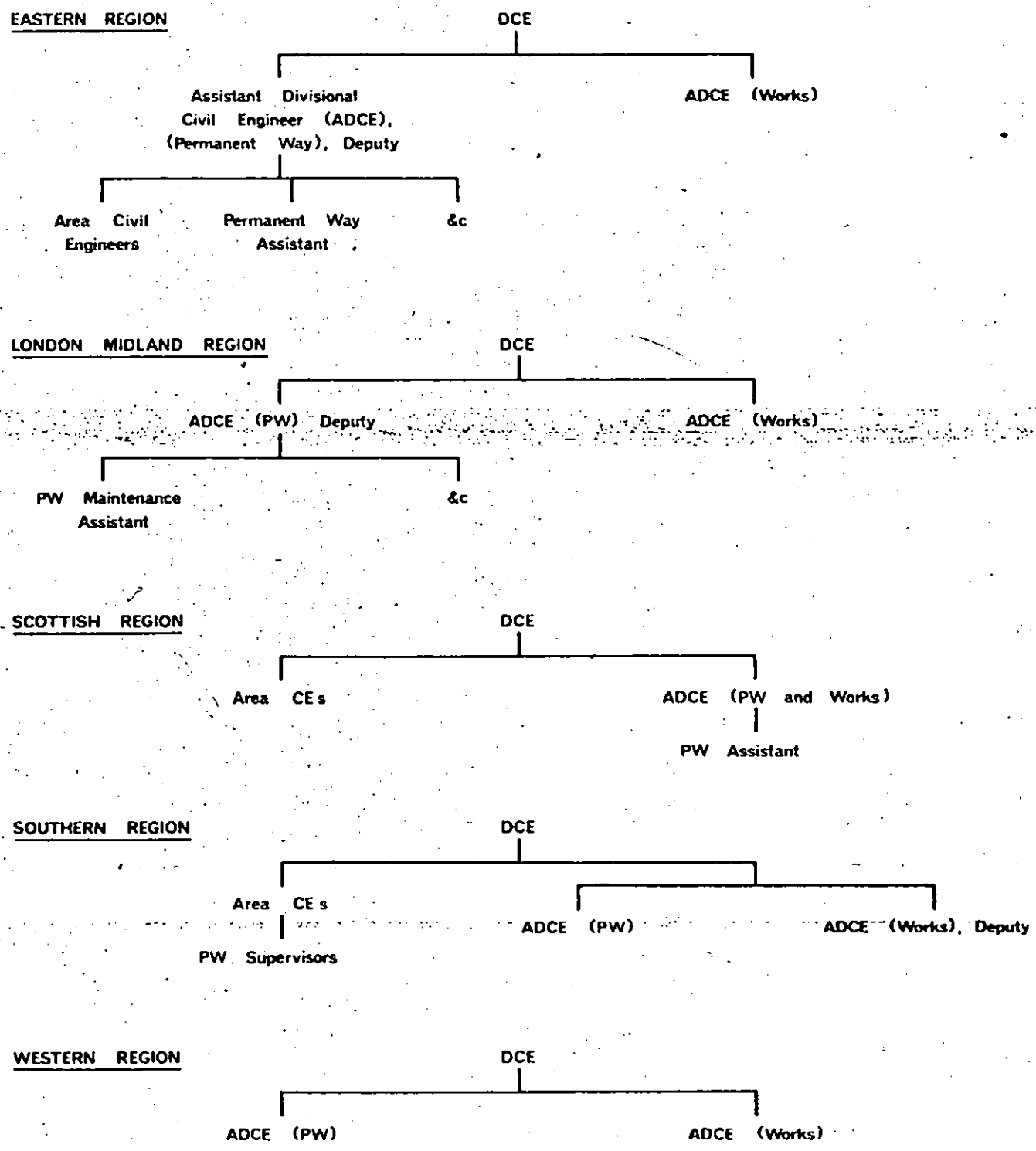

Fig. 3 Divisional Hierarchy

RAILWAY FORMATIONS. CONSTRUCTION AND MANAGEMENT OF BANKS AND CUTTINGS.

A description of the construction and management of banks and cuttings must take into account a wide variety of regional and historical factors. For example, Southern Region is distinctive for its use of a conductor rail, the very intensive use of a high proportion of its track, and the relatively short distances between stations. In contrast, there is only one intermediate operational station, Appleby, on the 72 mile stretch of railway between Settle and Carlisle in the London Midland Region.

Construction

The Stockton-Darlington Railway was opened in 1825, and the main trunk routes of the British railway system were constructed between 1830 and 1850. About 6,600 route miles of line had been built by 1850, rising to an eventual peak of 23,400 route miles in 1914, and descreasing to 11,300 route miles in 1975 (Chambers Encyclopedia 1970). The following excerpts illustrate some of the principal considerations in railway construction during the nineteenth century.

According to Wood (1838), the angle of slope of the banks and cuttings depended 'in some degree, upon the depth of the excavation, or height of the embankment; in the former, when the material is sand, gravel, chalk or gravelly clay, a slope of one and a half horizontal, to one perpendicular, is quite sufficient; and in excavations, up to thirty or forty feet, this slope has been found to stand very well. In some descriptions of clay, such as the plastic clay of London, and clay of a similar nature, a slope of one and three-fourths, or two to one, is necessary'.

A later writer, Day (1848), warned that 'there is a constant alternate expansion and contraction in the outer part of Clayey soils, occasioned by the humidity of the air, succeeded by heat and dryness, which fractures the crust of the slopes of embankments and admits the rain to pass into the interior. In order to secure them against such influence, the slopes are soiled and sown with hay-seeds, the soil being deposited on the slopes as lightly as possible'. As Day noted, 'the roots, by inserting themselves into the material' would hold the banks more firmly.

Wood (op cit) provided further detail, noting that 'on all the modern railways, the slopes are covered with a layer of soil, which is procured from the base of the embankments, or from the top of the cuttings; this layer of soil is spread over the face of the slope about six inches thick, or of the thickness which the soil from these places will yield. It is of great importance to the security of the slopes, that the soil should be laid on as soon as possible, after the excavation

is made, or the embankment consolidated; and sown with grass or clover, or both, to get a turf upon it before the slopes are affected by the action of the weather'.

It is difficult to assess how far the prescriptions laid down by Wood and Day reflected common practice or were heeded by the railway companies and contractors, but a contract drawn up between the Wirral Railway Committee and a contractor in 1893 (Public Record Office A) is unusually detailed and may serve as an example of the factors taken into account when constructing railways in the later nineteenth century.

The contract of 1893 related to the construction of a railway line near the River Dee in Cheshire, and required the contractor 'to remove and carefully put aside sufficient top soil from the site of the cuttings and embankments to soil the slopes when trimmed, and also the whole of the formation at the site of excavation, to a thickness of at least six inches, measured at right angles to the line of the slope; and where it may be in grassland, the turf is to be carefully cut into sods for the same purpose'.

To facilitate the development and maintenance of the slopes, the contract specified that 'in all cuttings a row of sods, not less than 1 feet 6 inches wide and 6 inches thick, is to be laid where directed by the Engineer at the foot of slopes to support the soiling or sodding above; and the cost of this is to be included in the price for soiling and sowing the slopes. The faces of the slopes are to be sodded or covered with a layer of soil 6 inches thick, with the turfs or soil previously removed for that purpose from the site of the embankments or cuttings ... The slopes and formation at the site of excavation when soiled are, at the proper season, to be sown with rye grass and white clover seeds, in the proportion of one-and-a-half pound of clover seeds and three bushels of rye grass seeds per acre, and the sowing repeated in case of failure until a good turf is established'.

Two other factors were of major significance in the construction of banks and cuttings. Day (op cit) asserted that brushwood should be used to drain the slopes of embankments because it afforded 'good space for the passage of water, and is not readily filled up by any loose material running therein'. The Wirral contract specified that 'whenever or wherever springs, soaks or streams of water may appear and issue from the face of the slopes, the Contractor will be required to make all proper drains'.

The other factor of importance was fencing. The Wirral contract required post and rail fencing to be erected and, between October and February, a quick-mound and quick fences were to be set out at the discretion of the engineer. The contract specified, 'the quicks are to be healthy plants of three years' growth, two years transplanted, set eight in a linear yard, in rows nine inches apart'. Day (op cit) noted that 'the appearance of some lines is very much improved by being partially planted at some places. In fact many small patches of land, and the foot of embankments, by being planted with useful timber, might not only be rendered valuable, but also improve the general appearance of the line'.

Early management

From the very earliest days of steam engines there was a serious risk of sparks from steam engines setting alight the scrub and grass on the banks and cuttings, and in upland areas a particular risk of the fires spreading to neighbouring moorland where control would have been especially difficult. Accordingly, the entire banks and cuttings were usually scythed or burnt on a regular and intensive basis. A few lengths received almost a 'garden' treatment. Through the personal initiative of the Chief Engineer of the London and North Eastern Railway, John Miller, that region became outstanding in the 1930s for the landscaping of the permanent way and stations.

Each Railway Company issued instructions 'for the guidance of all employees in the Engineers Department', and the following represent extracts from the Instructions issued by the London and North Eastern Railway in 1937.

i) Fire control. All undergrowth on the Company's land which may result in fires caused by sparks from locomotives spreading to adjacent property must be cut down, burnt if this can be done with safety, and/or cleared away.

ii) Weed control. All running lines, sidings and yards must be kept in a tidy manner and free from rubbish and weeds.
Grass and growth on banks must be cut, burnt and trimmed as directed.
Structures must be kept clear of weeds and other growth.

iii) Drainage. Particular attention must be given to (the drainage of) the slopes, and they must be thoroughly examined from time to time and means employed to prevent the accumulation of water either in the ditches or in hollows. The drains or ditches on and at the top of the slopes of cuttings must have special attention so that no accumulation of water is allowed to remain there.

iv) Screenings from ballast. They must not be placed on the adjacent slopes except on the authority of the District Engineer. Dirty ballast and material removed from the track must not be thrown where it is likely to impede free drainage.

v) Hedges. Hedges must be kept stock-proof. Where not to be layered they must be trimmed and cut annually, and all trimmings carefully gathered together in small heaps and burnt clear of telegraph wires and cables.

By the last war, it had become impracticable to scythe the entire width and length of banks and cuttings, and fresh instructions were drawn up. These were included in the Codes of Practice laid down by the Railway Executive in 1952, and included:

i) All lines in built-up areas ... whole of slopes to be cut
ii) All other lines ... top and bottom swathes only. Remainder burnt or sold.

The grass on slopes etc., should be cut or burnt before grass seeds ripen and scatter. When not required it should be gathered together and carefully burnt clear of telegraph wires, etc. Particular care must be taken to keep grass and weeds clear of cables.

During the war, even this less intensive level of management was often neglected, and brushwood took over many banks and cuttings at that time. When diesel locomotives replaced steam from the 1950s onwards, the cutting and burning of vegetation became less regular and intensive again.

The reorganisation of management work in the 1960s had the practical effect of still further reducing the level of management. Previously track maintenance had been carried out by 'small length gangs', usually a ganger, sub-ganger and three lengthmen, who were responsible for all permanent way work along their length. In the interests of economy and because of the modernisation programme, a mechanised maintenance system was introduced, whereby all heavy work was mechanised, leaving the remaining tasks to be performed by larger gangs of 12-14 men (track chargemen, trackmen and labourers, with a personnel vehicle), under a sub-inspector. The length of line delegated to each gang varied according to traffic density and other factors. In Southern Region, it is now on average 12.5 miles, but can be as much as 20 miles.

The Code of Practice laid down in 1952 noted that 'hedges are generally set a distance of four to six feet to their centre inside the boundary. They must be kept stockproof and it is best to trim them in the autumn, filling gaps or thin places by weaving longer shoots across from one side. All trimmings should be gathered up and burnt clear of telegraph and other wires and cables'.

At one time, about half the track in the Eastern Region area was bounded by hedges, but during the 1930s these began to be replaced by concrete posts and

rail in order to help reduce the need for management. Relict root systems of these removed hedges often survive.

The practice of maintaining a top ditch to act as a catch-water along the top of many cuttings was also discontinued in many parts from that time onward. There were fears lest cracks, especially in ditch sides on clay or similar formations, might let water into the cuttings.

Grass and scrub roots played an important part in sustaining the stability of slopes, and were generally unaffected by burning. When major disturbances occurred, for example because of track realignment, a rye-grass mixture was usually sown in order to help preserve bank stability.

Contemporary management

A new Code of Practice, prepared in 1976 but not yet issued, identifies the relatively few cases when some control of the vegetation is still needed. It states that:

i) A swathe of grass must be regularly cut in the vicinity of cable runs and at all other places where there is a particular fire risk.

ii) A similar swathe of grass may also be regularly cut for appearance reasons alongside station platforms, approach roads and adjacent to the boundary fence as directed by the Engineer.

iii) It may be necessary from time to time to control the growth of scrub on embankments and cutting slopes to prevent interference with overhead telephone lines, signal sighting or the view of approaching trains, particularly at unprotected crossings, and to enable vermin to be kept down as directed by the Engineer.

In the South-eastern Division of Southern Region, annual contracts have been awarded for clearing scrub where sighting problems have arisen; in Eastern Region, large scrub has been cleared where there was risk of the roots causing further instability on slopes of loose rock and unstable Liassic Clay formations. In Western Region, tracts of scrub have been cleared in order to promote greater tidiness and good husbandry on the track slopes.

Whilst the reduction of management brought considerable savings, the fact that this policy allowed scrub to become much more widespread meant that expenditure was likely to be much higher in the future. As the Chief Civil Engineer commented in April 1976, 'in the absence of regular cutting and burning the amount of scrub is increasing, and this is giving rise in places to a rapid and dangerous encroachment of the cess'.

Most concern has been shown in Western Region, where a more intensive management programme has now been introduced. This may be illustrated by reference to the expenditure index covering grass and scrub management, and minor earthworks, between 1970 and 1975, namely:

Year	Expenditure (index)	Inflation index
1970	100	100
1971	111	109
1972	131	119
1973	134	137
1974	221	181
1975	309	245

As an experiment, an extensive area of scrub was cut down and burnt on the Reigate line of Southern Region in 1976, and the stumps treated with chemicals. A year previously, a similarly extensive area was cleared between Whitley and Haslemere, although no chemicals could be used owing to the proximity of a nursery (see below: 'Chemical control of scrub').

Trees. The new Code of Practice, prepared in 1976, reiterated instructions that have been included in the Code of Practice since at least 1952, namely that:

> 'large trees growing on or near the Board's property must be examined from time to time and elm trees which may fall without warning should be examined more frequently. If the trees obscure the view of signals, level crossings, etc. or are likely to foul telegraph wires or endanger traffic if they are blown down they must be reported to the Engineer'.

The main problems arise from falling branches on electrified lines and from trees growing on such unstable formations as London Clay.

Where leaves adhere to the rails, a locomotive's wheels lose part or all their frictional effect, whilst the organic material may cause serious corrosion to the rails. The problem is most significant where trains, leaving a station, encounter a steep gradient in a deep, wooded cutting. The deep cuttings of the Oxted line in Southern Region may be cited, where recourse has to be made to topping the trees, and using water cannons and cosmic torches to disperse the leaves. Leaves and pine needles may also 'clog' up the ballast, and necessitate more frequent ballast-cleaning.

Vegetation control. Where necessary, this may be achieved by cutting, burning or the use of chemical controls.

a) Cutting. Allen motor-scythes have been used for small areas but the presence of debris and spent ballast in the long grass severely limited their value. Eastern Region have flail mowers in the Norwich and Stratford Divisions, and expect more to be purchased.

b) Burning. Eastern Region positively discourage any use of fire as a management technique because of the risk to neighbouring properties and to rolling stock and cables. In Southern Region, however, controlled burning is allowed throughout the year at the discretion of the lengthmen. It is argued that such fires cause less damage than accidental fires which are otherwise likely to occur in the tall vegetation.

c) Chemical controls. Spray trains apply herbicide between April and July to approximately 21,000 single line miles of running track each year. Pre-emergence control is mainly practised, but post-emergence treatment is applied where necessary. The aim is to ensure that the width of ballast should be 98% weed-free, and the cesses and inter-track spaces 95% weed-free.

The spray trains are equipped with a range of nozzle configurations to provide different patterns of spray as desired, and sophisticated arrangements for altering the proportions of chemical mixes and rates of application. The application rate of chemical per track mile varies according to the type of chemical used, density and type of weed growth, and the effectiveness of previous herbicide treatments. About 75 miles of line per day are usually treated, varying according to application requirements, watering points and normal traffic considerations.

Eastern Region is the only Region to have its own spray train. 4,600 miles of track were treated during the period from the first week of April to June 1976. The remaining 25 per cent of track in the Region was sprayed under contract by Messrs Fisons Ltd. and Messrs Chipman Ltd., who sprayed the Norwich, and the Stratford Divisions respectively. These two firms are the only contractors to have their own spray trains.

In London Midland Region, Chipman's train sprays the track of the Birmingham, London and Nottingham Divisions, and Fisons operate on the remainder.

In Southern Region, Chipmans cover the Central and Southwestern Divisions, and Fisons spray the track of South-eastern Division. In Western Region, Chipmans are

responsible for the South Wales Division and part of the Bristol Division, and Fisons for London Division and the remainder of the Bristol Division. There is no fixed divisional pattern for operations in Scottish Region.

Chemicals are also used to control weed growth on off-track areas, such as sidings, signal boxes and areas where fires might cause serious damage to cables, apparatus and structures. Some 12,000 acres were treated in 1975. Application is generally made by BR staff in Southern Region, and by contractors elsewhere.

A specimen tender form for the control of weeds is given in Appendix A, which indicates the detail given by BR in identifying areas of treatment, and the measures taken to ensure that the appropriate type of chemical is applied in the correct manner. Contracts are normally awarded for three years.

Herbicides in use. A list of weedkillers utilised by BR CCE staff is given in Appendix B. Of the chemicals shown atrazine, bromacil, sodium chlorate and diuron are soil acting compounds. Aminotriazole is a non-selective, foliar applied, translocated material, frequently mixed with soil acting herbicides to give wide spectrum control. Dalapon, 2,4-D and 2,4,5-T are foliar applied, translocated, selective herbicides. 2,4,5-T is used specifically on woody growth, and dalapon against grasses and reeds. All these compounds have been in use for many years and have been cleared under the Pesticide Safety Precautions Scheme. Strictly speaking their use on railway land comes outside the Agricultural Chemicals Approval Scheme (ACAS), and several of the brand names shown in Appendix B are not included in the 1976 edition of the ACAS list of approved products.

However, it will be noted in para 5 Appendix A, that outside contractors are required to use products that have been approved under the scheme.

Chemical control of scrub. With the development of scrub since the ending of regular management, there is now an increasing interest in the use of chemicals to control encroaching woody growth on banks and cuttings. Messrs Peter Waring (a Suffolk firm of contractors) have been conducting scrub control experiments over a period of two to three years in Eastern and Western Regions with foliar applications of chemicals. The firm re-sprays where necessary and is now prepared to guarantee control for a minimum of three years. Divisional staff and contractors elsewhere have cut areas of scrub, and followed this up with chemical stump treatment.

In Southern Region, Chipmans have used a spray train over a number of years to apply grass retardent in limited trials in the Horsham area, and in the Western

Region they applied a grass retardant to banks and cuttings between Oxford and Worcester in 1970 : the trials have not been repeated. Both Chipmans and Fisons have proposed the use of spray trains in London Midland Region for 'hosing down' areas requiring brushwood control, and have made experiments in the Birmingham Division, and in the Liverpool Division, respectively.

Pest control. All Regions are under pressure in particular localities to control excessive numbers of rabbits and, in some parts, foxes. In December 1974, it was estimated that British Rail spent £150,000 on killing rabbits and on associated scrub clearance. This included payments of between £3,000 and £4,000 to Rabbit Clearance Societies. In February 1975, the BR Property Board supported the National Farmers' Union in urging the re-introduction of grant aid for such Societies. It described how railway lines often formed the boundary between two farms and that, unless both farmers and the Board co-operated in a single clearance operation, the initiatives taken by one or two parties proved futile. The Board commented, 'Experience has shown that in most areas it is only the availability of grant aid that provides the incentive to farmers to get together and form Rabbit Societies, and only such Societies will arrange comprehensive clearance' of the type required by the Board.

There are instances in Cornwall of badgers' setts seriously weakening banks. Red deer cause significant damage on the line from Fort William to Mallaig in Scottish Region by jumping over fences and initiating or accentuating the erosion of banks and cuttings. The slopes have to be strengthened with heavier stone.

Advice on control work is given by the Disinfestation Section at Manchester (see Scientific Services, page 8). The work is largely carried out by BR staff in Eastern Region, and by contractors in other regions. Rabbit clearance societies are used, where still in existence. Extensive areas of scrub may have to be cleared in order to facilitate control where numbers of rabbits are excessive.

Ballast cleaning. Track is relaid on average once in 30 years, and the ballast sieved or cleaned about once in 15 years, although on such heavily used lengths as the Edinburgh to Glasgow line renewal may occur at least once in 10 years. Since 1960, ballast cleaning machines have been used on a significant scale, depositing the dirty ballast and refuse in a more regular manner along the sides of the permanent way, in ridges up to five feet wide at the base and three feet high. In some parts of Eastern Region, these machines may have been used up to three times.

The type of ballast varies. In all cases, the trackside ridges will also contain large quantities of dirty slag, coal dust and oil, and herbicide. About three or four years may elapse before most of these ridges begin to be colonised by vegetation.

In Western Region, the dirty ballast is not allowed to remain on cutting slopes unless it is intended to load and remove the material soon afterward. On embankments, it is spread over the slopes, in the interests of tidiness. In other regions, the dirty ballast is generally allowed to remain on the banks and cuttings, although so much has now accumulated along some lengths of line that the ridges will soon have to be trimmed or removed in order to prevent the material slipping into the cesses. During the last three or four years, Scottish Region have sold increasing quantities of spent ballast to contractors and local farmers for use in roadmaking. In many cases, the machinery can deposit the ballast directly onto the land of the adjacent farmer for his use.

Drainage. The introduction of continuous welded track and concrete sleepers has made good cess drainage especially important, and recent improvements have generally been to unprecedently high standards. These improvements may not, however, have significantly affected the drainage regimes of the banks and cuttings.

Grouting. This process is extremely economic in helping to strengthen banks. It was pioneered in Western Region and has been a standard practice in Western, Eastern and Southern Regions for over 20 years. Grouting appears to be less widely used elsewhere. Where adopted, the composition and drainage pattern of the banks and cuttings may be entirely transformed.

The regional structure of British Rail and vegetation management

Current practices for control and maintenance of vegetation on railway land are organised within the regional and divisional framework of British Rail. Detailed information about the methods used at specific localities can be obtained by contacting the appropriate Regional Chief Civil Engineer's office.

In the account of contemporary management given above, reference is made to procedures and experiences of individual regions in order to illustrate general points. Differences in practice and emphasis between and within regions are in some cases significant, but their impact on the wildlife content of the railway banks and cuttings should not be exaggerated. Since nationalisation, a unified management policy has been introduced, which reflects the overall resources and

capacity of British Rail. The differences engendered by the regional structure have been gradually removed, and their bearing on a scientific understanding of wildlife on the banks and cuttings is now relatively small. As indicated, the general policy throughout British Rail is one of minimum intervention, with any management that is carried out being done on an opportunity basis, or else very locally in response to a specific urgent problem. Areas that are regularly and consistently managed on the pre-1970 basis no longer exist as part of a deliberate regional, divisional or area policy.

WILDLIFE ON RAILWAY PROPERTY

It is the purpose of this section to indicate the stages in the development of formal, official interest in the value of railway banks and cuttings for wildlife, and the response of British Rail to requests to take nature conservation into account when carrying out management work.

Identification of areas of concern

On 12 April 1961, a member of parliament asked the Minister of Transport if he would direct the British Transport Commission not to use toxic sprays for the proposed treating of over 3,000 miles of railway line. The Minister replied that this was unnecessary because 'British Railways use only non-toxic weed killers and that no change in this respect is envisaged'.[1]

A few days later, the head of the newly-established Toxic Chemicals and Wildlife Section of the Nature Conservancy 'strongly recommended' that the Nature Conservancy should seek more details of the proposed use of weedkillers on railway lines as 'a matter of great urgency and importance'.[2] It was 'quite conceivable that even a few days delay might be disastrous'. The grass banks and cuttings owned by British Railways included a wide range of habitats. Many were rich in species and had remained relatively undisturbed since the time of their construction. Railway verges tended to be richer in species than roadside verges : he reported that a recent survey in Huntingdonshire, using the Cowslip as an indicator species, had identified 10 colonies (360 plants) along a length of 25 miles of roadside; six colonies (1,000 plants) had been found on seven randomly selected lengths of railway, each one-third of a mile long.

He went on to point out that, at a time when modern agricultural techniques were leading to the destruction of hedgerows and permanent pastures, the conservation value of the banks and cuttings had greatly increased. They had become exceedingly important reservoirs for wildlife : in many districts of Eastern and Midland England, the banks and cuttings provided the last resort of certain plant and animal species. Their survival could not be taken for granted : everything depended on the continuance of existing management policies on the part of British Railways.

The minute described how special trains had been used since 1960 for spraying an area of up to seven feet from the track with Weedex or a very dilute form of sodium chlorate. A trip made by a member of the Toxic Chemicals and Wildlife Section on one of the trains operated by Messrs Fisons Ltd. indicated that special

care was taken to prevent the drift of spray, and the operators of the train appeared 'to be strikingly efficient about this'. At present there was no damage to the flora and fauna of the banks and cuttings, but he warned that 'there is a very real danger that spraying will be extended from the immediate area of the rails to that of the embankments and cuttings in the future'. The minute concluded that 'no departure (should) be made from existing practices without consultation with the Nature Conservancy. Formal liaison should be established between British Railways and the Nature Conservancy over this matter as soon as possible'.

In July 1961, the Chairman of the Nature Conservancy wrote to the Chairman of the British Transport Commission, asking for confirmation that no change in spraying practice was contemplated and that the Nature Conservancy would be consulted if, at any time in the future, it was intended to spray a wider area. The letter stressed that the Nature Conservancy fully appreciated the great difficulties faced by British Railways, particularly those arising from the cost of manual labour and need to control pest species. But it stressed that the banks and cuttings were 'a national asset, both from the scientific and other points of view' in providing a 'protected harbourage' for wildlife.[3]

The Chairman of the British Transport Commission replied by assuring the Conservancy that only the track and cesses would be sprayed. Non-toxic weed killers would be used on 'a very limited scale' where grass-growth might interfere with cables. In one or two instances a brushwood killer was used to eliminate brambles as part of rabbit clearance schemes. The amount of disturbance to 'natural growth on the railway slopes' was minimal.[4]

During the remainder of the 1960s, interest was confined almost completely to the possible use of disused railway lines for nature conservation purposes. In a paper on the disposal of abandoned railway lines in 1963, the British Rail Board expressed its readiness to set up a regular procedure whereby the Nature Conservancy was informed of the lines for disposal in the hope that negotiations might be opened 'to the mutual advantage of both bodies'. Thereafter, lists of closed lines were sent to the Nature Conservancy, which passed them on to the voluntary bodies in the nature conservation movement.[5]

Policy on controlled-burning and its effects on wildlife

It was not until 1971 that attention was again focussed on the slopes of railway lines still in use. In April of that year, an extensive area of grass and scrub was burned between Cheltenham and Honeybourne, following complaints from local

farmers that foxes were causing injury to local flocks of sheep. A local naturalist protested at the devastation caused to nesting birds by the fire, and demanded that the licence which allowed British Rail to burn their slopes during the nesting-season should be revoked.

In response to an enquiry from the Nature Conservancy, the Chairman of British Rail explained why the licence was necessary.[6] Until the late 1960s, a swathe of grass was traditionally cut at the top and bottom of the slopes, and the grassland covering the remainder was burned two or three times a year. This helped to stop grass from seeding, and the seeds from drifting onto the cess and track ballast where, in time, weeds would grow and impede drainage. Controlled-burning and cutting also helped to reduce the chance of sparks from steam trains causing accidental fires which could easily spread to neighbouring properties. To facilitate this very necessary management work, the Ministry of Agriculture has issued a licence (Statutory Instrument 1949, 495) which allowed the slopes to be burned at any time of the year, thereby excluding British Rail from the Provisions of the Heather and Grass Burning (England and Wales) Regulations (Statutory Instrument 1949, 386).

The Chairman of British Rail conceded that management policies had now changed. During the 1960s, the introduction of spray trains had virtually eliminated any risk of weed growth in the cess and track ballast, and the replacement of steam engines had greatly diminished the risk of accidental fires, but he insisted that the licence was still required for controlled-burning throughout the year. Too much scrub and grass growth would threaten the safe-working of the railway and provide cover for such pests as the rabbit and fox. It was, for example, much cheaper to burn the scrub cover periodically than to allow the rabbits to establish themselves and then employ trappers. Whilst Divisional Civil Engineers were instructed to confine burning to the winter months wherever possible, there were occasions (perhaps due to bad weather or insufficient labour) when this could only be done in the bird-nesting season.

When the Department of the Environment sought its views, the Nature Conservancy supported British Rail in opposing any move to rescind the licence for year-round controlled-burning. Not only was it necessary to clear scrub in some parts for safety reasons, but controlled-burning would help to conserve those grasslands which had previously been maintained by fires caused by the sparks of steam engines and by the grazing effects of rabbits before myxomatosis. In a memorandum of 1975, the Nature Conservancy Council concluded that burning was an acceptable

form of management from the wildlife point of view, so long as 'very large stretches are not treated at the same time'. It was important to retain a mosaic-effect in the vegetation.[7]

In a letter to the Royal Society for the Protection of Birds (RSPB) in 1972, British Rail described the effects of controlled-burning on bird-life as negligible in view of the overall increase in the area of scrub. Even where burning continued into April, only resident nesting-species would be harmed, and they would have 'further broods later in the year'. The correspondent concluded that 'I am not sure what the long-term effect of the discontinuation of the regular grass cutting will have on the running of the railway, but I am sure that present policies are much better for the preservation of birds'.[8]

The formulation of management policies was nevertheless still at the discretion of British Rail, and the Nature Conservancy continued to press for closer liaison over the timing and location of work. However, a practical difficulty was identified in 1972, when the Department of Education and Science suggested that British Rail should give a written guarantee that no burning could take place before consulting the Nature Conservancy. Such a proposal immediately aroused fears within the Nature Conservancy lest its regional staff should be overwhelmed by requests for advice. There were simply too few officers to cover every proposed fire, in view of all their other commitments.[9]

The RSPB pressed for a different kind of control, namely 'a close season for scrub cutting'. At a meeting in 1973, representatives of the RSPB suggested on eleven-, and preferably a fifteen-, week close season, extending from 1 April to 15 July in each year. This would not only cover the main breeding season, but the ban would be particularly helpful in protecting 'such scarce and local birds as whinchats which in some areas have become closely associated with, or even dependent on, railway embankments'. When clearance took place, clumps of hawthorn, bramble and other scrub might be left as cover for the birds.[10]

In the course of further correspondence in 1976, British Rail told the RSPB that the Regional Chief Civil Engineers had drawn the attention of their staff to 'the need for a close season, but it is unlikely that the Supervisors can remember the dates'. To help remedy this, the opportunity was being taken to insert a short section on the need to protect birdlife in the Trackman's Manual which was being revised. This section now states:

> to prevent disturbance to nesting birds, scrub clearance and grass burning should not, unless essential, be carried out between the beginning of April and the middle of June. Wherever possible complete removal of scrub cover should not take place, small clumps being retained to afford nesting sites for birds.

Due to difficulties in compiling other parts of the Manual, the Code of Practice had not been printed and circulated by the end of 1976 (see page 13).

The continued trend toward scrub and woodland was further emphasised in a letter from the Chief Civil Engineer to the Department of the Environment in May 1976. The virtual cessation of regular cutting and burning had 'already led to bramble and scrub problems in places, and unless some action is taken eventually rail passengers will lose their open views of the countryside'. He described how 'the Nature Conservancy are seriously concerned about the risk of the loss of the only remaining large areas of "natural" grasslands within the Eastern part of England ... it is likely that this natural grassland on railway land plays a greater part in the national ecology than trees on railway land'.[11]

Policy on the use of herbicides and their effects on wildlife

Further impetus was given to demands for greater liaison when the Nature Conservancy Bill was debated by parliament in July 1973. A member of parliament referred to the desirability of British Rail consulting the Nature Conservancy Council on the management of railway slopes, and the Minister, in replying to the debate, supported the idea. A few days later, one of the Conservancy's regional officers emphasised in an internal minute that there was still no formal liaison between the Conservancy and British Rail, either at a national or local level. He warned that escalating laboour costs would soon place 'strong pressures on Divisional Engineers to experiment with the use of herbicides to prevent grassy swards from developing by natural succession into scrub and tree dominated communities'.[12]

Matters again came to a head in 1975 when the Nature Conservancy Council learned that a three-year contract had been placed by British Rail for spraying scrub with herbicides. It was decided to check the facts as 'a matter of considerable concern and urgency'. In response to enquiries, British Rail advised the Nature Conservancy Council that 'we do not now resort to chemical spraying to clear grass and weeds from the lineside. Not only is this expensive to carry out, but it is difficult to prevent chemicals drifting outside the areas under attention'. Instead the grass growing around cables and buildings was cut, and the remainder was burned where necessary.[13]

When the Daily Telegraph published a report of paraquat being used to control brambles along a two-mile stretch of railway embankment at Berwick in September 1975, the Nature Conservancy Council sought further clarification. British Rail responded by describing the spraying as an experiment, adopted because of the impossibility of finding sufficient staff to carry out the more traditional methods of control. A month later, The Guardian published a letter complaining of the use of fire as a management tool : the Chief Civil Engineer for British Rail replied by defending the use of controlled burning, but added 'control is now mainly achieved by using weedkillers and growth inhibitors'.[14]

The situation was reviewed in an internal memorandum of the Nature Conservancy Council, which described how British Rail had 'been most helpful in resisting pressures to use herbicides on embankments and cuttings', and that it would be a tragedy for nature conservation and aesthetic reasons if a new policy for the widespread use of herbicides and/or growth retardents was introduced. On the other hand, 'a small amount of selective spraying would not be harmful from the national point of view if it could be controlled'. In a letter to British Rail in November 1975, the Nature Conservancy Council proposed closer liaison, adding that 'since it is clear that some railway verges are more important than others as reservoirs of wildlife ... it may be practicable to reach an agreed schedule indicating the kinds of and types of verges which should not be sprayed and conversely those which could be sprayed without detriment to nature conservation. In these latter cases, it would be valuable to have agreement about the kinds and frequency of spraying'.[15]

In a similar review of the situation in April 1976, the Chief Civil Engineer for British Rail commented, in an internal memorandum, that there was general acceptance of the fact that 'once brushwood and brambles had formed on the embankment slopes, there would be no environmental reasons why these should not be sprayed with proprietory brushwood killer, provided that this was done with hand held sprays and was restricted to areas of scrub only'. However, the resources for this work were necessarily limited, and the chemical had to be selected with considerable care. Whilst the paraquat used at Berwick had killed the ground weeds, the main cause of the trouble, the brambles, had suffered only a temporary die-back. Although the diluted paraquat did not constitute a health hazard, 'there were very serious risks if the undiluted material is drunk'. The contractors had agreed to find alternative chemicals not on the Poisons List.[16]

Nature reserves on railway property

Most of the Sites of Special Scientific Interest on railway property have been notified on account of their geological interest. The cuttings provide some of the finest exposures of certain rock formations. However, several areas of borrow pits have also been scheduled for their botanical and ornithological interest. In 1971, two sites in Huntingdonshire were scheduled. One of these at Five Arches Bridge, between Huntingdon and Peterborough, consisted of a series of borrow pits with an unusually large variety of willows and osiers, and the unpolluted areas of open water were an important refuge for birds in an otherwise intensively arable area. The nearby Woodwalton Railway Marsh was scheduled because of the wide variety of plants in the small base-rich marsh, which were becoming increasingly rare on the neighbouring farmland.[17]

In negotiations with British Rail over the scheduling of these two sites, the East Anglian Region of the Nature Conservancy stressed that scheduling would 'in no way diminish the rights of railway employees and engineers to enter and carry out any necessary inspections on works upon the land'. The Conservancy asked to be given 'prior notice of any large scale works which might extensively damage the vegetation', but this was left entirely to the 'discretion' of British Rail. In response to a request from the District Estate Surveyor of British Rail, the Conservancy agreed to exclude the actual railbed and banks from the scheduled area of Five Arches : the 'main wildlife interest' was centred on the open water bodies of the borrow pits.

Appendix C identifies Sites of Special Scientific Interest which include or are adjacent to railway property. The latter have been included because the use and management of the banks and cuttings of the permanent way might conceivably have an important bearing on the wildlife content of the neighbouring SSSI.

At a meeting with British Rail in 1973, representatives of the RSPB stressed the potential value of many lengths of railway bank and cutting as nature reserves. They cited how several county naturalists' trusts had entered into agreements with local authorities for the management of selected roadside verges as nature reserves, and suggested that 'many trusts would (also) welcome the opportunity of co-operating with British Railways regarding the designation of particular stretches of railway embankment as of special scientific and conservation interest'.[18]

There were already a few precedents. In 1971, the Bedfordshire and Huntingdonshire Naturalists' Trust had entered into an agreement for the lease of 14 acres of land

at Denton Covert, running parallel to the railway line through Holme Fen, Huntingdonshire, separating the railway from the National Nature Reserve of Holme Fen. This new Trust reserve was designed to conserve examples of fen birch woodland, together with associated plants and animals : the Trust has also developed an area of grassland for the encouragement of such rare plants as Luzula pallescens, and to provide a firebreak between the railway and woodlands of the reserve.[19]

The Trust paid a nominal rent of £10 per annum for the reserve of Denton Covert : as its Estate Officer pointed out, the Trust was providing considerable help to British Rail by taking over responsibility for installing a fire break and by 'maintaining the property in an improved manner'. From British Rail's point of view, however, such areas of land were almost insignificant. When the Trust suggested leasing the scheduled sites of Five Arches and Woodwalton Railway Marsh from British Rail in 1971 (see above), the District Estate Surveyor replied that he was 'unable to give any priority to these small lettings', and no lease was arranged.

The Conservation of Wild Creatures and Wild Plants Act, 1975

The Act made it illegal to kill, harm, possess or offer for sale any plant or creature included in the schedules of the Act, or any species subsequently added to those schedules. However, the Act provided exemption for any person acting 'in pursuance or furtherance of any obligation imposed, or in exercise of any powers conferred, by or under an Act of Parliament', and this was interpreted to mean that British Rail was exempt from the terms of the Act. Nevertheless, the Western Region of British Rail informed the South-west Region of the Nature Conservancy in September 1975 that it wished to provide the maximum protection possible to any scheduled species which occurred on railway banks and cuttings.[20]

In its reply, the South-west Region of the Nature Conservancy Council gave information on two scheduled species, the sand lizard and smooth snake, which occurred on at least three lengths of line, namely:

1 the Swanage to Wareham line, where 26 sand lizard adults had been recorded at Norden and where a hibernation area for the smooth snake had been identified at Furzebrook.

2 the Bournemouth/Poole/Dorchester line, where both species were found at Moreton to Winfrith, Sandford to East Holton, Rockley to Hamworthy, Poole to Parkstone, and Branksome to Meyrick.

3 the Christchurch to Southampton line, at Hinton Admiral to Walkford (probably both species), Sway to Setley (smooth snake only), and Woodfidley to Ashurst (smooth snake only).

The Region gave the grid references to the exact location of the sites and asked that the information should be treated in confidence.

Due to changes in land use and management, the heathland habitat of these reptiles was becoming extremely fragmented, and often the only surviving tracts occurred on railway property. The South-west Region of the Nature Conservancy Council, therefore, stressed the need to avoid damaging the banks and cuttings, especially where the scheduled species occurred. It would be better to cut down scrub rather than resort to burning or chemical controls. In order to minimise labour costs, volunteers such as the Conservation Corps might be employed. It was also important to avoid using Cyanide gas for controlling rabbits and foxes when the reptiles were hibernating.

In a review of management policies along these lengths of line, British Rail agreed to ban gassing and restrict the use of burning, but decided not to interfere with the tipping of waste from ballast-cleaning. Not only would a ban on tipping be impracticable but also unnecessary because the snakes and lizards could probably escape from any loose material falling upon them. In order to put these special arrangements into effect, and yet keep the presence of the scheduled species secret, it was decided to implement them over a longer length of railway line than that requested by the Nature Conservancy Council. As a result, the policies were applied to the entire length of line affecting the New Forest and Dorset sites.

Ecological research on railway property

In view of the importance of railway property for wildlife and the likelihood of changes in management policy, there was an urgent need for basic ecological information on the characteristics of railway banks and cuttings. From the early 1970s onwards, the Toxic Chemicals and Wildlife Section of the Nature Conservancy pressed for the opportunity to obtain this information, noting there were similarities with motorway verges on which some work had been completed.

In April 1976, the Nature Conservancy Council commissioned an ecological study of railway banks and cuttings from the Institute of Terrestrial Ecology. Following the visits to the Headquarters of British Rail, described in the Introduction to

this report, the Civil Engineers' Committee of British Rail agreed to help in selecting a number of suitable sites for detailed field investigation. In a letter of April 1976, the Chief Civil Engineer stated, 'in the long term it is to be hoped that the Institute will be able to recommend a low cost treatment of railway embankments that will satisfy both the railway and ecological requirements'.

PART II - FIELD WORK

INTRODUCTION

Safety

Questions of safety were impressed upon us by BR during our meetings and we were always very conscious of the safety aspects of our work. For this reason we did not enter tunnels or cross viaducts, although this made access to some areas more difficult. We generally walked in the cess rather than on the track, always against oncoming traffic, and wore high visibility jackets. We stopped walking and stood back when a train was heard approaching, as the noise of one train could mask the noise of another coming from the opposite direction. We acknowledged our presence to engine drivers, and liaised with signal box staff where there might be any question in their minds about our authority to be on railway land. We contacted the appropriate BR Regional/Divisional/Area staff to inform them of the dates of our working in their sections, and carried the relevant Walking Permits. In the Southern Region we were especially aware of the hazards of the 750 volt conductor rail.

Period of investigation

The fieldwork was done between 7 June and 23 September 1976, during a period of extreme drought. Many spring flowering annual plants will have been under-recorded, as will other plants that may have been affected by the dry weather.

Choice of sites

In view of the lack of information about the ecological characteristics of railway land referred to earlier, it was decided to base the initial field reconnaissance upon as detailed as possible investigation of a limited number of sections, arranged to give experience of the various criteria that might be used in a later, more objective, programme. It will be appreciated that in the short period of time between the approval of this project and the start of fieldwork, it was only possible to arrange a simple programme with BR, which nevertheless involved a number of meetings, the issuing of passes, and liaisons with nominated BR staff.

The original five sections for investigation were thus chosen on the basis of the following criteria:-

a) Needing to fall in different regions of BR.
b) Acceptability to BR, with particular respect to safety.
c) N-S orientation of the route so as to avoid complications that might be introduced by northerly versus southerly aspects of the vegetation.
d) Variations in geology over the chosen section.
e) Geographically spread over the country.
f) Previous biological information, eg Dony's site at Sharnbrook Summit (Dony 1953).
g) Convenience (eg the Huntingdon-Peterborough line in close proximity to Monks Wood).

Unfortunately the section at Shrewsbury that had been chosen to represent the western part of the country, and also the Western Region of BR, had to be abandoned for logistic reasons.

Thus of the four sections that were visited, north, south, midland and eastern parts of the country were represented in the Southern Region, London Midland Region, and Eastern Region of BR. There were geographical contrasts between the lowland heaths and chalk outcrops of the Wealden series in the south; the carboniferous limestones, boulder clay and Permian sandstone of the northwest; and the less dramatic boulder clay dominated areas over undulating Jurassic strata at Sharnbrook and close to Monks Wood, representing the midlands and the east, in regions of extensive, intensive arable agriculture.

Recording procedures

Two levels of recording were made: a) notes taken during an initial walk over the sections, followed by b) more detailed records at individual sampling sites selected from the preliminary assessment of the whole section.

On the four sections of the railway that we visited there were quarter mile posts showing distances from London termini; in other places the distances might be shown from some other major railway centre. In addition on some lines chainage distances were marked between mile posts. However, these distance markers could be missing from less important lines (eg the freight line that we travelled on between Blackburn and Hellifield), so that they cannot be relied upon.

In the preliminary 'walk-over' the quarter mile posts were used as recording points where brief notes were made, and photographs of both sides of the

railway were taken. The photographs in black and white, and/or in colour, are held at Monks Wood. Whilst the quarter mile posts provided a convenient sample of the formation and vegetation types over the sections of line, the rate of change from one formation (cutting, embankment, flat) to another was often so rapid that major features were frequently missed, even at this moderately intensive level of sampling.

The choice of detailed sampling sites was made subjectively with the intention of providing a range of examples of (1) the herbaceous vegetation types most commonly seen, (2) of particular discrete areas that appeared qualitatively different from the common types, (3) of particularly herb rich grassland communities.

In the sampling of these sites, records were taken in uniform areas of vegetation covering a number of facies of the chosen types occurring at that site, using a rectangular frame 1 m^2, divided in 10 subquadrats of 0.1 m^2. Two or more quadrat records of a particular facies might be taken depending upon the area. Presence of species in each subquadrat was recorded, together with an overall assessment of cover/abundance on the Domin scale for the complete 1 m^2 quadrat. The results of these records are detailed in Appendix D. In addition to the quadrat records, lists were made of additional species not in the quadrats but occurring in the same apparent vegetation type in the immediate vicinity.

In areas of very coarse, matted, or tall herbaceous vegetation (eg some Brachypodium pinnatum or Arrhenatherum swards, reed beds or areas of bracken) a 2 x 2 m^2 quadrat was used in which Domin assessments only were made.

In some areas of dense bramble, or of very dried-up, open, thin vegetation (eg following burning), or when there was a very large area of very uniform vegetation, a variation on the standard 1 m^2 recording method was attempted late in the season, where two 1 m^2 quadrats were placed by random co-ordinates within a larger 100 m^2 quadrat, from which a total species list was made. The 1 m^2 quadrats were recorded by 0.1 m^2 subquadrats and overall Domin assessment as above. It was thought that this method used by L.K. Ward (private comm.) for scrub recording, might give a better representation of these vegetation types.

The complete list of 401 vascular plants for the sections of railway investigated in 1976 is given in Table 1, with the following additions:

Agros gig
Triti aes

Jugla sp.
Picea abi
Popul nig
Prunu sp.
Ribes san
Rubus ida
Ulmus sp.

Anthr cau
Althe ros
Aquil sp.
Arabi sp.
Arabi tha
Arena ser
Aspar off

Brass rap
Campa lat
Carex paniculata
Ceras bra
Centr rub
Cheir min
Cuscu epit
Dacty mac ssp eri
Echin sp.
Epilo lan
Erige ace
Eupho amy
Hiera sp.
Hiera aur
Hiera brun
Hiera perp
Hiera umb
Hyper mon ?

Lathy lat
Lathy syl
Linar pur
Lupin sp.
Lyciu chi
Minua ver
(Montbretia)
Oenot ery
Osmun reg
Parna pal
Plata chl
Polyg mul
Salvia pra
Saxif umb ?
Scirp syl
Serra tin
Stach off
Sysim alt

Table 1. Species recorded on railway land June to September 1976.
See text for additional species.

GRASSES
Agrop can
REP
Agros can
STO
ten
41 Aira car
42 pra
82 Alope gen
84 myo
PRA
Antho odo
ARRHE ELA
Avena fat
Brach PIN
syl
Briza med
262 Bromu com
ERE
268 lep
*mol
ram
ste
Calam epi
Cynos cri
DACTY GLO
Desch cae
fle
Festu aru
gig
*ovi
PRA
*RUB
815 Festu lol
933 Glyce flu
max
Helic pra
pub
Holcu LAN
mol
Horde mur
993 sec
Koele cri
Loliu mul
PER
Melic uni
1296 Miliu eff
Molin cae
Nardu str
Phala aru
Phleu ber
*PRA
Phrag com
Poa ang
ANN
1499 com
1504 nem
*PRA
1506 sub
TRI
Siegl dec
Trise fla
Vulpi bro
2228 myu

WOODY-CLIMBERS
Acer cam
pse
Aescu hip
Alnus glu
Betul pen
pub
Bryon dio
289 Buxus sem
Calys *sep
Casta sat
Clema vit
Coryl ave
Crata mon
570 oxy
762 Euony eur
Fagus syl

Fraxi exc
Heder hel
Humul lup
Ilex aqu
1080 Junip com
Ligus vul
Lonic per
Malus syl
Pinus syl
1555 Popul tre
1611 Prunu avi
1614 dom
1616 pad
spi
Querc cer
1638 pet
rob
1675 Rhamn cat
1694 Ribes nig
1696 syl
uva
Rosa *
1707 arv
1708 *can
can
1712 mic
1719 pim
1714 *rub
1722 *vil
1726 Rubus cae
*fru
Salix sp
1784 alb
1787 aur
1788 cap
1789 *cin
1790 cin
1793 fra
1801 pur
1805 vim
Sambu nig
Sarot sco
Sorbu AR1
auc
1994 Spira sal
Syrin vul
Tamus com
Taxus bac
Theiy san
2063 Tilia cor
Ulex eur
2113 gal
2114 min
2115 Ulmus car
gla
pro
Vibur lan
2185 opu

HERBS
Achil mil
pta
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SUMMARY OF RESULTS

Detailed descriptions of the four sites, and presentations of the vegetation data are given in Appendix D.

Eastern Region BR Huntingdon-Peterborough section. 12 miles of track were surveyed, with a marked contrast between deep cuttings in boulder clay and Oxford clay in the south, and medium to very large embankments, borrow pits, and waste areas in the north, together with ditches and open water associated with the low lying fens. Two sites on the cuttings and three on the embankments were recorded in detail. These showed contrasting vegetation between base rich, relatively undisturbed but haphazardly burnt grasslands of the cuttings, and the much more disturbed vegetation of the embankments, often with encroaching scrub. Reed beds were common in the damper areas at the foot of the embankments, and there was invasion by bracken in the acid peatlands in the proximity of Holme Fen NNR.

242 species were recorded from the section as a whole. The highest average number recorded per quadrat in an individual facies was 25 species per metre square for an Arrhenatherum/Bromus erectus/Poa pra s.l. sward in the cuttings. The lowest average number was two species in a 4 m^2 of Phragmites and Urtica dioica at the base of the embankment running through Holme Fen wood.

In addition to the vegetation analyses, a comparison was made of the land use along the corridor of the line in the year 1844 (before the line was built), and in 1977. This showed the extent of the change from mixed arable, pasture and rough pasture with sedge, to almost universal arable in 1977. It was confirmed by a more detailed analysis of individual fields along a subsection of the route. A further analysis was made of land use in 1977 of an alternative corridor for the railway route proposed in the 1840's. The general effect was to show the contribution of the railway line in providing wildlife habitats in a predominantly intensive arable area, where these habitats would either not exist, or would be very significantly reduced, in the absence of the railway line.

A further overall analysis was made of the importance of the various habitats for birds. In contrast to the botanical interest, which tended to be concentrated on the herb rich grassland sites of the cuttings, the coarser vegetation on the embankments, the developing scrub areas, and the open water with fringing reed beds were more likely to be valuable habitats for birds.

The presence of two notified SSSI's and of two other sites of conservation importance was noted. Other suggested areas that might qualify at least as being of local conservation importance were also identified.

Southern Region BR Shottermill-Rowland's Castle (London-Portsmouth line). 13½ miles of track were surveyed across lower greensand strata to the north of Petersfield, and upper cretaceous strata to the south, with deep cuttings in chalk where the line crossed the ridge of the South Downs. Consequently the vegetation changed sharply in the region of Petersfield and the valley of the R. Rother from being markedly calciphilous in the south to markedly acidiphilous in the north. Four sites for detailed analysis of the vegetation were selected : one in the deep chalk cutting immediately south of the exit from the Buriton Tunnel through the ridge summit; one in an area of lower chalk/upper greensand on the northerly slope leading up to the ridge from Petersfield; one in acid heathy vegetation in the area of Liphook station; and a final small site in a more wooded area at Hammer Bottom two miles north of Liphook.

246 species were recorded for the section as a whole. The highest average number recorded per quadrat in an individual facies was 34 species per metre square in a Festuca rubra/Carex flacca closed sward, with 100% occurrence in subquadrats of Origanum vulgare, Plantago lanceolata, Poterium sanguisorba, at the Buriton Tunnel chalk cutting site. The lowest average number was for 9 species per metre square in the acid, shaded, low cutting site at Hammer Bottom, where Arrhenatherum, Festuca rubra and Equisetum arvense were the principal species. It was of interest to note that the average number of species recorded per metre square (for all facies) in the acid areas was 13, and the average total per facies was 34; whereas the comparable figures in the neutral/base rich area between Petersfield and the South Downs was 21 and 43, and in the chalk cutting was 29 and 63.

North of Petersfield in the acid areas of generally unimproved grassland, woods and streams it was not supposed that the vegetation and habitats of the railway track were of any conservation significance. South of Petersfield in the more base rich area there were herb rich grassland swards and habitats of recognised wildlife value, whose conservation importance would have to be assessed in relation to the existence of such attributes in other neighbouring land uses.

London Midland Region BR Bedford-Irchester. 12 miles of track were surveyed, crossing the boulder clay capped watershed between the eroded jurassic and the recent alluvial deposits of the Ouse valley in the south, and the Nene valley in the north. The Ouse valley part of the route was characterised by embankments across the water meadows, and cuttings through the ridges of higher ground left by the very sinuous meanders of the river. The boulder clay covered watershed included the Sharnbrook Summit area with a deviation of the slow lines through the Sharnbrook Tunnel and considerable cuttings, although the fast lines were also in quite deep cutting but at a higher level. Four sites for detailed analysis of the vegetation were selected. One of these included embankment and cutting in the R. Ouse valley area. The other three were respectively north and south of the Sharnbrook Tunnel by the slow lines, and in the Summit region of the fast lines, in the approximate area of the previous records made by Dony (1953).

237 species were recorded for the section overall. The highest average number of species per quadrat in an individual facies was 22 per metre square in a Poa angustifolia/Lotus corniculatus sward of desiccated, rabbit grazed vegetation in cutting south of Sharnbrook Tunnel. The lowest average number was of 7 species per metre square in an open desiccated area of Brachypodium pinnatum/Poa angustifolia with Lotus corniculatus on the northeastern aspect bank of the fast line cutting at Sharnbrook Summit. The very disturbed area of railway land in the R. Ouse valley was recorded by general listing, from which 98 species of often ruderal plants were noted on embankment and cutting over a half a mile length of track. The embankments in particular were heavily covered in ballast cleanings, cinders and other spoil and showed signs (charred woody vegetation) of recent fires.

The area of the baulk over the Sharnbrook Tunnel is an existing Beds and Hunts Naturalists Trust site of conservation importance, whilst banks near Wymington to the north are important as the habitat of the national rarity Cerastium brachypethalum. Otherwise the railway may be said to make an important contribution to wildlife habitats in a region of intensive agriculture associated, however, with woods, mineral workings and other artefacts.

London Midland Region BR Outhgill-Appleby (Settle-Carlisle line). 13½ miles of track were surveyed in an area of millstone grit and carboniferous limestone interspersed with boulder clay, and permian sandstones also with boulder clay. The route passed from the unenclosed moorland of Mallerstang Common, through

a region of predominantly permanent grassland and occasional arable down to the valley of the R. Eden. There were three tunnels and four major viaducts; the section was characterised by rapid changes from cutting to embankment. Five sites for more detailed analysis of vegetation were selected. The first south of Birkett Tunnel was in the moorland region, and the opportunity was taken to compare the vegetation on the Nardus/Holcus lanatus/Cynosurus, Juncus, Carex, Galium saxatile and Trifolium repens dominated vegetation of the moor, with the lusher Agrostis tenuis/Festuca rubra/Holcus lanatus, Achillea millefolium, Plantago lanceolata, Potentilla erecta dominated vegetation inside the railway fence. It was noted that the most significant development of woodland in this area was also inside the railway boundary free from grazing pressures. Other facies recorded at the site were on the steep rock cutting by the tunnel itself, in grass swards on the cutting farther south, and on a very large embankment. Further sites were taken to the north associated with three disused station areas (Kirkby Stephen, Crosby Garrett, Great Ormeside), and the north entrance to the Helm Tunnel. Both cuttings and embankments were recorded.

No general list of species was made for this section, but a total of 178 species was recorded in the individual facies. There is no reason to suppose that the total number of species from a list for the whole of this section would not be comparable to the number of c 240 recorded at the other sections. The highest average number of species per quadrat in one individual facies was 32 for a Brachypodium sylvaticum/Festuca rubra/Trisetum flavescens sward, with Carex flacca, Chrysanthemum leucanthemum, Lotus corniculatus, Plantago lanceolata, Sanguisorba officinalis, Succisa pratensis, in a cutting in the area of the disused Crosby Garrett station site. The lowest average number was 7 in a very coarse Brachypodium sylvaticum/Poa pratensis embankment vegetation, with Trifolium medium.

It seemed to us that there were a number of sites in this section that were of considerable conservation interest, and some that would be of conservation value even if similar areas were represented in the neighbourhood. If such areas were not present, there might be an urgent case for investigating the railway sites in detail with a view to assessing their need for sympathetic management and protection.

PART III - DISCUSSION

LITERATURE SURVEY

The best known and possibly the only account of the flora of a significant area of used railway land in Britain is that of Messenger (1968), for the old county of Rutland. A dissertation on the conservation interest of railways in Dorset was prepared by Jarman (1974). Dony (1974) had discussed some aspects of recording and interpretation of railway flora. Lousley (1970) emphasised the interest and potential importance of the flora of railway land.

When an account has been prepared shortly after the closure of the line (eg Burns 1964; Perring & Huxley 1965) the descriptions would have fitted that of the flora immediately before the line was closed. Nevertheless, with the impending closure of a line, management during the period of suspense is likely to be minimal, so that the process of change from a managed to an unmanaged situation would have already begun.

An account entitled 'A railway flora of Teviotdale' was published by Braithwaite (1976), describing fieldwork in 1975 of the line north and south of Hawick in Teviotdale, closed to traffic in 1969. It was noted in 1975 that this line was in a particularly interesting stage of floristic transition from vegetation that would have been typical during the days of active use and management, to early stages of the changes following abandonment. A reference was made in this paper to a similar, unpublished, study made in 1972 on a disused line between Galashiels and Gorebridge.

A particular difference that can be noted between the recorded floras of used and disused lines concerns the invasion of the ballast, and track bed if the ballast has been removed, of disused lines. Total weed control is practiced on almost the entire length of active railway lines, so that the dynamics of this invasion of the ballast/track bed after closure of a line is of particular interest in terms of the species first colonising, and the competition that takes place between herbaceous and woody plants for dominance as the vegetation cover closes over.

Searches have been made through all the British county floras published since 1930, and other botanical works containing references to railway land, for details of species that might be found on railway property. References in the

floras occur in the normal directory of species, or are included in specific habitat studies (eg Dony - 'Flora of Bedfordshire' 1953); otherwise descriptions might be found in the introductory chapters. In general, references to rough grassland species are under-represented in the floras for railway land, because they can be more easily found elsewhere. For a species to be mentioned as occurring it usually has to be (1) rare or absent elsewhere, (2) notably a 'railway' plant, or (3) occurring on the special habitat provided by the ballast and cinder bed of the permanent way. Only Messenger (1971) from Rutland, and Cadbury et al (1971) for Warwickshire, specify railway habitats for the majority of species known to occur on railways. Of these two, Messenger's list is the more complete. Bryophytes and Pteridophytes, which are both very important orders of plants occurring on railways, are often under-represented, as are more difficult groups of critical species such as the Rubi or the Hieracia. Thus the individual treatment of railway land for occurrence of species varies widely in the floras. Nevertheless, some 1,200 species are cited, and have been entered on punch cards, from which it is proposed to produce a computer print-out of the information in various forms. Floras having particular references to railway habitats, and occurrences of species, are listed below.

Flora of Bedfordshire (Dony 1953). Habitat studies nos. 1 & 45.
The Flora of Berkshire (Bowen 1968). Lists on p. 46.
Flora of Derbyshire (Clapham 1968). Habitat studies nos. 20 & 80.
Leicester and its region (Ratcliffe & Conolly 1972). Chapter 5, p. 140-1.
Flora of Rutland (Messenger 1971). Many references.
Flora of Surrey (Lousley 1976). Notes p. 46-8.
The Flora of Wiltshire (Grose, 1957). Subsection M, p. 724-5.
A computer mapped Flora of Warwickshire (Cadbury et al 1971).

In addition to specific accounts of the flora (and fauna), a number of appraisals have been made of disused railway land for recreation and nature conservation (eg Appleton 1970, Christian 1964; Countryside Commission 1970; Davidson 1975; Exmoor Society 1970; Lindsey County Council 1971, Parham 1972). Descriptions of railway habitats have also occurred in Regional and other surveys (eg Lloyd et al 1971) as part of more general descriptions of habitat and vegetation diversity.

Besides these botanical and planning papers, both zoological and geological works are known to exist but have not been seen. Likewise the titles of a

number of continental papers containing references to occurrences of plants on railway land have been seen, but only those of Suominen (1969a, 1969b) have been studied.

Literature on the use of chemicals for control of vegetation appear more frequently, usually written by the technical staff of the chemical companies involved. Thus the house journal 'Down to Earth' of the Dow Chemical Corporation of America is a frequent source of references to the use of the chemical picloram. Other relevant papers have appeared under the general title of Industrial Weed Control (eg Proc. N.C. Weed Control Conf. 1975 No. 30, 87-101). Two recent papers written from the railway point of view appear in the International Railway Journal (Anon 1976), and the Journal of the Permanent Way Institution (Castell 1976).

GENERAL DISCUSSION

Limit of the study

The work has been limited to active railways. These have the characteristics that administrative procedures exist for access, and that management rests in the hands of one organisation. Disused lines are often both fragmented physically and in terms of ownership, whilst management is haphazard or non-existent. Disused lines have many actual and potential attributes for wildlife and recreation, but the aims and problems of ecological investigations into them are different to active railways, so that it has been rightly decided that this project should be confined to railway land still in the hands of BR and managed by the Board.

Estimated acreage of land

An acreage of 6.6 acs/mile has been calculated for the Shottermill-Rowland's Castle section of the Waterloo-Portsmouth line, and 26 acs/mile for the Huntingdon-Peterborough section of the London-Edinburgh line. Messenger (1968) estimated 50 yards between boundary fences over 49 miles of railway in Rutland. If one deducts an estimated 10 yards for the track, then 40 yards is left for the verges, to give 15 acs/mile. Calculations by Way (1976) for the acreage of land by motorways, which have similar characteristics to railways, provided an estimate of 12.6 acs/mile. Alexander (1975) quotes 2.88 ha/km (11.4 acs/mile) for the entire area of the double track disused line from Okehampton to Tavistock. Over the 11289 miles of line in active use in 1976 (HMSO 1976) the acreage of associated land can thus be estimated at 74,500-293,500 acs, with the likelihood

that the actual figure is around the mean of 185,000 acs. This area is that associated with the track mileage, and will not include other possibly extensive areas associated with sidings, storage and port facilities, and other unsuspected areas owned by BR.

Types of formation

a) Flat areas - Where the track is on level ground with the neighbouring land the verges are usually narrow, and often disturbed by dumping.

b) Embankments - These are generally steep with angles of 30° or more. In recent years they have been much affected by dumping of ballast cleanings from the track, and have rarely been formally managed except for pest control requirements. Consequently they are generally covered in bramble or very coarse herbaceous vegetation, and in some instances with dense scrub and developing woodland. Where ballast has recently been tipped, an unstable scree habitat is formed supporting an opportunistic open vegetation of species such as Chamaenerion angustifolium, Heracleum sphondylium, Potentilla reptans, Papaver sp., Urtica dioica, Convolvulus arvensis, typical grasses and young scrub.

c) Cuttings - are often steep (that is steeper than are found in general by motorways), but less affected by disturbance. A narrow band of ballast may have been tipped over the lower 1.5 m of the bank, but this is unlikely to be very extensive in view of the danger of its sliding back onto the track. More attention has evidently been given to the regular mowing and burning of cutting slopes in the past, and the incidence of scrub and woodland on cutting slopes may still be related to the traditional management practices before 1970.

d) Stations and sidings - In the past these were usually kept 'tidy' by the station staff but this is rarely the case now. However, the effects of this comparatively intensive management are still evident in the vegetation patterns today. In particular herb rich swards with the finer grasses may be associated with station areas. Control of vegetation in sidings and around buildings and structures is currently achieved by the use of total weedkillers, but where these are not used ruderal vegetation and early colonists of the cinders and ballast are typical.

e) Borrow pits, quarries and disused land still in BR ownership - There is no functional management (ie related to the working of the railway) of these areas. They are only likely to be managed as a result of extreme pressure from

neighbouring landowners for the control of pests. They are often extensive and represent some of the few totally wild and unmanaged areas in the lowlands.

Management of vegetation

As noted in Part I, there has been minimal regular management of banks and cuttings in recent years for economic reasons. No evidence has been found that policies of regular selective management of vegetation by main lines exists at the expense of minor routes. Management appears to be on an ad hoc basis depending on the availability of labour (or cash for contracts), and the priorities involved. Nevertheless, a hazardous situation where vegetation is obscuring sight lines, threatening to fall on the track, or affect the formation (ie by weakening the structure or affecting drainage) is more likely to be dealt with on a major route than a minor one. However, as noted above, regular seasonal management of extensive areas is not practised, and the only control at the present time is of restricted local areas.

As a result of the lack of management over the last few years growths of bramble, scrub and woodland have proliferated. These are now reaching proportions where the railway is being affected and hazards of obscuration, damage to formations, falling branches, trees and leaves are producing real problems in addition to the traditional problem of access for pest control. With an acute shortage of suitable labour the Civil Engineers are under pressure to consider the chemical control of these growths. There is little doubt that the use of chemicals would provide the desired effects, but we have no data at the moment on the economic aspects of this work, or their effect on wildlife habitats. Whilst the use of total weedkillers on the track has been regarded as unexceptional by conservation organisations, the more extensive use of selective herbicides on the banks has been a source of concern to both the Nature Conservancy (Council) and the Royal Society for the Protection of Birds - see Part I.

Habitats and plant records

a) Habitats. It is evident from the 1976 field work that a very wide range of habitats occur by railway lines, and that some of these habitats (eg natural grassland in built up areas; herb rich natural grasslands in areas of intensive arable farming; mixed grassland and woodland habitats in areas of sheep grazed moorland) are only found in particular localities because of the railway. In addition the ballast/cinder habitat, and the tipped ballast on embankment habitat, are special to railways and are qualitatively different to other

habitats. Railway lines are found from sea level to over 1000 ft (Beattock Summit 1029, Aisgill 1169 ft), but are most commonly found on lower ground and especially following valleys. Because of the very low permissible gradients and the technology available at the time that the railways were built, tunnels and viaducts were more commonly used than the massive earthworks now associated with motorways, although some very large earthworks and other impressive feats of civil engineering were performed. The result of this is that the railways tend to keep to the lower agricultural ground, and as a consequence they occur in just those areas of agricultural change (NCC 1977) where wildlife conservation is under the greatest pressure.

b) Vegetation. We have found a wide range of grassland types and of herbaceous plants, all of which, in their various proportions one to another are likely to be referable to well known phytoassociations. However, it seems probable that the most common vegetation types are coarse ± herb rich grasslands; ruderal species and bramble (especially on embankments where there has been ballast tipping); and encroaching scrub.

The railways are typically 100 to 150 years old, although there is no guarantee at any given locality that some form of disturbance, drainage or restructuring has not occurred since. Nevertheless most of the major disturbances should be dateable so that an opportunity exists for the study of vegetation developing over a known period of time. It is well established (eg Wells et al for chalk grassland 1976) that there are gradual changes in the species composition of grasslands maintained as grasslands with increasing age, and that the botanical (and thus the conservation) interest also increases. Many railway grasslands are now becoming of an age that they represent the only grassland habitats of any antiquity in the surrounding countryside. Nevertheless, without some continuance of the management that created them, many of these railway sites are likely to be lost. Even now they are generally the exception rather than the rule, and are often associated with areas (such as rural railway stations) where there has been quite intensive management in the past.

In respect of the particular vegetation types that we have recorded, we have not had an opportunity to compare these with those occurring outside the railway boundary. However we do feel it likely that at all four of the sections we surveyed there were sites that would be of conservation importance in a local context, and in some instances in a national context. From the grassland point of view the cuttings were generally the most botanically interesting, although

some embankments, such as the base rich clay embankments at Woodwalton close to Monks Wood, can be important enough to require protection.

c) Zoological. We have not had an opportunity to make any studies of the fauna of railway land. An assessment of the potential of the Huntingdon-Peterborough section for birds is included in the report on that section. The concern of the RSPB about the management of railway land for bird habitats has been described in Part I. Special arrangements have been made between NCC and BR over the management of railway land in the New Forest and Dorset Heaths areas for the smooth snake and the sand lizard. Railway banks are a major habitat for rabbits, there are many records of foxes and some of badgers.

For the more mobile species of mammals, birds and flying insects, railway land may provide feeding ground or resting/breeding areas or both, but for less mobile animals railway land may provide a relatively protected preferred habitat for all activities, and so have a particular importance for them.

d) Geological. It is notable that the majority of SSSI's occurring on railway land (see Appendix C) are geological sites in railway cuttings, where there are good rock exposures either of the strata, or of fossil beds.

BR Organisation and points of contact for NCC

a) H.Q. Formal links already exist between NCC, GB HQ and BR HQ at the most senior level, and at managerial level in the Chief Civil Engineer's Office.

b) Regional. Although formal liaison should exist between BR Regional staff and NCC Regional staff, it is likely that the Divisional and Area Civil Engineer's Offices of BR will be most concerned with the implementation of NCC conservation proposals. It is thus suggested that the NCC Regional staff should contact the appropriate Regional Office of BR (where this has not been done already, and where it is thought desirable) in order to obtain an introduction to the Divisional Office of BR to establish a liaison at Divisional Civil Engineer/ARO level. It is possible that for day to day liaison this would be further delegated to Area or District offices of BR, depending upon the degree of responsibility held by them, which may differ from one BR region to another.

CONCLUSIONS

The programme of work described in this report has provided experience of the administrative procedures, logistics and particular problems of work on railway land. It has given experience of the physical nature of the land, and of a range of the vegetation types that are likely to be found, together with indications of the continuous variability of both. The result of this is that we have now a body of information on which to base assumptions as to profitable lines of investigation for the future of the project. This information, some of which is contained in the report, and some of which is purely personal, has been the basis of detailed discussions leading to the proposals made below.

PROGRAMME 1977/78

Objectives

In the light of experience gained in 1976/77 it is suggested that the objectives of this project, supposing that support continues at the levels proposed in the contract letter of 23 November 1976, should be:

a) To carry out an objective survey of BR lands in order to provide an overall assessment of the biological resource, including a comparison of the vegetation of cuttings and embankments.

b) To carry out separately surveys of sites on BR land that are known to be, or which may be, of special conservation interest.

c) To continue archival searches in order to provide historical data about railway construction and the development of vegetation on railway land, in particular:
   i) to relate the location of lengths of railway line to the geography, geology and soils of their respective areas,
   ii) to assess the age, methods of construction and subsequent management of banks and cuttings, and to relate these factors to the present-day flora.

d) To maintain liaison with BR staff in order to obtain information about present-day management and possible changes in management. To advise NCC on the implication of any changes.

e) To maintain a watching brief on the development of herbicides and growth-regulating chemicals, and other management techniques, that might be used in the future.

Criteria for Success

a) Resource Survey. The production of annual interim reports region by region, and of a final report on the railways of England and Wales.

b) Special Sites Survey. The production of a data file on the sites of conservation interest.

c) Archival Searches. Contributions to both the resources survey reports, and the special sites file.

d) Liaison with BR. The build-up of personal contacts in the Civil Engineer's departments at HQ, Regional, Divisional, Area and District levels of BR. The success of this liaison will depend upon the respect that we can build up for the relevance and objectivity of our work; this in turn should make easier the acceptance of any proposals based on the work that might be made by NCC to BR.

e) New Management Techniques. A background knowledge of the development of management techniques for natural grasslands, and, especially, for scrub control.

Methods 1977

The projected period of the contract runs until 1981, giving four years in which to study the four Regions of BR in England and Wales. In 1977/78 it is proposed to work in the Eastern Region of BR. It is necessary to survey on the basis of BR regions for thier administrative convenience.

a) Resource Survey. The Eastern Region of BR has been divided into five geographical subregions of equal area, but excluding certain urban/industrial areas. 60 working days have been allocated for field site work, allowing one paired site (see below) per day. The sixty paired sites have been divided amongst the subregions in proportion to the length of railway track.

The positions of the primary sites in each subregion have been decided by random co-ordinates of the national grid to arrive at 10 km grid squares in which a railway line is marked. The site entry points have been taken as the position of the nearest public access to a railway line, working clockwise from the centre of the $2\frac{1}{2}$ inch OS map corresponding to the random co-ordinates.

In addition to these randomly placed sites, an equal number of associated sites orientated North/South and East/West (within 25° of the cardinal point in all but four instances, and all within 40°) with a cutting and an embankment marked on the 2½ inch map, have been picked. The criteria for these sites have been a) orientation, b) access, c) where there is a choice, degree of closeness to the associated random site.

At each primary site there will be an overall description of vegetation and physical criteria, and detailed vegetation analysis at three points quarter-of-a-mile apart, on either side of the track. At each associated site there will be overall assessments coupled with comparable detailed assessments on the opposing aspects of the cutting and embankment formations.

It is intended that the detailed vegetation data should be classified using an appropriate technique, thereby providing a basis for comparison within each region and eventually between different regions.

In addition to these intensive records of individual sites, it is anticipated that it will be possible to make extensive surveys using facilities provided by BR to travel in the brake vans of freight trains, or the driver's compartments of diesel units. These surveys are likely to rely on the interpretation of photographs of trackside taken at regular intervals from the train.

b) Special Sites Survey. Information about the location of these sites may come from:

i Regional Officers of NCC (already approached in the Eastern Region of BR for 1977)

ii County Naturalist's Trusts, other natural history organisations, and interested individuals including BR staff

iii Analysis of site records of plants included in County floras

iv Our own experience

It is proposed that these sites should be recorded in a standard format (eg based on the BRC Rare Species Card, or Habitat Record Card) that could be collected together in a common file for reference.

However, it is proposed that detailed vegetation data should also be collected at these sites in the same way as in the objective survey so that they could be used in conjunction with the classification derived from that survey.

c) Archival and Historical Studies. The programme of consulting relevant printed and documentary sources would continue. Particular importance will be attached to discussions with BR staff who have detailed personal knowledge of lengths of railway lines, over many years.

d) Liaison with BR. Would continue at all levels.

e) Management information. Would continue to be collected in the normal course of duties.

Resources

PSO	J.M. Way
PSO	R.G.H. Bunce
PSO	J. Sheail
ASO	J.O. Mountford
ASO	A.R. Laws (UWIST Sandwich Course Student - 4 months)
ASO	Sally Oakes

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7 ibid

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9 NCC, File C10/05/04

10 RSPB File : British Rail

11 British Rail HQ, Files of CCE

12 Parliamentary Debates, Commons, vol. 859, 467 and 494; NCC, File C10/05/04

13 NCC, File C10/05/04

14 NCC, File C10/05/09

15 ibid

16 British Rail HQ, Files of CCE

17 Nature Conservancy Council, East Midland Region, Files S/93 and S/352

18 RSPB File : British Rail

19 Bedfordshire and Huntingdonshire Naturalist's Trust Files : Denton Covert and Woodwalton Railway Marsh and Five Arches

20 Nature Conservancy Council, South-west Region, Files

APPENDIX A

BRITISH RAILWAYS BOARD

WEEDKILLING TRACK SPRAYING

PARTICULAR CONDITIONS OF CONTRACT

1. DESCRIPTION OF WORK

The work comprises treatment for control of weed growth for the period and on the lines within the areas hereunder in accordance with the Description of Control and Schedule of Quantities.

Area / Division / District .....

.....

Lines

All running lines, platform lines and running loops indicated in the schedule excluding track through tunnels.

Sidings and Off Track Areas

The area on the Area/Division/District shown on the schedule and diagrams.

2. PERIOD

Period of Contract ..... year/s commencing ..... and ending on .....

3. SPECIFICATION OF CONTROL

For the purpose of this Contract the required standard of control throughout the Area/Division shall be as follows:-

A. All Running Lines

(i) Ballasted areas of track.

Over the width of the ballast and up to a maximum distance of 5 ft 0 ins outside the running edge of the running rail, 98% weed free.

(ii) Cesses, wideways and intertrack spaces associated with running lines, 95% weed free.

The width of the cess will be considered to be the distance from the ballast toe to the toe of bank or top of cutting slope approx. 7' 6" from the rail on average but up to a maximum of 10 ft. from the rail.

B. Sidings & Off Track Areas

In sidings, yards and depots, including 4 ft. ways and cesses, 95% weed free.

The limit of control for all off track work to be 8 ft. 0 in. from the running edge of the outermost rail of the outermost siding in any group and where wide inter-group spaces exist each group of sidings shall be considered separately.

The percentage of control is to be taken as a percentage of bare ground within the limit of control.

4. METHOD OF CONTROL

The normal method of control on running lines will be by spray train. In yards, sidings and off track areas including areas beyond the efficient reach of the spray train, will be normally carried out by methods that do not require possession of railway track and which are capable of efficient operation in sidings etc. occupied by wagons.

The Contractor shall give to the Engineer a programme of utilisation of the spray train not less than twelve weeks before the first day on which he requires the train to run.

The Engineer will endeavour to meet the required programme, subject to traffic requirements, but the Contractor will be required to comply with the times arranged for the train running provided that he shall not be required to spray:-

(i) more than 9 hours in any period of 24 hours.
(ii) when weather conditions are, in the Contractor's opinion, unsuitable for effective and safe spraying.

Night and/or Sunday running may be necessary from time to time to comply with traffic operation requirements.

In complicated station areas it may not be possible to provide spray train facilities on all lines and weed control must be effected by other means.

The Engineer undertakes to provide facilities as aforesaid for spraying a minimum average of 75 miles for each period of 9 hours spraying in the Contractor's Programme, on any of the specified lines.

If for reasons outside the control of the Contractor this average mileage is not achieved, the Board will pay to the Contractor a surcharge at the rate quoted in the Schedule of Quantities per mile untreated. If due to default by the Contractor this mileage is not achieved he shall pay to the Board 150% of the rate quoted in the Schedule of Quantities per mile untreated.

It is essential that no spraying be carried out whilst the train is being propelled, unless the spray train is of a special push/pull operating unit design such that whilst the locomotive remains at one end continuously, the driver can change ends and drive the train, by means of cable links, from a front driving cab incorporated in the spray coach (ex. DMU).

5. CHEMICALS TYPE RATE & FREQUENCY OF APPLICATION

The Contractor will acquaint himself with every type of weed growth to be controlled including dealing with weeds as covered by the Weeds Act 1959, or any revision thereto and will govern the application of chemicals accordingly.

Contractors shall have a free choice of weedkillers but all chemicals utilised must be products which have been officially approved under the Ministry of Agriculture Fisheries and Food Agricultural Chemical Approval Scheme and applied in accordance with the label instructions and also be approved by British Rail Scientific Services Department.

The Contractor shall not apply any chemicals that are toxic, inflammable or corrosive or incorporated in the official poisons list or chemicals which are known to have an adverse effect on wheel/rail adhesion of rails such as to cause wheels to slip.

Before commencement of any spray programme Contractors will provide the Regional/Territory Engineer with full details of the products they intend utilising.

The Board will provide reasonable facilities for inspection at any time without charge.

6. PLANT AND EQUIPMENT

The Contractor shall supply all apparatus required for the application of chemicals, including spray train, manual spray packs, equipment for spreading solid weed killers etc.

The Board will supply without charge to the Contractor all Motive Power, Brake Vans and other Vans necessary for the running of the spray train on the same number of occasions as year's of the Contract or the extension thereof on each line. The Board will supply without charge to the Contractor all necessary water, but the Contractor must be prepared to accept supplies which may entail overnight filling of water tanks in the spray trains.

Details of locations of water supply points will be provided by the Engineer. The Board will also supply the Contractor's reasonable requirements of diesel oil and Propane (Calor Gas) on payment at cost price if required.

All plant supplied by the Board to the Contractor shall remain the property of the Board but shall be used at the sole risk of the Contractor.

7. TRAIN CREW

The Board will supply without charge to the Contractor, engine crew and guard necessary for the movement of the spray train, together with any necessary supervision to ensure that the train movement is carried out in accordance with the traffic programme.

It is essential that no spraying be carried out whilst the train is being propelled, unless the spray train is of a special push/pull operating unit design such that whilst the locomotive remains at one end continuously the driver can change ends and drive the train, by means of cable links from a front driving cab incorporated in the spray coach (ex. DMU).

8. SAFETY AND PROTECTION

To assist in the prevention of accidents to men working on or about the Permanent Way a Pamphlet (B.R. 12323/3) has been published by the Board, a copy of which shall be issued by the Contractor to each employee engaged on this work. Copies of this Pamphlet can be obtained by the Contractor on application to the Engineer.

No work may be undertaken by employees of the Contractor on the Permanent Way without the provision of a lookout man for protection. Applications for a lookout man should be made to the Divisional/Area Civil Engineer giving a minimum of three days notice. All lookout men will be provided by the Board without charge to the Contractor. The names and addresses of the Divisional/ Area Civil Engineer to be provided by the Engineer on application by the Contractor.

9. INSPECTION AND ASSESSMENT

It is the broad intention of this contract to present the appearance of a weed free Railway.

If, however, at any time, not less than eight weeks after the initial treatment, the Engineer shall deem any area to be below the specified standard of control, the area in question shall be jointly examined and assessed by representatives of the Engineer and the Contractor. Should the bare ground be less than that required by the specified standard of control, the Contractor shall carry out supplementary treatment at his own expense within fourteen days of receiving a written notice from the Engineer.

Any such supplementary treatment shall normally be by manual means, but should the degree of failure be such as to require the use of the spray train, the full cost of running this train, including motive power, train crew etc., shall be paid by the Contractor at prevailing rates.

Weeds without roots in the defined control area shall be counted as bare ground.

Assessment of such substandard section will normally be by mutual agreement between the Engineer and the Contractor.

10. VARIATIONS

The Board reserves the right to delete or add lengths of track or acreage from or to the programme of treatment at any time.

Payments in respect of deletions and additions will be made in accordance with the rates quoted in the Schedule of Quantities as applied to the periods over which weed control is effected.

Variations to agreed Schedules shall be recorded in a book and certified by the representatives of both the Engineer and Contractor, copies to be retained by each.

Payments in respect of variations shall be as follows:-

Deletions

The mileage or acreage of any contract items not carried out to be agreed with Contractor, multiplied by the prevailing rate per mile or acre and the resulting sum deducted from the total contract payment.

Additions

Payment will be made as separate items within the annual accounts. The annual amount paid for each addition will be calculated by multiplying the additional mileage or acreage by the quoted rate appropriate to and divided by the number of years remaining to completion of Contract at the time of addition to the Contract.

11. TERMS OF CONTRACT

The Board reserves the right to terminate the whole Contract or any item or items separately on the 2nd March in any year prior to the completion date upon giving to the Contractor four months notice of intention to do so.

In the event of termination prior to the completion date the Board will compensate the Contractor for higher than average chemical costs incurred.

85% of the annual amount should be claimed by the Contractor one month after completion of the initial treatment. Payment to be effected within one month of receipt of invoice subject to satisfactory results having been achieved. 15% Retention Fund to be payable on November 30th annually subject to any remedial treatment requested by the Region/Territory having been satisfactorily carried out and the requisite standard of annual control having been achieved.

APPENDIX B. Weed Killers - Utilised by BR CCE staff.

Classified Products - Herbicides	Proprietary and Trade Name	Formulation	Application Equipment
Aminotriazole and Atrazine	ATLAZIN (Chipmans)	Wettable powder	Spray train/Mechanical spray
" " "	PRIMATOL A.A (Ciba Geigy)	" "	" " " "
Aminotriazole and Atrazine and 2,4-D	HERBAZINE SPECIAL (Fisons)	" "	" " " "
Aminotriazole and Bromacil	DESTRAL - B.R. (Borax)	" "	" " " "
Atrazine	HERBAZINE A80 (Fisons)	" "	" " " "
"	WEEDEX A80 (Ciba Geigy)	" "	" " " "
"	GRANULAR HERBAZINE (TOTAL)-A(Fisons)	Granules	Hand/Knapsack/Mechanical Spreader
"	WEEDEX A40 (Ciba Geigy)	"	" " " "
Atrazine, Sodium Chlorate, and 2,4-D plus a fire depressant	CHLOREA GRANULES (Chipmans)	"	" " " "
Atrazine and Sodium Chlorate	GRANULAR HERBAZINE CHLORATE (Fisons)	"	" " " "
Atrazine and Bromacil	BOROCIL (Borax)	"	" " " "
Bromacil	HYVAR X (Borax)	Wettable powder	Spray train/Mechanical spray
Bromacil with Dalapon and 2,4-D	B.R. DESTREL SUPER (Borax)	" "	" " " "
Bromacil and Diuron	KROVAR I (Borax)	" "	" " " "
Diuron	CHIPCO DIURON 80 (Chipmans)	" "	" " " "
"	KARMEX (Borax)	" "	" " " "
2,4-D and 2,4,5-T	SPONTOX (May and Baker)	Liquid	Mechanical spray
2,4,5-T	PHORTOX 50 (Fisons)	"	" "
Sodium Chlorate/Calcium Chloride with approved additive	B.R. SPECIFICATION NO. 625 item 1	Liquid concentrate	Spray train
Sodium Chlorate/Sodium Carbonate and Chalk	B.R. SPECIFICATION NO. 625 item 2	Dusting powder	Hand held cartons

LIST OF SITES OF SPECIAL SCIENTIFIC INTEREST (SSSIs) on or adjacent to railway property

ENGLAND

AVON	Saltford Railway Cutting	ST 684673	1 ha	geological
BEDFORDSHIRE	Oakley Railway Junction Pit	TL 027520		
	Pinnade Phosphatic Nodule Bed	TL 178493	6 a	geological
BERKSHIRE	Thatcham Reed Beds LNR	SU 507665	54 ha	
BUCKINGHAMSHIRE	Rushbeds Wood	SP 667155	44.5 ha	
CAMBRIDGESHIRE	Dernford Fen	TL 473505	42 a	
	Five Arches	TL 202830	6 a	
	Woodwalton Marsh	TL 212813	1 a	
CORNWALL	Marazion Marsh	SW 515318	190 a	
CUMBRIA	Meathop Fell Woods	SD 435799	42 ha	
DEVON	Isley Marsh	SS 490330	28.33 ha	
	Meldon Aplite Quarry	SX 570921	45.25 ha	geological
	Meldon Quarry	SX 571926	56.49 ha	geological
	Warleigh Point	SX 448610	12.7 ha	
DURHAM	Hawthorn Dene	NZ 435458	28 ha	
ESSEX	Benfleet & Hadleigh Marshes	TQ 830845	3900 a	
	Cattawade Marshes	TM 090329	247 ha	
	Gaynes Parks and Wintry Wood	TL 482026	664 a	L.T.E.
	Hatfield Forest	TL 538202	441 ha	
	Pitsea Marsh	TQ 744867	170 ha	
	Stour & Copperas Wood	TM 190313	96 ha	
GLOUCESTERSHIRE	Blockley Station Brickworks	SP 182370	20.7 ha	geological
	Frampton Mansell Railway Cutting	SO 914028	0.8 ha	geological
	Hailey Farm Railway Cutting	ST 950018	7 ha	geological
HAMPSHIRE	Fleet Pond	SU 821551	141 a	
	Lower Test Valley	SU 360153	640 a	
	Micheldever Station Cutting	SU 518435	6 a	geological
	New Forest	SU 2808	70,000 a	
HERTFORDSHIRE	Brickett Wood Common	TL 130010		
	Hitchin Railway Cutting	TL 197394		geological
	Sawbridgeworth Marsh	TL 491158		
KENT	Folkestone Warren	TR 272384		
	Ham Street Woods	TR 010342		
	Hoads Wood	TQ 953426		
LEICESTERSHIRE	Buddon Wood & Swithland Reservoir	SK 560145		
	Glaston Tunnel & Railway Cutting	SK 896016	7 a	
	Seaton Tunnel & Railway Cutting	SP 913989	13 a	
	Narborough Bog	SP 549979		

LINCOLNSHIRE	Wickenby Wood	TF 080827	45 ha	
	Wilsford & Rauceby Warren	TF 030436		
NORFOLK	Bridgham & Brettenham Heaths	TL 924865	467 ha	
	Ouse Washes	TL 500899	2525 ha	
NORTHUMBERLAND	North Northumberland Coast	NU 045465	3700 a	
NOTTINGHAMSHIRE	Attenborough Gravel Pits	SK 526346	360 a	
	Clarborough Tunnel Top	SK 749827	13 a	
	Finningley Gravel Pits	SK 685997	104 a	
	Portland Park & Studfold Triangle	SK 498553	37 a	
OXFORDSHIRE	Port Meadow	SP 497083		
SHROPSHIRE	Oss Mere	SJ 565438		
	Stoke Wood & View Edge Quarries	SO 434807		
SOMERSET	Bruton Railway Cutting	ST 687347	4 a	geological
	Lusty Quarry Site	ST 681346	1 a	geological
	Saltford Railway Cutting	ST 684673	3 a	geological
SURREY	Badshot Farm Chalk Pit	SU 861478	0.8 ha	geological
	Banstead Downs	TQ 255610	129 ha	
	Bookham Commons	TQ 128565	155 ha	
	Mole Gap to Reigate Escarpment	TQ 185525	1700 ha	
	Staines Moor	TQ 041734	603 ha	
	Whitmoor Common	SU 985535	155 ha	
SUSSEX	Ditching Common	TQ 335183		
	Old Lodge Warren	TQ 545305		
TYNE & WEAR	Claxheugh Rock	NZ 364576	9 a	geological
	Ford Limestone Quarry	NZ 364574	43 a	geological
WARWICKSHIRE	Alvecote Pools	SK 252045	556 a	
	Earls Wood Reservoir, Clowes Wood & New Fallings Coppice	SP 102740	152 a	
	Harbury Railway Cutting	SP 377603	64 a	
	Parkfield Road Quarry	SP 493759	20 a	geological
	Sutton Park	SP 098974	2148 a	
WILTSHIRE	Corsham Railway Cutting	ST 863694	3.6 ha	geological
	Purton Brick Pit	SU 086888	9.7 ha	geological
	Quidhampton Chalk Pit	SU 113314	1 ha	geological
YORKSHIRE, NORTH	Beck Hole	NZ 820020	425 a	
	Norton in Ribblesdale Cutting	SD 805720	7 a	geological
	Kirkham Abbey Gorge	SE 737670	706 a	
	Newtondale	SE 815920	3617 a	
	Strensall Common	SE 648596	1700 a	

YORKSHIRE, SOUTH	Anston Stones Wood	SK 532831	94 a
	Sandall Beat	SE 613037	
	Totley Wood	SK 326816	

SCOTLAND

AYRSHIRE	Western Gailes	NS 318360	355 a	
BERWICK	Burnmouth Coast	NT 966602	211 a	geological
DUNBARTONSHIRE	Ardmore Point	NS 314785	348 a	geological
	Kinghorn Coast	NT 277875	145 a	geological
	Lindores Loch	NO 265165	141 a	
INVERNESS-SHIRE	Alvie	NH 873093	751 a	geological
	Drumochler Hills	NN 630740	22,000 a	
	River Spey-Insh Marshes	NH 795032	2,470 a	
PERTHSHIRE	Carsebreck & Rhynd Lochs	NN 865095	1620 a	
	Glen Garry	NN 729701	1460 a	geological
	Pass of Killiecrankie	NN 920670	230 a	
	Shingle Islands	NN 974530	100 a	
RENFREWSHIRE	Castle Semple & Barr Lochs	NS 360587	667 a	
	Loch Libe	NS 435557	43 a	
WEST LOTHIAN	Philipstown Muir	NT 065768	37 a	

WALES

CLWYD	Gronant Dunes	SJ 080842	662 a	
DYFED				
(Cardigan)	Dyfe (NNR)	SN 634912	3973 a	
(Carmarthen)	Ffair-fach	SN 628211	2 a	geological
	Llanllwch Mire	SN 365188	102 a	
(Pembrokeshire)	Shealshook Railway Cutting & Pit	SM 967171	7 a	geological
MID GLAMORGAN	Alun Valley	SS 896763	100 a	
SOUTH GLAMORGAN	Ely Valley	ST 061789	536 a	
	East Aberthaw Coast	ST 042658	145	
GWYNEDD				
(Anglesey)	Malltraeth Marsh	SH 442710	3015 a	
	Trewan Sands Crossing	SH 319750	37 a	geological
	Ynys Leurad	SH 275793	501 a	
(Caernarvonshire)	Glaslyn Marshes	SH 582385	440 a	
	Llyn Ystumllyn & Ynys Cyngar	SH 525384	854 a	

Map 1

REGIONS AND DIVISIONS OF BRITISH RAIL 1977

Regional Boundary

Divisional Boundary

0 20 40 60 80 Miles

20 40 60 80 100 120 140 Kilometres

SCOTTISH

North East

North West

South East

South West

Newcastle

EASTERN

LONDON MIDLAND

Preston

West Riding District

York District

Liverpool

Crewe

Manchester

Sheffield

Doncaster

Nottingham

Norwich

Birmingham

Kings Cross

Liverpool Street

South Wales

Watford

WESTERN

London

SOUTHERN

West of England

South Western

Central

South Eastern

Inverness
Aberdeen
Dundee
Perth
Edinburgh
Glasgow
Berwick
Kilmarnock
Dumfries
Stranraer
Carlisle
Newcastle
Sunderland
Hartlepool
Middlesbrough
Darlington
Barrow
Harrogate
York
Blackpool
Preston
Leeds
Hull
Halifax
Wakefield
Huddersfield
Bolton
Manchester
Liverpool
Grimsby
Doncaster
Holyhead
Sheffield
Retford
Chester
Crewe
Newark
Stoke-on-Trent
Nottingham
Derby
Grantham
Stafford
Shrewsbury
Leicester
Peterborough
Wolverhampton
Birmingham
Birmingham
Kettering
Coventry
Rugby
Worcester
Northampton
Cambridge
King's Lynn
Norwich
Ipswich
Harwich
Colchester
Fishguard
Gloucester
Cheltenham Spa
Oxford
Swansea
Newport
Swindon
Reading
LONDON
Southend
Bristol
Cardiff
Bath
Margate
Canterbury
Ashford
Dover
Folkestone
Salisbury
Taunton
Southampton
Worthing
Brighton
Hastings
Portsmouth
Newhaven
Eastbourne
Exeter
Bournemouth
Ryde
Weymouth
Newton Abbot
Plymouth
Penzance