TRANSPORT RESEARCH LABORATORY

The effectiveness of the utility reinstatement specification

Prepared for Traffic Policy Division, Department of the Environment, Transport and the Regions

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Executive Summary

The objectives of the research were to monitor the effectiveness of the new national Specification for Excavation and Reinstatement of Openings in the Highway, issued in support of the New Roads and Street Works Act 1991 (NRSWA), to identify any problems with the Specification or standards of workmanship and to identify amendments or improvements that may need to be made in the future. The research work described was carried out for the Traffic Policy Division, Department of the Environment, Transport and the Regions (DETR).

With the introduction of NRSWA, all statutory undertakers are, for the first time, fully responsible for all aspects of excavation and reinstatement of the highway. They are required to reinstate to national performance standards and to comply with minimum guarantee periods in accordance with the new Specification.

A TRL study, commissioned by DETR, was carried out to identify any problems following the introduction of the Specification relating to compliance and standards of workmanship. Work commenced in 1993 by setting up sample studies and monitoring programmes in several Highway Authority areas in co-operation with national utility companies comprising Electricity, Gas, Water, Telecommunications and Cable TV.

The results of the study show that wide variations in reinstatement practice exist which are not specific to any particular utility company or Highway Authority area. The main aspects of reinstatement practice where problems occur are the number of compaction passes, layer thicknesses, use of suitable compaction equipment and storage of materials on site. Improvements are needed in all these areas if good quality reinstatements are to be achieved consistently. At the time of the study, the majority of operatives had not yet undergone training and it is clear that the observed standard of workmanship reflects this.

The majority of sites were found to be in a ‘good’ or ‘very good’ condition at the time of the second TRL visit. The age of the sites was generally between 9 and 12 months at the time of these visits. The most common defect present in the sites of ‘adequate’ or ‘poor’ quality was edge depression and the likelihood of further deterioration was considered to be significant.

Data provided by the Highway Authorities in their Highway Authorities and Utilities Committee (HAUC) quarterly reports show a wide variation in defect levels. However, no evidence is presented to show that any specific utility company had a higher degree of failure than the others.

It is recommended that:

i further monitoring of the study sites should be undertaken to establish the longer term performance of the sites

ii bi-annual monitoring of randomly selected sites should be undertaken by an independent body and, if this monitoring identifies the need, measures taken to improve compliance with the Specification

iii the training requirements for utility supervisors and operatives in the areas of compaction and materials specification should be reviewed

iv if further monitoring identifies the need, measures should be taken to improve the supervision of reinstatement work nationally

v the specified reinstatement designs for footways should be reviewed based on the existing construction and the level of trafficking.

1 Introduction

In 1984 the Government set up a committee, chaired by Professor M R Horne, to review the existing Public Utilities Street Works Act 1950 (PUSWA). Their report, entitled 'Roads and the Utilities' (Horne et al 1985), made 73 recommendations for improvement in street works. The recommendations included the provision of a new national Code of Practice Specification for the Reinstatement of Openings in Highways (DOT et al 1992), hereinafter referred to as the 'Specification'. The report also recommended improved methods and materials to raise the standard of reinstatements carried out on the national network.

Under the New Roads and Street Works Act 1991, hereinafter referred to as 'NRSWA', all statutory undertakers are, for the first time, fully responsible for all aspects of excavation and reinstatement of the highway. Statutory undertakers making openings in highways are required to reinstate to national performance standards and to comply with minimum guarantee periods. A review of the impact of street works was completed by the Street Works and Advisory Committee (SWAC), followed by a Government response (Department of Transport et al, 1996). The evidence presented in these reports highlighted deficiencies in reinstatement practice and procedures, amongst them compliance with the Specification. Although much progress has been made in recent years towards improved reinstatement performance, much work remains to be done if the benefits of the new Act are to be realised by the public.

A TRL study, commissioned by the Department of the Environment, Transport and the Regions (DETR) (formerly Department of Transport (DOT)), was carried out to identify any problems with the standards being achieved following the introduction of the Specification and to see if any aspects were in need of amendment or improvement. Standards of workmanship were also monitored to identify any shortcomings in current practice under the requirements of the Specification.

The work commenced in 1993 by setting up sample studies from a number of Computerised Street Works Registers (SWRs) and monitoring programmes in eight main Highway Authority areas in co-operation with the National Joint Utilities Group (NJUG); comprising Electricity, Gas, Water, British Telecom, Mercury Communications and Cable TV. Data were collected and stored on a small database system for analysis. This report describes the various stages of this work and presents the results on the compliance of 168 trench reinstatements with the Specification and comments on the standards of workmanship being achieved.

2 Objectives

The main objectives of the study were:

i to evaluate the effectiveness of the new Specification for excavation and reinstatement of openings in the highway

ii to identify any problems with the Specification or standards of workmanship

iii to examine the possible consequential damage to the road pavement caused by trenching and the presence of utility apparatus

iv to produce a machine capable of measuring profiles of surfaces where trench reinstatements have taken place.

This report covers objectives (i) and (ii).

Objective (iii) was the subject of a separate project for Highways Agency and five TRL reports containing long-term performance studies are to be published soon. Where appropriate, observations from that research which are related to this study are included in this report. Objective (iv) was met in 1994 with the publication of three project reports (Spong 1994, Spong and Cooper 1994a, Spong and Cooper 1994b) on the use of profile techniques for the measurement of surface unevenness on trench reinstatements and footway surfaces in general.

3 Code of practice specification

3.1 General

The Specification (Specification for the Reinstatement of Openings in Highways: A Code of Practice) (Department of Transport et al 1992a) was published in June 1992 to support the New Roads and Street Works Act 1991. The Act's introduction was seen as a major step forward in the control and administration of street works and necessary for the benefit of road users who were seeking improvements in standards of workmanship and a reduction in delays caused by street works.

The Foreword of the Specification states 'Under section 71 (in Scotland, section 130) of the NRSWA an undertaker executing street works must, when reinstating a street, comply with whatever specification may be prescribed for materials to be used and standards of workmanship to be observed. The undertaker must also ensure that the reinstatement conforms to prescribed performance standards, in the case of an interim reinstatement, until a permanent reinstatement is effected, and, in the case of a permanent reinstatement, for the prescribed period after completion of the reinstatement'.

The Specification gives guidance about how reinstatements should be carried out and the required standards. It states the following 'It should be noted that if an undertaker fails to comply with his duties under section 71 or 130 he commits an offence. Compliance with the Code will satisfy the undertaker's statutory obligations; failure in any respect to comply with it, whilst not of itself an offence, will be evidence of a breach of such obligation'.

The Specification was prepared by a working party of the Highway Authorities and Utilities Committee (HAUC) and was the subject of extensive consultation with interested organisations. From its introduction as an authoritative document on reinstatement practice, it has become a nationally adopted standard.

The Specification contains detailed information on the designs, methods, materials and equipment for reinstatement and guidance on best practice under the

following headings:

Performance requirements
Excavation
Surround to apparatus
Backfill
Flexible and composite roads
Rigid and modular roads
Footways, footpaths and cycle tracks
Verges
Compaction
Ancillary activities, eg. test holes, sewers
Remedial works

Particular attention has been given to the provision of extensive guidance notes to avoid any misinterpretation of the Specification requirements on the part of the utility operatives and supervisors and the Highway Authority inspectors. However, there is no statutory requirement on the part of the Highway Authorities to be trained in the requirements unless they are executing street works.

3.2 Reinstatements

Two types of reinstatement are permissible under the Specification; temporary and permanent. For the purpose of NRSWA and associated legislation, they are defined as:

Interim

'the orderly placement and proper compaction of reinstatement layers to finished surface level, including some temporary materials'. (Department of Transport et al 1992a, p.v).

Permanent

'the orderly placement and proper compaction of reinstatement layers up to and including the finished surface level'. (Department of Transport et al 1992a, p.v).

Provision also exists for immediate works which do not necessitate a full reinstatement. These are defined as:

Immediate

'works comprising the orderly replacement of excavated material, reasonably compacted to finished surface level with a cold-lay surfacing'. (Department of Transport et al 1992a, p.v).

The undertaker is required to start and complete reinstatement as soon as practicable, notifying the street authority of completion of either an interim or permanent reinstatement by the end of the next working day. If an interim reinstatement is performed, the undertaker must carry out the permanent reinstatement as soon as reasonably practicable, but at least within the prescribed period of six months.

Whilst undertakers have the responsibility for reinstatement after their works are completed, the street authority has powers to inspect, investigate and report on these works and reinstatements. The non-statutory Code of Practice for Inspections (Department of Transport al 1992b) sets out two key procedures to be followed for sample inspections and defect inspections. TRL supervisors undertook the role of the inspector during the research study.

3.3 Performance requirements

An undertaker executing street works is required to carry out the excavation and reinstatement in accordance with the Specification. Where alternatives are permissible, the undertaker is able to select from the options allowed. Regardless of which alternative is selected, the undertaker must guarantee the performance of the reinstatement for the relevant guarantee period and comply with the relevant standards.

The permanent guarantee period commences on completion of the permanent reinstatement and is two years for trenches up to 1.5m deep and three years for deeper trenches. An interim reinstatement is normally made permanent within six months.

Performance requirements apply to all reinstatements whether immediate, interim or permanent. If, at any time during the guarantee periods, the surface profile of the reinstatement exceeds any of the intervention levels prescribed in the Specification, remedial action is required to return the surface profile to an as-laid condition. No new guarantee period is required unless the cumulative settlement intervention limit is exceeded and any re-excavation and subsequent reinstatement, as agreed to be required by the Highway Authority and undertaker, has been satisfactorily completed.

Performance requirements include:

Surface profile

- as-laid profile
- edge depression
- surface depression
- surface crowning
- combined defects

Structural integrity

- cumulative settlement
- bad ground

Surface characteristics

- surface regularity
- skid resistance
- texture depth
- polished stone value (PSV)

Attention to these requirements will ensure the structural integrity of the reinstatement and the surrounding pavement is maintained. There is a high risk of structural failure to the pavement and poor trench performance if the quality of the workmanship falls below the required standards and compliance with the Specification is minimal.

4 Methodology

Because the NRSWA is so wide ranging and affects Highway Authorities (HAs), utility companies and contractors in different ways, the methodology adopted for

the project involved several different facets. A programme was designed to gain quality data from typical trench sites which could be considered as representative of national practice. The main aspects of the work were as follows:

1 Design of two standard site visit forms, one to record the observations during excavation and reinstatement and the other to record performance data during the guarantee period.

2 TRL arranged for trained trench supervisors to make visits to utility works in progress and to record their observations at all stages of the reinstatement work on the standard visit forms.

3 Information from site visits were entered into a database system developed at TRL to hold data related to all aspects of the trench including location, construction and design. A series of routines were set up to analyze the data.

4 Highway Authorities provided TRL with data on the performance of the utility companies in their areas. These were sent in the form of summary data of the type produced for the quarterly local HAUC co-ordination meetings.

5 Highway Authorities with the most compatible computerised Street Works Registers provided TRL with notice information. Random sites were selected and questionnaires were sent out to the utility companies requesting further information about the trench and its reinstatement design and to the Highway Authorities requesting performance data.

6 Follow up visits were made to the utility sites observed by the TRL inspectors after approximately six months or longer to assess the early-life performance of the reinstatements.

Each of these aspects is discussed in detail in sections 4.1 to 4.6 of the report.

TRL approached eight Highway Authorities, seven in England and one in Scotland, and local councils near to TRL who all agreed to co-operate in the study. The areas were chosen to represent a wide range of geographical locations, Authority types (eg Metropolitan Authorities, Boroughs, County Councils) and density of population. The Authority areas involved in the study were as follows:

Birmingham City Council
Kent County Council
Cheshire County Council
Lothian Regional Council
Devon County Council
Nottinghamshire County Council
London Borough of Ealing
Westminster City Council
Reading Borough Council*
Henley District Council*
Northampton County Council*
Walton and Hersham District Council*

*Reading, Henley, Northampton and Walton and Hersham Councils have been classified in the report as 'Thames/Other' because only a few sites were visited.

4.1 TRL visit forms

Two standard visit forms were designed by TRL to record:

i information about reinstatement practice

ii the performance of the reinstatements under the guarantee period.

The format of the forms were discussed with individual utility companies through contact names supplied by the National Joint Utilities Group (NJUG). After a lengthy consultation period, the forms were reduced drastically because it was considered that the utilities would not be able to provide all the information initially being sought for the study. The study objectives were subsequently constrained by the utilities response. Nevertheless, it was possible to produce meaningful observations of trench excavation, reinstatement and performance and robust conclusions, albeit on a smaller data set. Copies of the final standard visit forms as agreed with all interested parties, are given in Figures A1 and A2 of Appendix A to the report.

4.2 TRL trench supervisors

TRL used five trained supervisors to make the visits to utility works in progress and to record their observations of reinstatement practice on the standard visit forms. The supervisors were trained at a number of different national training centres to gain their accreditation. Therefore, it is considered that no bias of opinion exists in the comments made by the supervisors. The inspections were carried out in accordance with normal street works practice with emphasis on the ability of the utility or contractor workforce to comply with the required standards and the Specification.

4.3 TRL database system

A database, based on the Paradox V4.5 database system, was specifically developed on a microcomputer (PC) at TRL to store the site observation data collected by the TRL supervisors, for later analysis. It comprises details of:

- road category
- road construction type
- initial site condition
- local subgrade
- trench dimensions
- excavation details
- excavation equipment
- remedial work
- type of pipe or cable and dimensions
- compaction equipment and weight
- materials and thicknesses
- surface condition
- other work, eg. overbanding
- labour
- HAUC training

Part of the analysis presented in the report is based on these data.

The study also relied on notice and inspection data stored in the Highway Authorities' Computerised Street Works Registers (SWRs). It was perceived at an early stage that transfer of relevant notice and inspection data to the TRL database system would be difficult and dependent on the ability of the Highway Authority registers to output data in a format which could be interpreted by the TRL database system. The information available to TRL was thus limited and generally less robust than originally envisaged. Nevertheless, data from three Highway Authority SWRs were stored and used to generate random sites for a 'follow up' utility questionnaire. This is discussed more fully in Section 5.11 of the report.

4.4 HAUC quarterly summary data

Under the auspices of the regional HAUCs, Highway Authorities and undertakers hold regular co-ordination meetings to resolve differences, where they exist, and to promote procedures to maximise public safety and minimise inconvenience. At a local level, most groups meet at least every three months, ie. quarterly. TRL were invited to attend a number of these meetings to explain the purpose of the research study and to gain the co-operation of all interested parties. TRL were well received by those in attendance which allowed the provision of HAUC quarterly summary data to be set up. Each Authority supplied summary data from their SWRs, at regular intervals as requested by TRL, so that analyses of notice and inspection data could be carried out.

This source of data proved valuable, although each Authority provided it in different formats which necessitated some additional analysis for meaningful comparisons to be made. The results of this analysis are discussed in Section 5.9 of the report.

4.5 Random sites from HAUC notices

As mentioned in section 4.3, using the random sites selected from the TRL database, a 'follow up' questionnaire was designed and is reproduced in Figure A3 of Appendix A. It was sent to utility companies requesting further information about each trench and its reinstatement design. It was hoped this would provide a link between the notice and inspection data stored on the Highway Authorities' registers and the data recorded by the utilities at the time the trench was excavated and reinstated. The full history of the trench, including any defects at the time of inspections, could then be determined. Unfortunately, this approach proved less than satisfactory because the nationally prescribed six per cent sample rate produced only a few sites which had been inspected and defects were recorded for only a few of these sites.

The results of the analysis of these few sites are given in Section 5.11 of the report.

4.6 Performance data

The performance requirements stated in the Specification were examined and it was decided that the most important factors contributing to structural integrity of trenches needed to be assessed. Thus, the following performance factors were included on the visit forms and measured or checked during each site visit:

1st site visit

a surface crowning

b surface depression

c edge depression

d texture depth

e use of vertical sealing

f use of tack coat

g use of overbanding

h material sampling

2nd site visit

a surface regularity

b surface texture

c skid resistance

d overbanding

e surface deterioration eg. cracking

Because the visits covered the periods of excavation, reinstatement and the guarantee period, the assessment of compliance with the performance criteria in the Specification was wide ranging. The results of these observations are given in Section 5.6 of the report.

5 TRL site observations

It became clear from discussions with representatives of the utility companies and Highway Authorities that little detailed information was available about actual reinstatement practice. The Street Works Registers set up by the Highway Authorities were used mainly for recording notices of openings and generating sample inspections. In general, the utilities tend to give their sub-contractors a specification to follow but hold little information about individual reinstatements. In order to find out what work was done and to see how the Specification was followed in practice, it was decided that TRL would need to carry out observations of reinstatement work in progress.

Contact was made with the utility companies in the study areas and arrangements were made for the TRL qualified trenching supervisors to observe reinstatement work in operation. In general, all those approached in the utility companies were extremely helpful and few problems were encountered.

5.1 Stage one site visits

The first stage of the site visits was to observe the various stages of trench reinstatement taking place. Such information as the location of the site, the existing construction, the materials used, the standard of workmanship and the design option was collected from a wide range of typical reinstatements. A number of permissible design options for trench reinstatements are given in the Specification and a typical reinstatement construction is given in Figure 1.

In general, the site visits consisted of the TRL trench supervisor visiting an area for three or four days and liaising locally with the utility local supervisors. A contact point was arranged, usually in a local utility depot, where each morning the TRL supervisor could receive a list of the location and type of work carried out by each of the sub-contracting teams of operatives for that day. Once these work schedules were received, the TRL supervisor travelled round the locations until operatives were found who were carrying out reinstatement work. This was often a time consuming process, particularly if the TRL supervisor was unfamiliar with the area, and difficulty was frequently experienced trying to arrive on site while work was taking place because operatives were regularly called away from particular jobs to deal with emergencies.

Once on site, the TRL supervisors observed the work taking place and completed a visit form. Frequently, the various stages of excavation and reinstatement were carried out by different teams of operatives, or even by different contractors, and so were not all observed by the TRL supervisors. This occurred most often with the permanent reinstatement of the surface, usually carried out by specialist contractors within two or three days of the interim surface being laid. Hence, some sections of several visit forms were left blank although, in most cases, the majority of the reinstatement work was witnessed by the TRL supervisors and detailed observations were made.

Reinstatement sites totalling 168 were observed in the eight main Authority areas and other areas. Table 1 gives a list of utilities covered in each Authority area.

Table 1 Completed utility site visits

	Elec-tricity	*Gas*	*Water*	*BT*	*Mer-cury*	*Cable TV*	*Authority totals*
Birmingham	-	4	5	3	-	-	12
Cheshire	7	5	10	-	-	-	22
Devon	8	4	12	-	-	-	24
Ealing	-	8	5	-	-	-	13
Kent	6	7	12	5	-	6	36
Lothian	3	6	1	-	-	-	10
Nottinghamshire	-	4	4	-	-	5	13
Westminster	2	7	6	1	5	3	24
Other/Thames	-	-	13	-	1	-	14
Utility totals	26	45	68	9	6	14	168

5.2 Stage two site visits

'Follow up' visits, ie. Stage Two visits, were made to each of the sites visited in Stage One to assess their early life performance. TRL supervisors evaluated each site in terms of surface condition, deterioration such as settlement, crowning, edge depressions, surface unevenness and other defects as listed on the visit forms (see Appendix A). This information was required to link the causes of any problems identified at Stage Two to those found during the Stage One visit. Using this approach, it was possible to identify problems at the reinstatement stage which had the greatest effect on the performance of the trench and the surrounding pavement.

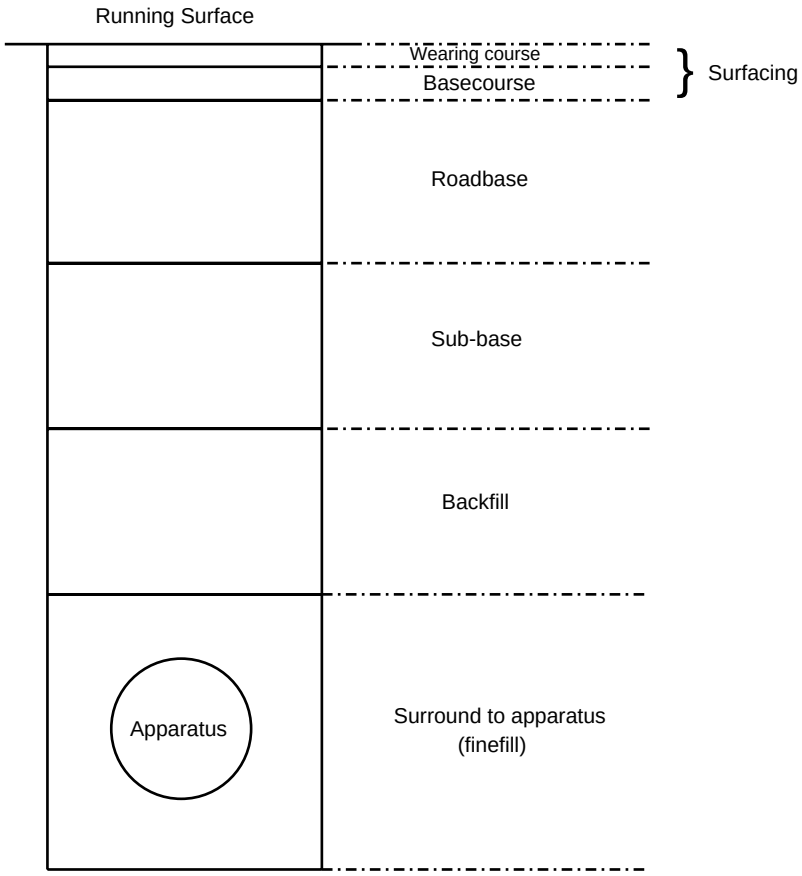

Figure 1 Typical reinstatement construction

5.3 Photographic evidence from TRL site observations

The TRL supervisors observed typical site practice amongst a range of excavation and backfill operations carried out by utility companies or their contractors. Plates 1 to 7 illustrate practice which does not comply with the Specification. Problems were encountered with material stockpiling, poorly compacted material, material grading, excavation which is likely to lead to consequential damage, undercutting of the road surface, unsuitable compaction plant and absence of jointing sand between flags. However, good practice was also identified and is shown in Plates 8 to 10 in respect of good clean trench edges, correct compaction procedure and a good final reinstatement surface. Plate 10 also demonstrates poor co-ordination of works because a redundant column sited within a newly reinstated area will be the subject of future excavation and reinstatement.

Plate1 Poor material stockpile storage

Plate 2 Poorly compacted Type 1 sub-base material

Plate 3 Poorly graded material

Plate 4 Increased risk of consequential damage

Plate 5 Undercutting increases the risk of poor compaction

Plate 6 Unsuitable compaction plant

Plate 7 Absence of jointing sand between flags

Plate 8 Good quality saw cut opening

Plate 9 Correct compaction procedure

Plate 10 Good quality permanent reinstatement

Good practice is also shown in Plate 11 where an operative is seen applying edge sealant to the saw cut edges of an opening prior to the reinstatement of bound materials. Plates 12, 13 and 14 show good compaction technique of both bound and unbound materials and the correct use of a vibrating roller and vibrotampers.

Plate 11 Use of edge-sealing material

Plate 12 Good compaction technique (bound materials)

Plate 13 Good compaction technique (bound materials)

Plate 14 Good compaction technique (unbound materials)

Plate 15 shows general untidiness on site which makes contamination of materials more likely. The operatives are also using unsuitable compaction plant. Plate 16 shows a poor quality final reinstatement where the finished surface is poor and damage has been caused to the surrounding surface.

Plate 15 Untidy working practice, unsuitable compaction plant

Plate 16 Poor quality final reinstatement

Plates 17 and 18 show reinstatements weaving from the footway to the carriageway in an attempt to avoid damaging tree roots. This is inefficient and makes it more difficult for future undertakers to excavate either the footway or carriageway without encountering other apparatus.

Plate 17 Avoiding damage to tree roots (poor planning)

Plate 18 Avoiding tree roots (poor planning)

Plates 19, 20, 21 show good quality reinstatements of flexible, modular and concrete footways. Plate 22 shows a good quality carriageway reinstatement.

Plate 19 Good quality flexible reinstatement

Plate 20 Good quality modular reinstatement

Plate 21 Good quality concrete reinstatement

Plate 22 Good quality carriageway reinstatement

5.4 General comments made by TRL supervisors

The TRL supervisors were asked to comment on any aspects of the work they had observed which were of a general nature and were not entered on the visit forms. Some of these observations were based on conversations with utility representatives or contractors, and as such are hearsay. Nevertheless, they were heard a number of times from a number of different sources and so are included as representative of wider views.

There seemed to be some confusion caused when contractors were asked to follow a different specification when working for a Highway Authority (HA) than that when working for utility companies. There were also reports of the HA insisting on contractors following the HA specification even though they were working for a Utility. Some Authorities employ 'Considerate Contractors' schemes which monitor utility contractors for noise, tidiness, disturbance, etc. However, it was reported that these schemes often do not apply to contractors working for the HA which sometimes caused ill feeling. It was suggested that these matters could be resolved at the local HAUC level and that contractors should be represented at these meetings.

It appeared that most supervisors have now been trained but that few operatives have yet received any training under NRSWA. There were claims that some utilities were not checking the training of their contractors. One major utility no longer uses trained supervisors; the responsibility for supervision has been passed on to its contractors and the utility supervisors act as 'Quality Assessors'. Any fines incurred due to defects are passed on to the contractor as recharges. However, other utility companies exercise much greater control over their contractors and issue them with detailed instructions for carrying out reinstatements. In general, the level of training and supervision was variable.

As far as reinstatement practice is concerned, layer thicknesses and compaction passes were the areas where most problems are likely to occur. Many operatives do not seem to understand the requirements of the Specification in this regard. More rigorous training in this area is desirable and would ensure better quality reinstatements.

Other more general comments include:

- The storage and separation of excavated materials was often poor. This was often due to the inadequate working areas provided in order to prevent 'unnecessary' disruption to the public.
- Compaction around the apparatus was often poor because contractors considered that there was a danger of causing damage.
- The majority of excavated material was removed from site even though much of it could be re-used; excavated material was frequently used to surround the apparatus and as backfill material but imported granular Type 1 material was normally used for the sub-base layers.
- The newer utility companies, such as Cable TV companies, were often able to absorb the requirements of the NRSWA legislation whereas there was a tendency for older companies to be less flexible in their working practices.
- The practice adopted by Cable TV companies of saturating an area with teams of operatives shortened the duration of the disruption, but was often perceived by the public as causing greater nuisance.

In general, the TRL supervisors felt that utility companies and contractors were trying to comply with the Specification and that the standard of work was improving. However, there are areas which need improvement, particularly in the engineering aspects of the reinstatement.

5.5 Results of stage one site observations

The initial analysis was repeated once the Stage One visits were completed and the collected data entered into the TRL database. Routines were written to analyze data related to factors such as the number of compaction passes, design options used and compliance with the Specification.

Because of the complexity of the various reinstatement options permitted in the Specification, the analysis of whether individual sites had complied with the Specification was carried out manually. A TRL researcher decided if each reinstatement met the requirements of the Specification for that particular site and chosen design option.

Figures 2 to 17, summarising the results of this analysis, are given in sections 5.5.1 to 5.5.4 of the report.

5.5.1 Site environment

Site category

Figures 2 to 6 relate to the general environment of the visited sites. Figure 2 shows a breakdown based on the site categories as defined in Sections S1.3 and S1.4 of the Specification. It was found that the majority of sites were in the footway (54.7 per cent), followed by Type 4 roads (23.5 per cent). All other categories accounted for 21.8 per cent of sites.

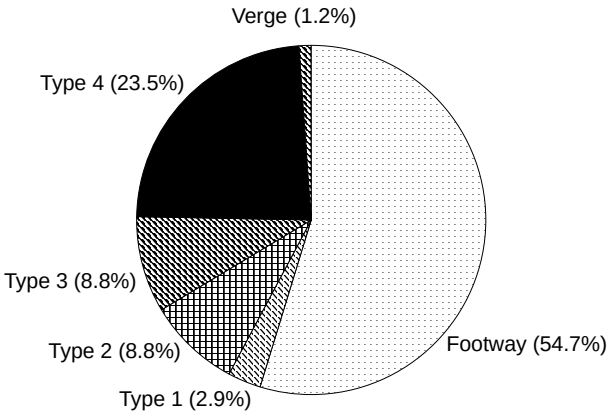

Figure 2 Site categories

Footway construction

Figure 3 provides a breakdown of the existing construction of the footways sites. It was found that 65.6 per cent of footway sites were of flexible construction and 29 per cent of footway sites were of a modular construction. Rigid and composite constructions accounted for only 5.4 per cent of footway sites.

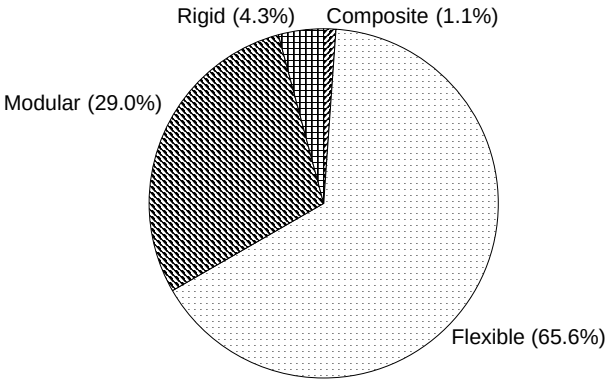

Figure 3 Footway construction types

Carriageway construction

Figure 4 provides a similar breakdown for carriageway sites. Here it was found that 60 per cent of carriageway sites were of flexible construction and 24 per cent were of rigid construction. Composite and modular constructions accounted for 16 per cent of sites.

Site condition

The condition of each site, at the time of reinstatement, was also assessed by the TRL supervisors. A breakdown of the results is shown in Figure 5. 76.8 per cent of the sites were adjudged to be in a *'good'* condition, 13.4 per cent of sites were considered to be *'in need of maintenance'*, 4.9 per cent were considered to be in a *'poor'* condition and 3.7 per cent appeared to have been recently constructed, ie. *'less than five years old'*. Only 1.2 per cent of sites were considered to be *'requiring reconstruction'*.

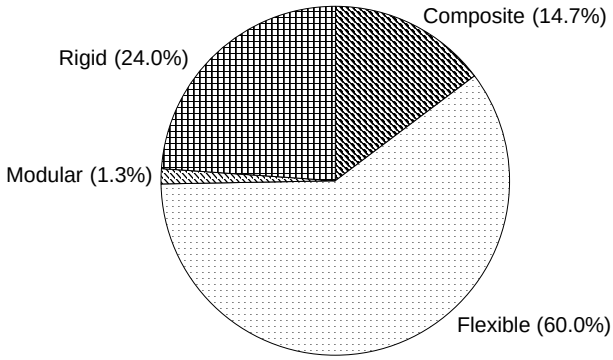

Figure 4 Road construction types

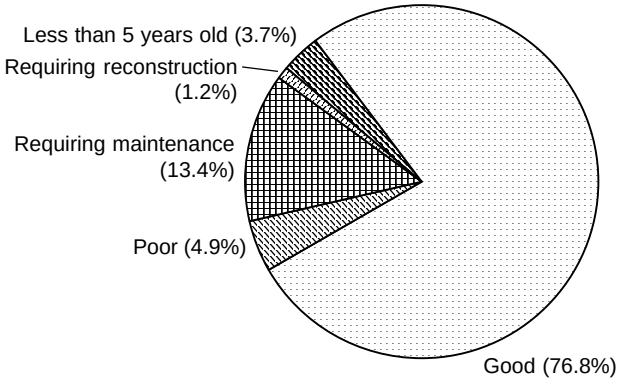

Figure 5 Initial site condition

Local subgrade

The TRL supervisors were also asked to identify the local subgrade at each site as defined in Appendix A1 (Backfill materials) of the Specification. The proportion of each subgrade type is shown in Figure 6. 38.1 per cent of subgrades were identified as Class D (cohesive), 35.7 per cent were identified as Class C (cohesive/granular) and 17.9 per cent were identified as Class B (granular). At 8.3 per cent of the sites the subgrade could not be identified because backfilling had already begun when the TRL supervisor arrived on site. No subgrades were identified as Class A (graded granular).

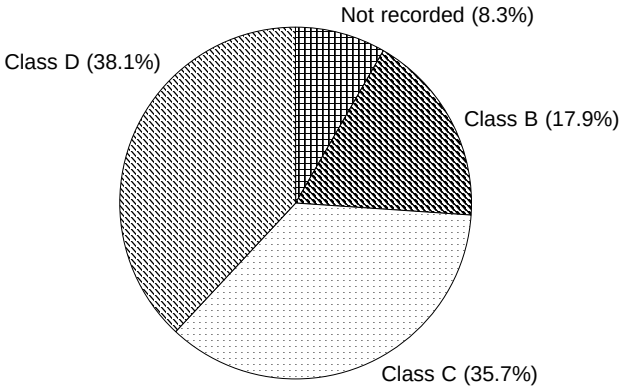

Figure 6 Local subgrade

Summary

The environmental conditions, associated with the site locations, may not be entirely representative of the national network. The 168 sites were chosen to cover a wide range of sites, both urban and rural, in nine areas. Certainly, the majority of reinstatement work takes place in the footway and the majority of roads and footways are of flexible construction. However, the subgrades and initial site conditions may be more localised.

5.5.2 Size of openings

The size of the observed openings was also recorded by the TRL supervisors. Cumulative frequency distributions have been calculated for the length, width and depth of all the sites.

Figure 7 shows the cumulative frequency distribution of site lengths; approximately 98 per cent of openings were less than 100m in length and 80 per cent of openings were less than 10m in length. Figure 8 shows in more detail the distribution of site lengths for sites less than 20m in length; 50 per cent of observed openings were less than 2m in length.

Figure 9 shows the cumulative frequency distribution of the width of openings; no observed openings were more than 2500mm wide, 85 per cent were less than 1000mm wide and 45 per cent of openings were less than 500mm wide.

Figure 10 shows the cumulative frequency distribution of opening depths; 95 per cent of openings were observed to be less than 1500mm deep, ie. not *'deep'* excavations as defined in Section S1.2.2 of the Specification.

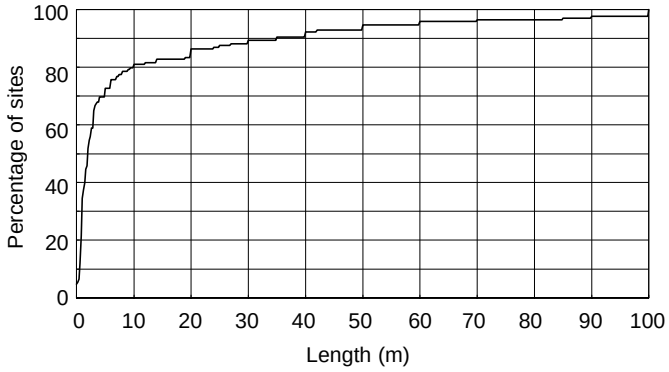

Figure 7 Distribution of site lengths

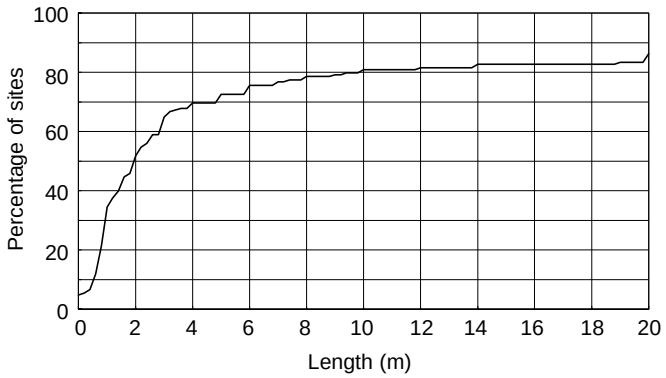

Figure 8 Distribution of site lengths (<20m only)

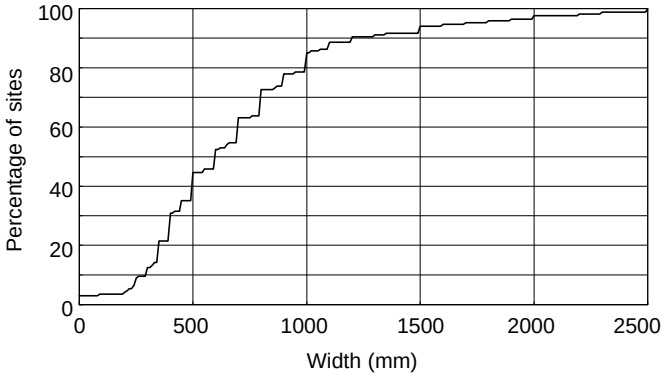

Figure 9 Distribution of site widths

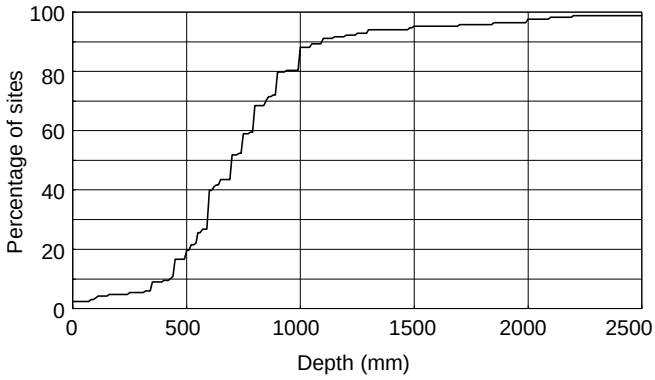

Figure 10 Distribution of site depths

5.5.3 Reinstatement practice

The TRL supervisors were asked to record the reinstatement method adopted at each site. It is generally accepted that permanent reinstatement of openings on the first visit minimises disruption to the public. However, it is often more cost effective for the undertaker to reinstate the surfacing material as a separate operation. Indeed, many employ separate teams of operatives for this purpose. Various reinstatement methods are permitted in the Specification and are defined in Sections S6.1 (flexible and composite roads), S7.1 (rigid and modular roads) and S8.1 (footways and cycleways). These reinstatement methods are summarised below:

All permanent reinstatement

The entire structure shall be reinstated to a permanent standard at the first visit.

Permanent basecourse reinstatement

The basecourse and substructure shall be reinstated to a permanent standard at the first visit. A permissible interim material shall be extended to the surface as the interim wearing course.

Permanent roadbase reinstatement

The roadbase and substructure shall be reinstated to a permanent standard at the first visit together with an interim basecourse and wearing course.

Permanent sub-base reinstatement

The sub-base and substructure shall be reinstated to a permanent standard at the first visit together with an interim surfacing as for Permanent Roadbase Reinstatement.

Reinstatement method

The occurrence of these permitted reinstatement methods was analyzed. The results are broken down in Figure 11. At 52.4 per cent of the sites visited, an *'all permanent reinstatement'* method was used, a *'permanent sub-base reinstatement'* method was used at 30.4 per cent of the sites, a *'permanent roadbase reinstatement'* method was used at 8.3 per cent and a *'permanent basecourse method'* was used at six per cent of the sites. The reinstatement method was not recorded at three per cent of the sites.

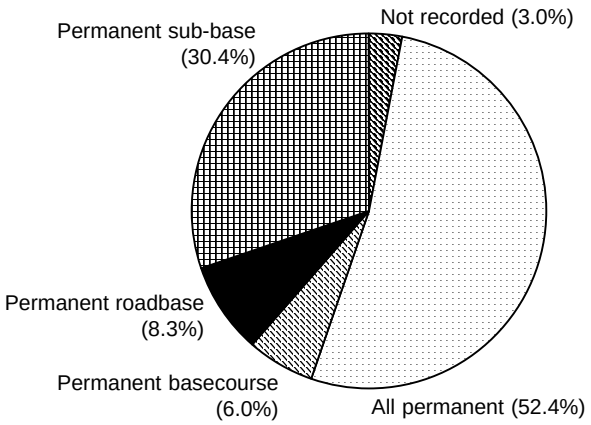

Figure 11 Reinstatement method

Imported materials

A breakdown of the materials imported to site is given in Figure 12. The materials are defined in Appendix A2 of the Specification. The abbreviations used throughout this report are based on the Specification and are explained in Table 2.

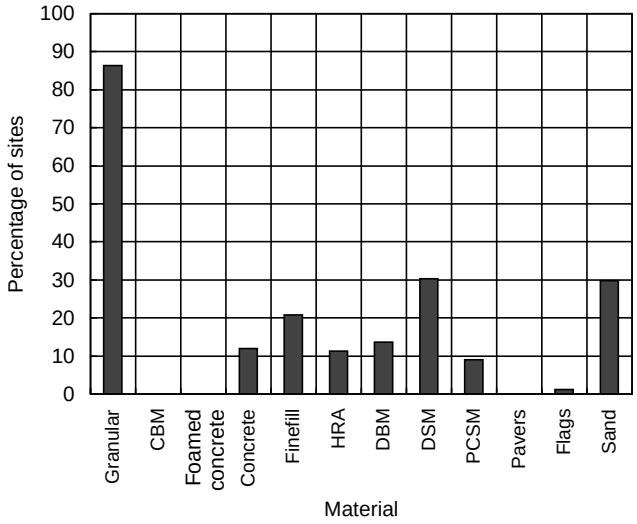

Figure 12 Imported materials

Table 2 Abbreviations for material types

Abbreviation	*Definition*
CBM	Cement Bound Material
Fmd Conc	Foamed Concrete
HRA	Hot Rolled Asphalt
DBM	Dense Basecourse Macadam
DSM	Deferred Set Macadam
PCSM	Permanent Cold-lay Surfacing Materials

Granular type material was the most common imported material, used at 86.3 per cent of sites while DSM, used in interim reinstatements, was the next most common at 30.4 per cent of sites. Sand, for bedding modular materials, etc, and finefill, used to surround the apparatus, were imported to 29.8 per cent and 20.8 per cent of sites respectively. Of the other materials observed, concrete was used at 11.9 per cent of sites, HRA at 11.3 per cent of sites, DBM at 13.7 per cent of sites, PCSM at 8.9 per cent of sites and flags at 1.2 per cent of sites.

Compaction Plant

The permitted types of compaction plant and the required number of compaction passes are defined in Appendix A8 of the Specification. The TRL supervisors were asked to record the type of compaction plant used on each of the sites. A breakdown of the results is given in Figure 13. The vibrotamper is the most commonly used item of compaction plant and was used at 86.9 per cent of sites. Vibrating rollers were used at 19 per cent of sites, hand rammers at 14.3 per cent, vibrating plates at 4.2 per cent and percussive rammers at only 1.8 per cent of sites.

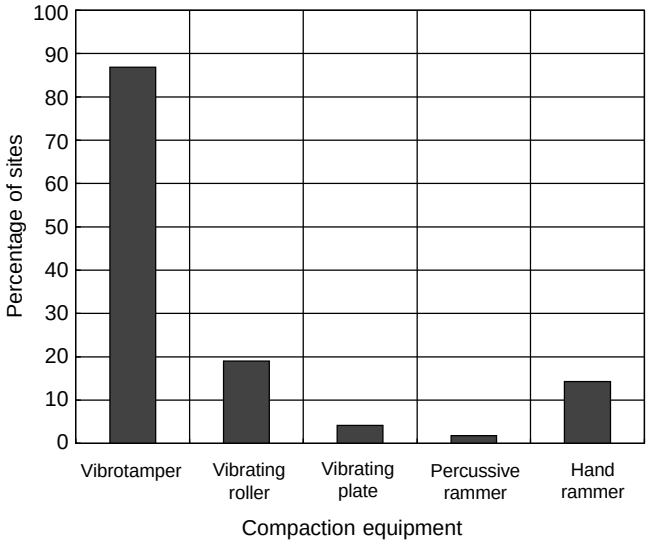

Figure 13 Compaction equipment used

Summary

The observed reinstatement practices were largely as expected; all permanent reinstatements account for approximately half of the sites visited, granular materials

are the most commonly imported materials and vibrotampers are the most popular item of compaction plant used by undertakers.

5.5.4 Compliance with Specification

The observed reinstatement practices were compared with the requirements for reinstatement design and compactive effort described in Appendices A2 to A7 of the Specification.

Reinstatement design

Analysis was carried out to compare the observed reinstatements with the design options permitted in the Specification. The options are defined by particular road type, existing construction and reinstatement method used. Figure 14 shows the results of this analysis. 71.2 per cent of sites were found to be reinstated to the correct design option (ie. the correct materials were used for that particular road type, construction and reinstatement method). 18.2 per cent of sites were found to contain layers of an incorrect thickness and 10.6 per cent of sites contained incorrect materials for the chosen design option. This means that the structural integrity of three out of ten trenches could be compromised by the selection of a weaker design than that specified.

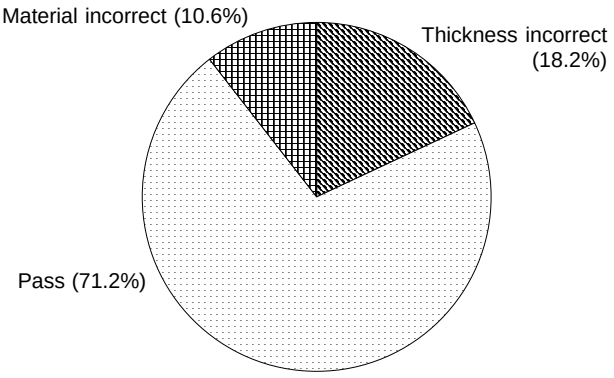

Figure 14 Design correctness

Compaction

The degree of compaction applied to each layer within the reinstatement is defined in Appendix A8 of the Specification in terms of layer thickness, material type and compaction plant used. The compactive effort is generally accepted, amongst highway engineers, as being the most important factor affecting the long-term performance of the reinstatement. A comparison was made between the observed compactive effort and the Specification. The results are shown in Figure 15. Only 3.3 per cent (just five) of the sites where compaction was observed were all the layers of the correct thickness and each received the correct compactive effort. There were discrepancies at 96.7 per cent (146) of the sites between the Specification and the observed compaction.

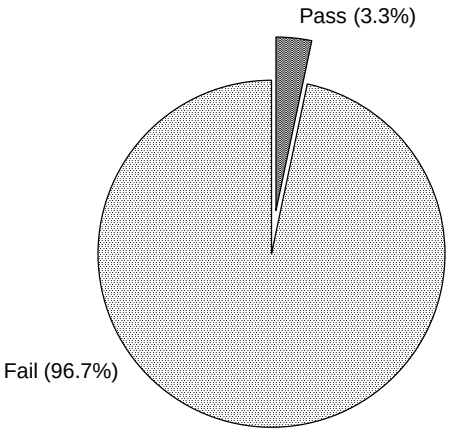

Figure 15 Compaction correctness

Causes of compaction failures

The reasons for the failure of these sites were investigated. The results are shown in Figure 16. The most common reason for failure was insufficient passes which occurred at 70.8 per cent of the failed sites. At 19.6 per cent of the failed sites the material had been laid in layers which were too thick whilst at 17.3 per cent of the sites the material had been laid in layers which were too thin. At 11.9 per cent of the failed sites, incorrect compaction plant had been used.

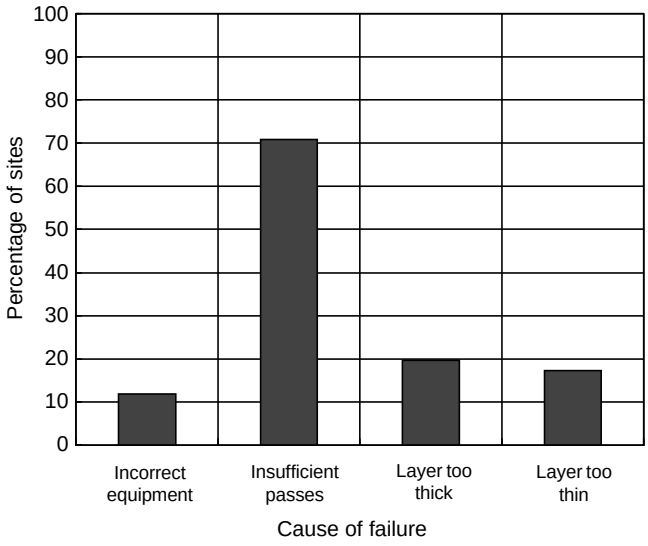

Figure 16 Compaction failures

Further analysis was carried out to examine the degree of compaction failure by putting the failed sites into four bands according to their depth. The four bands and the total number of sites in each band are defined in Table 3.

Table 3 Depth bands for analysis of trenches

Depth bands		*Total No. of Sites*
Band 1	<500mm	28
Band 2	500mm - 1000mm	120
Band 3	1001mm - 2000mm	16
Band 4	>2000mm	4

Figure 17 shows cumulative frequency curves for the four bands showing the percentage of layers receiving the correct degree of compaction. Each point on the graph shows the proportion of failed sites (y-axis) plotted against the proportion of layers correctly compacted (x-axis). The point where each line meets the y-axis shows the proportion of sites with zero layers compacted correctly.

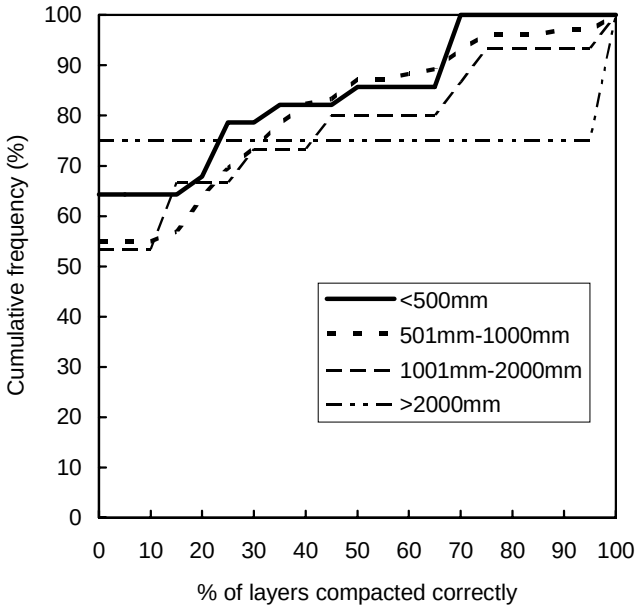

Figure 17 Distribution of layer compactions

All of the failed sites in Band 1 had less than 70 per cent of layers compacted correctly, approximately 85 per cent had less than 50 per cent of layers correctly compacted and approximately 65 per cent had no layers compacted correctly.

In Band 2, approximately 97 per cent of failed sites had less than 75 per cent of layers correctly compacted, approximately 87 per cent had less than 50 per cent of layers correctly compacted and approximately 55 per cent of sites had no correctly compacted layers.

In Band 3, approximately 95 per cent of failed sites had less than 75 per cent of layers correctly compacted, 80 per cent had less than 50 per cent of layers correctly compacted and approximately 53 per cent had no layers compacted correctly.

In Band 4, approximately 75 per cent of sites had no layers correctly compacted. However, because there were only four sites in this band, this result is less significant, despite three of the four giving no layers correctly compacted.

Summary

The results show that compactive effort and layer thicknesses are the weakest part of undertakers' compliance with the Specification. The requirements of the Specification were fully met at only five of the 151 sites where compaction was observed. Of the sites failing to comply with the compaction requirements, more than 50 per cent had every layer which was not compacted in accordance with the Specification. This demonstrates that further training is needed in the compaction process to avoid poor consolidation of the trench which could then lead to early failure.

5.6 Results of stage two site observations

The sites visited in Stage One were re-visited by TRL supervisors and their condition assessed against the performance requirements set out in Section S2 of the Specification. The results were recorded on the Stage Two visit form, given in Figure A2 of Appendix A.

5.6.1 Age of reinstatements

In order to carry out the Stage Two visits in the most efficient way, a complete area was visited and all sites in that area were inspected regardless of the time since the Stage One visits. This resulted in reinstatements of different ages being inspected. Figure 18 shows a cumulative frequency curve for the age of the sites at the time of their Stage Two visit.

Figure 18 Distribution of site ages at Stage Two visit

From the curve, approximately 60 per cent of the sites were between 9 and 12 months old and approximately 30 per cent were more than 12 months old at the time of the Stage Two visits. No reinstatements were less than 8 months old at the time of the Stage Two visit.

5.6.2 Results of observations

166 of the 168 sites were revisited during Stage Two; two of the sites could not be located by the TRL supervisors.

The TRL supervisors were asked to record the presence and dimensions of any defects and also to categorise the general condition of the reinstatement as being *'very good'*, *'good'*, *'adequate'*, or *'poor'*. Generally, sites with defects which failed the performance criteria described in Section S2 of the Specification were given a rating of *'poor'* and sites with defects within the performance criteria and/or minor surface problems were given a rating of *'adequate'*. Other sites were awarded a rating of *'good'* or *'very good'* depending on the TRL supervisor's

judgement of the reinstatement condition.

Figure 19 shows the proportion of the general condition of the sites at the time of their Stage Two visits, in which 45.2 per cent of sites were adjudged to be in a *'very good'* condition and 36.3 per cent were adjudged to be *'good'*. The TRL supervisors considered 7.7 per cent of sites to be *'adequate'* and 1.8 per cent to be *'poor'*. 7.7 per cent of the sites were either in the verge or had been resurfaced between the Stage One and Stage Two visits making it impossible for the TRL supervisor to assess their performance. 1.2 per cent of sites could not be located by the TRL supervisor.

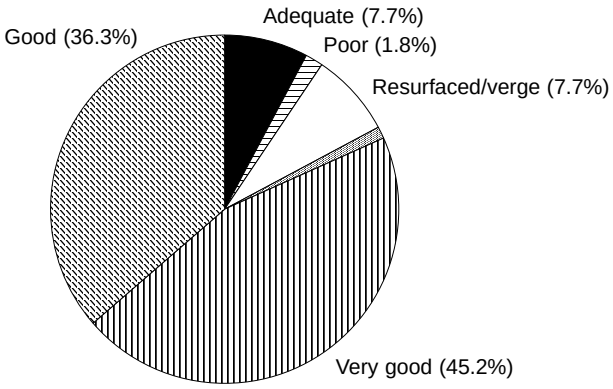

Figure 19 Condition of sites at Stage Two visit

Assessment of 'adequate' sites

Of the 13 sites adjudged by the TRL supervisor to be of an *'adequate'* general condition, three had no specific problems. Five of the remaining ten sites had edge depressions ranging from 3mm to 8mm (ie. less than the 10mm intervention limit set out in the Specification). Surface depression or crowning was not present in any of the *'adequate'* sites. The severity of the ten sites with other surface problems are summarised in Table 4 (none of the problems were described as *'severe'*):

Table 4 Severity of problems at 'adequate' sites

Surface problems	*Minor*	*Moderate*
(i) Surface cracking	3	3
(ii) Edge gaps/cracks	4	1
(iii) Surface fretting	4	1

5.7 General observations

Table 5 shows details of the additional work that the operatives were observed to carry out on site and any information they were seen recording. The work included vertical sealing, overbanding, application of tack coat, recording the hot mix asphalt temperature on delivery to site and matching of surface materials, texture and skid resistance with the surrounding construction. None of the treatments were widely used and, because of limited data, no specific conclusions can be made.

Table 5 Additional work details (Stage One visits)

	N/A	*VS only*	*VS & OB*	*VS & TC*	*VS & MR*	*Clegg tester*	*Hot mix temp*
Additional work	136	21	7	3	1	-	-
Recorded details	165	-	-	-	-	1	2

VS - Vertical sealing MR - Metal reinforcement
OB- Overbanding Clegg - Clegg impact tester compaction readings
TC - Tack coat N/A - Not applicable/not seen

Vertical sealing of the edges of the reinstatement was observed at 32 sites in total. At seven of these sites, overbanding was also used; three had a tack coat applied and one contained metal reinforcement.

The operatives were observed recording general information at only three sites. At two of these sites, the temperature of the asphalt material was recorded when it arrived on site and at one site the compaction of the granular materials was checked using a Clegg Impact Tester.

Additional data collected during the Stage Two visits are detailed in Table 6. All the sites visited during the Stage Two visits had been permanently reinstated. Surface regularity was found to meet the requirements of the Specification at all but two of the sites. Three sites, where the adjacent surfacing was HRA, were not resurfaced with HRA, as required by the Specification. The surface texture was adjudged not to match the surrounding surfacing at seven sites and there were no sites where the skid resistance of the sites did not appear to match the adjacent surfacing.

Table 6 Additional surface condition details (Stage Two visits)

Surface condition	*N/A**	*Yes*	*No*
Surface regularity OK?	15	148	2
Matches adjacent HRA?	133	29	3
Matches adjacent surface texture?	13	145	7
Matches adjacent skid resistance?	14	151	0
Overbanding used ?	31	62	72

**Not applicable*

Overbanding was carried out at 62 sites and was not carried out at 72 sites. The 31 sites marked 'N/A' in Table 6 were of modular construction.

5.8 Case studies

As a result of the relatively small number of sites containing defects, all the *'poor'* sites and four *'adequate'* sites, those were considered to have evidence of potential structural problems, were individually examined in detail. Scale sections of these eight sites and the reinstatement details are given in Appendix B.

SITE 006: [Plate 23]

This site consisted of an interim reinstatement in a flexible footway of good condition. The opening was 700mm long, 700mm wide and 900mm deep. Although the operatives reported that they had received training, four of the seven

material layers received insufficient compaction passes. Furthermore, the backfill material was observed to be poorly graded with a moisture content which appeared to be too high (as detailed in the field identification tests described in Appendix A1.6 of the Specification).

The site was revisited after 15 months and a 7mm edge depression was found to be present. Although within the intervention limits set out in the Specification, this depression may worsen with time.

Plate 23 Site 006

SITE 016: [Plate 24]

This site consisted of an all-permanent reinstatement in a modular footway of poor condition. The opening was 700mm long, 500mm wide and 750mm deep. The operatives reported that they had received training but, although all the material layers received the correct number of compaction passes, incorrect compaction plant was used. The moisture content of the backfill material appeared to be marginally too high.

The site was revisited after 15 months and was found to be in a poor state. The reinstatement had a 10mm edge depression (ie. equal to the intervention limit set out in the Specification) and there was severe surface cracking, severe edge gaps/cracks and severe fretting. The problems with this site are probably due to the poor local condition and are compounded by the use of incorrect compaction plant.

Plate 24 Site 016

SITE 047: [Plate 25]

This site was an interim reinstatement in a Type 3 road which was adjudged to be requiring maintenance. The opening was 150m long, 450mm wide and 825mm deep. The operatives reported that they had not received training. Although the finefill material surrounding the apparatus was compacted, the two layers of granular sub-base material received no compaction passes. The surfacing material was compacted but with only half the recommended number of passes.

The site was revisited after 11 months and was found to have a 3mm edge depression; well within the intervention limits in the Specification. The surface regularity appeared unsatisfactory and the texture of the surface did not match that of the adjacent surfacing. The reinstatement had minor surface cracking, minor edge gaps/cracks and minor surface fretting. Although these three defects do not exceed the intervention limits set out in the Specification, the lack of compaction may mean that the condition of the reinstatement will worsen as it is trafficked.

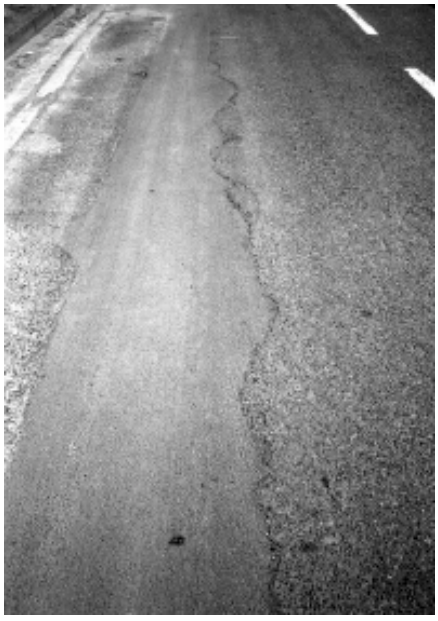

Plate 25 Site 047

SITE 074: [Plate 26]

This site consisted of an all permanent reinstatement in a modular footway which was considered to be requiring maintenance. The opening was 3m long, 1m wide and 565mm deep. Although the operatives reported that they had received training, the granular sub-base material received only 4 compaction passes rather than the 12 recommended in the Specification for the equipment used.

The site was revisited after 9 months and was found to have a 8mm edge depression and there was moderate surface cracking. Although within the intervention limits set out in the Specification, the condition of the reinstatement may worsen with time.

Plate 26 Site 074

SITE 097: [Plate 27]

This site consisted of an all permanent reinstatement in a modular footway which was considered to be requiring maintenance. The opening was 9.4m long, 870mm wide and 800mm deep. The operatives reported that they had received some training but three of the four layers of granular sub-base material received less than half the recommended number of compaction passes.

The site was revisited after 10 months and was found to have a 8mm edge depression. There was also minor surface cracking and minor edge gaps/cracks. Although within the intervention limits set out in the Specification, the condition of the reinstatement may worsen with time.

Plate 27 Site 097

SITE 155: [Plate 28]

This site consisted of an all permanent reinstatement in a modular footway of good condition. The opening was 1.2m long, 600mm wide and 800mm deep. Although the operatives reported that they had received training, the material layer surrounding the apparatus was too thick and two layers of granular sub-base material received insufficient compaction passes. As the work involved the repair of a leaking pipe, it was also noted that there was water present in the trench.

The site was revisited after 10 months and was found to be in a poor condition. The reinstatement had a 15mm edge depression (ie. greater than the 10mm intervention limits set out in the Specification), a 8mm surface depression and there were also severe edge gaps/cracks. The poor condition of this reinstatement is probably due to the presence of water in the trench and compounded by the insufficient compaction passes and unsuitable layer thickness.

Plate 28 Site 155

SITE 157: [Plate 29]

This site consisted of an interim reinstatement in a Type 2 road considered to be in a good condition. The opening was 2.2m long, 500mm wide and 900mm deep. The operatives reported that they had received training but none of the material layers were compacted with the recommended number of passes and one layer of granular sub-base material was too thick.

The site was revisited after 12 months and was found to be in a poor condition. The reinstatement had a 15mm surface depression (ie. outside the 12mm intervention limit set out for a 500mm wide reinstatement in the Specification) and there were moderate edge gaps/cracks. The poor condition of this reinstatement may be due to the insufficient number of compaction passes and incorrect material thicknesses.

Plate 29 Site 157

5.9 Highway Authority summary data

In order to provide information about the general performance of undertakers in each of the areas visited by TRL supervisors, each of the eight main participating Highway Authorities was asked to provide TRL with summary data of the type supplied to the quarterly HAUC meetings. The data summarise the numbers of notices, openings, inspections and inspection failures by each undertaker in the area and is used to provide undertakers with indications of their performance. The data received by TRL is summarised in Tables C1 to C17 in Appendix C. Care must be exercised when interpreting this summary data because each Highway Authority has its own system and the data often covers different periods. The origin of the data and the names of the individual undertakers have been coded to protect, as far as is possible, their anonymity.

Earlier data, supplied by the Highway Authorities, has been supplemented by data covering the period 1 April 1995 to 31 March 1996. Some HAs have been unable to provide additional information and, in these cases, the data supplied earlier has been used.

Some terminology used in the tables may require explanation. Undertakers are required to send *notices* to the HA giving notification of work about to take place in the highway. The length of notice depends on the type of work (eg emergency, minor works, major projects etc) and the traffic sensitivity of the site. These notice periods range from *'within two hours of work starting'* for emergency works to *'one month advance notice and seven days notice of start date'* for major projects. As more than one notice can be issued for some sites and notices are sometimes withdrawn when work is rescheduled, the number of notices received by a HA is not necessarily the same as the number of openings which were actually made.

Under the NRSWA, the HAs monitor the performance of undertakers' work by making random inspections at each of the following five stages:

Category 1 inspections	During excavation
Category 2 inspections	Whilst reinstating (including any interim phase)
Category 3 inspections	Immediately after permanent reinstatement (within one month)
Category 4 inspections	Between six and nine months after permanent reinstatement
Category 5 inspections	During the one month preceding the end of the guarantee period

The random inspections are based on *inspection units* which ensures that the number of inspections reflects the number or scale of the works. In most cases one inspection unit is equivalent to one opening but excavations longer than 200m are counted as one inspection unit for each 200m or balance thereof. Additionally, up to five small openings can count as one inspection unit providing they are all subject to the same notice, they are all made within ten working days, they are all within 500m of each other and the aggregate length of all the excavations does not exceed 200m.

The HA can inspect a random sample of six per cent of inspection units for each undertaker at each of the five inspection categories. The HA receives payment from the undertaker for each of these sample inspections. Additional payment is received by the HA if any of the inspection units are found to be defective, ie. they do not comply with the requirements of the Specification. The HA is also permitted to make further investigatory inspections for which no payment is received unless inspection units are found to be defective.

Summary data from seven of the participating HAs is given in Tables C1 to C17 in Appendix C.

Authority 1

Table C1 summarises the undertaker performance data from Authority 1 for three complete financial years from 1 April 1993 to 31 March 1996. Approximately 30,000 notices were received each year and approximately 16,000 inspections were carried out each year; this represents an inspection rate of approximately 53 per cent and therefore includes a large number of investigatory inspections. The rate of failed inspections is 9.6 per cent, 13.8 per cent and 17.1 per cent respectively for each of the three years which represents a steady increase. *[NB The performance data from HA work has been removed from the results for 1995/96 as the 100% failure rate (one inspection, one failure) would strongly influence the mean failure rate.]* The Cable TV companies tend to have the highest failure rate but also have a high inspection rate which suggests that the HA makes additional investigatory inspections of undertakers with a poor performance record.

Authority 2

Data from Authority 2 is summarised in six-monthly blocks in Tables C2 and C3. Table C2 covers the period 1 January 1994 to 30 June 1995 while Table C3 covers the period 1 July 1995 to 30 June1996.

The data from Authority 2 did not include the total number of notices received, these figures were estimated from the number of random inspections assuming a sample rate similar to other Authorities. An estimated 27,000 notices were received by Authority 2 in total and approximately 4,000 random inspections were made. In addition to the random inspections, 1,600 investigatory inspections were made although this number decreases significantly from 1,367 to 19 over the five data sets. The number of defect notices is high (approximately 9,300 in total) which suggests that some inspection units receive more than one defect notice and that reports of defects come from other sources, eg. members of the public.

Authority 3

Two sets of performance data from Authority 3, covering financial years 1994/95 and 1995/96, are summarised in Tables C4 and C5. The two sets are slightly different because the Authority has modified its requirements. However, the information in the two sets is essentially the same.

The total number of notices received each year is similar to the number of actual inspection units (ie. approximately

45,000). The total number of inspections made by the Authority is approximately 22,000 in 1994/95 and slightly higher at 28,000 in 1995/96. The number of defect sample inspections has fallen slightly from 1,335 (ie. 6 per cent) in 1994/95 to 1,057 (ie. 5.7 per cent) in 1995/96. This overall fall occurs in spite of the presence of Cable TV companies in the 1995/96 data set which have a high sample defect rate. This suggests an improvement in the performance of all other undertakers.

Authority 4

Tables C6 to C8 summarise the performance data from Authority 4 covering the financial years 1993/94 and 1994/95. There is a wide discrepancy between the estimated and actual inspection units until Table C8 when the two figures are in better agreement. This is because the Authority estimates the number of inspection units by averaging the actual number of inspection units from the three previous financial years.

The number of actual inspection units can be seen to suddenly increase in the third quarter of 1994/95 when the Cable TV companies began operations. However, there is no trend in the inspection pass rate over the two financial years. Generally, Authority 4 has a relatively high inspection failure rate with a maximum of 37.9 per cent in the second quarter of 1994/95 (Table C7). Because the high failure rate applies to all undertakers, this suggests that Authority 4 has a more rigorous inspection regime than other Authorities.

Authority 5

Two sets of data were received from Authority 5, one related to inspection results by inspection category (Table C9) and the other to undertaker performance (Table C10). All the data covered the period 1 July 1994 to 31 March 1995. Very few Category 5 inspections were made until January 1995 when significant numbers of reinstatements were reaching the end of their two year guarantee period. The largest numbers of *'unseen'* sites occurred in Category 1 and 2 because these inspections depend on the HA inspectors arriving on site whilst work is taking place. The majority of failures occurred during Category 1 and 2 inspections which suggests that non-compliance with the Specification and signing and guarding cause more problems than early life performance. However, problems not apparent during Category 3 inspections, may appear later, ie. during Category 4 or 5 inspections.

The performance of undertakers is shown in Table C10. There were a relatively small number of actual inspection units reported (approximately 4,000) and a total of approximately 2,500 inspections were made which resulted in an inspection failure rate of approximately 7.0 per cent.

Authority 6

Table C11 shows data from Authority 6 covering the financial year 1993/94 broken down by undertaker. Because no such breakdown could be provided by Authority 6 for 1995/96, Table C12 presents total values.

In both years, approximately 12,000 notices were received. The total number of inspections increased from 4,886 (38 per cent) in 1993/94 to 5,938 (47 per cent) in 1995/96. However, the rate of defective inspections almost halved from the already low 3.0 per cent in 1993/94 to 1.7 per cent in 1995/96.

Authority 7

Summary performance data was supplied by Authority 7 for five undertakers covering the period 1 April 1995 to 31 March 1996. The data provides a detailed breakdown of the performance of each undertaker and is given in Tables C13 to C17.

The total number of inspections for all undertakers was approximately 7,200. The data shows that the failure rates ranged from 4.0 per cent to 10.8 per cent and that the failure rates were generally higher at earlier stages of inspection, ie. Category 1 and 2.

The data also shows reasons for failures. The majority of failures were for signing and guarding and backfill operations. Some of the backfill failures occurred at inspections carried out after permanent reinstatement and, therefore, were identified as a result of coring or other detailed investigations. There were very few failures for crowning but significant numbers of failures for trips, surface depressions and combinations of defects. There were also high numbers of aborted visits associated with Category 1 and 2 inspections, ie. when work is taking place.

5.10 Coring data

Authority 7 supplied TRL with data summarising the results of a coring exercise carried out in November 1994. The results should not be considered as representative of the performance of sites nationally but, when combined with the failures identified by Authority 7 in 1995/96 by coring, they give an indication of the type of results which can be found when reinstatements are cored and their design compared with the Specification.

The results of the coring exercise are given in Table C18. The results show that 188 cores were tested of which 77 per cent failed to meet the requirements of the Specification for material thickness. As the sample is limited, it is difficult to draw accurate conclusions from the data. However, the 1995/96 performance results from Authority 7 are much better than the 1994 coring tests which suggests that standards of compliance with the Specification have improved.

No coring data was available from the other participating Authorities.

5.11 Utility 'follow up' data

TRL were supplied with data taken directly from the computerised street works registers (SWRs) of three Highway Authorities. The other participating Authorities were unable to supply data in a format compatible with the TRL database system. Sites covering a range of utilities were selected at random from the three data sets. Forms were generated for each of these sites and approximately ten forms were sent to each relevant utility company. An example of the form is given in Figure A3 of Appendix A.

The forms request information about the reinstatement

design option used and the working methods employed. This additional information was intended to supplement the data collected during the Stage One site visits.

In total, 140 forms were sent to utility companies in the three Highway Authority areas. 84 forms (60 per cent) were completed and returned to TRL. The data was transferred from the forms into the TRL database system.

It was decided that the performance of these 84 sites should be investigated by asking the relevant Highway Authorities to comment on the results of any inspections which were made of the sites. Another form was designed and automatically generated from the database. This form asked the Highway Authorities to identify the inspection category (if any) during which the site was inspected, whether it failed and, if so, whether any remedial work was carried out. An example of this second form is given in Figure A4 Appendix A.

Of the 84 forms which were sent to the Highway Authorities requesting performance information, 75 were returned (89 per cent). Of these 75 sites, 53 had not been inspected (71 per cent); of the 22 sites which had been inspected, there were two Category 1 inspections (9 per cent), ten Category 2 inspections (45 per cent), five Category 3 inspections (23 per cent), four Category 4 inspections (18 per cent) and just one Category 5 inspection (5 per cent).

Of the 22 inspected sites, nine had failed (41 per cent). All the failures occurred during Category 2 inspections (ie. during backfilling) and were all from one utility company in one area. Although based on randomly selected sites, these results may not be representative of the performance of sites nationally because the size of the sample is small. A larger sample, such as the Highway Authority data discussed in Section 5.9, upon which the random inspection regime is normally based, would give more representative results. This investigation could be undertaken by the regional HAUCs.

The results of the follow up approach are summarised in Table 7 below. The names of the three Highway Authorities have been coded using the same system used in Section 5.9.

6 Summary of results

Analysis of the Stage One TRL site observations has shown the following:

1 The majority of reinstatement work took place in footways, most of which were of a flexible construction.

2 The majority of observed openings were small; half were less than 2m in length and only five per cent were 'deep' as defined in the Specification.

3 In general, an all-permanent reinstatement method was adopted by the majority of undertakers.

4 Many of the contractors carried out interim reinstatements, often using deferred set macadam as an interim surface material. The permanent surfacing materials were generally laid by specialist contractors.

5 Granular sub-base was the most commonly imported material and the most common item of compaction equipment was the vibrotamper.

6 The majority of reinstatements were carried out using the correct design option. However, more than a quarter of sites were incorrect in terms of either the materials used or the layer thicknesses.

7 Compaction is the area where most problems occurred. The design and compaction requirements of the Specification were met at only five of the 151 sites where compaction was observed. Of the sites failing to comply with the compaction requirements, more than 50 per cent did not have a single layer compacted in accordance with the Specification.

Analysis of the Stage Two TRL site observations has shown the following:

1 The majority of sites were between nine and twelve months old at the time of the second visit.

2 Approximately 82 per cent of sites were adjudged to be in a 'good' or 'very good' condition. Approximately nine per cent were either resurfaced or not found and

Table 7 Results of utility 'follow up' forms

	Results of utility 'follow up' forms								
HA/Utility	*Total sites*	*Cat 1*	*Cat 2*	*Cat 3*	*Cat 4*	*Cat 5*	*Not inspected*	*Failed*	*Remedial work*
Authority 1									
Electricity	8	-	-	-	2	1	5	0	-
Water	14	-	-	2	-	-	12	0	-
Authority 2									
Water	10	2	-	1	-	-	7	0	-
Authority 3									
Gas	7	-	-	-	-	-	7	0	-
Water	9	-	1	1	-	-	7	0	-
Electricity	7	-	-	-	-	-	7	0	-
Cable TV	20	-	9	1	2	-	8	9	9
Total	75	2	10	5	4	1	53	9	9

approximately nine per cent were adjudged to be of 'adequate' or 'poor' quality. However, it must be noted that the majority of the sites were in the footway and were therefore subject to little or no trafficking.

3 The most common type of defects present at the sites of an 'adequate' or 'poor' quality was edge depressions probably caused by inadequate compaction.

4 Of the nine per cent found to be of 'adequate' or 'poor' quality, the likelihood of further deterioration was considered to be significant.

The HAUC summary data supplied by the Highway Authorities has demonstrated the following:

1 The majority of utility reinstatement work is carried out by Gas, Water, Electricity and Telecommunication companies. The volume of work carried out by Cable TV companies is increasing.

2 Some Highway Authorities target particular utilities, whom they consider are not complying with the Specification, for investigatory inspections.

3 There is wide variation in the rate of inspection failures between Highway Authorities, which may demonstrate that some Authorities are more rigorous in their inspection programme than others.

4 The majority of inspection failures occur during Categories 1 and 2, ie. while work is taking place. These are also the categories with the highest proportion of unseen sites and abortive visits due to the problems of arriving on site while work is in progress.

5 From the available data, the average defect rate is of the order of ten per cent.

Results of coring exercise undertaken by one Highway Authority showed:

1 77 per cent of cores tested failed to meet the requirements of the Specification material thickness.

Utility 'follow up' data demonstrated:

1 Of the 140 sites randomly selected from three Street Works Registers, data were available for 75 sites.

2 Of these 75 sites, 53 were not inspected under the Highway Authorities' sample inspection regime.

3 Of the 22 inspected sites, nine failed during Category 2 inspections, ie. backfilling.

4 Because all nine failed sites were from one utility company in one area, the results are inconclusive.

7 Conclusions

The general impression gained from the TRL site visits is that the majority of utility companies and their contractors are attempting to comply with the requirements of the Specification. However, there are still wide variations in reinstatement practice which are not specific to any particular utility company or Highway Authority area.

The main aspects of reinstatement practice, where problems have been identified, are the number of compaction passes, layer thicknesses, use of suitable compaction equipment and storage of materials on site. Improvements are needed in all of these areas if good quality reinstatements are to be consistently achieved. At the time of the study, the majority of operatives had yet to undergo training. It is clear that the standard of workmanship reflects the degree of training received.

Approximately 70 per cent of the reinstatement design options used complied with the requirements of the Specification. However, more than a quarter of the sites observed were incorrect in terms of either the materials used or the layer thicknesses.

Approximately 82 per cent of sites were found to be in a 'good' or 'very good' condition at the time of the second TRL visit. The age of the sites was generally between 9 and 12 months at the time of these visits. The most common defect present in the sites of 'adequate' or 'poor' quality was edge depression and the likelihood of further deterioration was considered to be significant.

Data provided by Highway Authorities in the HAUC quarterly reports showed a wide variation in defect levels. This indicated that some Authorities are more rigorous in their inspections than others. No evidence was presented to show that any specific utility company has a higher degree of failure than any other.

8 Recommendations

Performance Monitoring

1 It is recommended that a series of second re-visits is undertaken, 12 months after the first re-visits were made, to establish the longer term performance of the sites.

2 It is recommended that bi-annual monitoring of randomly selected sites should be undertaken by an independent body and, if this monitoring identifies the need, measures should be taken to improve compliance with the Specification.

Specification Requirements

1 It is suggested that the specified reinstatement designs for footways may need to be reviewed based on the existing construction and the level of trafficking.

Training/Supervision

1 It is recommended that the training requirements for utility supervisors and operatives, in the areas of compaction and materials specification, is reviewed.

2 It is suggested that measures are taken to improve the supervision of reinstatement work nationally.

9 Acknowledgements

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Appendix A: TRL data collection forms

MONITORING THE EFFECTIVENESS OF THE NEW ROADS AND STREET WORKS ACT 1991

Site Visit By :- Visit No:- Date :- Weather :-

Contact Name and Tel No :-

	TRL Ref:
UTILITY	Ref:
STREET AUTHORITY	Ref:
SITE ADDRESS	National Grid Ref:
	POST CODE
REINSTATEMENT ITEM No	LOCATION

ROAD CATEGORY	1	2	3	4	Unmade

OTHER SITE	Footway	Cycleway	High Duty f/w	High Amenity f/w	Verge	Unmade

CONSTRUCTION TYPE	Flexible	Composite	Rigid	Modular	Other

EXISTING CONSTRUCTION									
LAYER NO. (From Top)									
MATERIAL									
THICKNESS									

RECONSTRUCTION METHOD	All Permanent	Interim	Permanent Basecourse	Permanent Road Base	Permanent Sub-base

INITIAL LOCAL CONDITION	Less than 5 Yrs old	Good	Requiring Maintenance	Poor	Requiring Reconstruction

LOCAL SUBGRADE	Class A	Class B	Class C	Class D

SIZE OF OPENING	Length	Width	Depth

EXCAVATION DETAILS	Undue damage to road surface?	Y	N	Excavated material stored properly?	Y	N
	Trench width adequate?	Y	N	Trench supports necessary?	Y	N
	Water present in trench?	Y	N	Damage to other apparatus?	Y	N

EXCAVATION EQUIPMENT	Roadsaw	Breaker	Hand Tools	Mechanical Excavator	Trench Supports

PIPE DETAILS	Diameter	Type	Material

COMPACTION EQUIPMENT	Vibrotamper VT	Vibrating Roller VRS/VRT	Vibrating Plate VP	Percussive Rammer PR	Hand Rammer HR
WEIGHT OF EQUIPMENT					

RE_USE OF MATERIAL	Class A	Class B	Class C	Class D	None

N115: TRL Site Visit Form (Visit 1) 5 July 1995

Figure A1 Stage One visit form

IMPORTED MATERIAL(S)	HRA	DBM	DSM	PCSM	Concrete	Finefill
	Granular	CBM	Foamed concrete	Pavers	Flags	Sand

	Surround	Backfill									
MATERIAL											
LAYER NUMBER											
LAYER THICKNESS											
COMPACTION PASSES											
COMPACTION EQUIPMENT											
OK? (Y or N)											

SURFACE REGULARITY	Surface Crowning	Surface Depression	Edge Depression	Texture Depth
MEASUREMENT (mm)				

ADDITIONAL WORK	Vertical Sealing	Tack Coat	Overbanding	Material Sampling	Plastic Membrane	Metal Reinforcement

RECORDED INFORMATION (By Utility)	Hot Mix Temperature	Weather Conditions	Surface Regularity	Skid Resistance	Texture Depth

LABOUR UTILISED	Inhouse Workforce	Contractor(s)

HAUC TRAINING (Yes, No, Some or NA)	Utility Supervisor	Contractors' Supervisor	Operatives

FURTHER COMMENTS

Figure A1 Continued

MONITORING THE EFFECTIVENESS OF THE UTILITY REINSTATEMENT SPECIFICATION

SITE VISIT BY: VISIT NO: **2** DATE: WEATHER:

DATE OF 1ST VISIT:	TRL REF:
UTILITY:	UTILITY CODE:
STREET AUTHORITY:	AREA CODE:
SITE ADDRESS POST CODE: GRID REFERENCE:	
LOCATION:	

CLOSING DIMENSIONS	Length:		Width:	
GENERAL CONDITION	Very Good	Good	Adequate	Poor
SURFACE REGULARITY MEETS REQUIREMENTS?			Yes	No
IF ADJACENT SURFACE IS HRA, IS TRENCH HRA?			Yes	No
SURFACE TEXTURE AT LEAST MATCHES ADJACENT?			Yes	No
SKID RESISTANCE APPEARS SATISFACTORY?			Yes	No
HAS OVERBANDING BEEN USED?			Yes	No
SURFACE CRACKING?	None	Minor	Moderate	Severe
EDGE GAPS/CRACKS?	None	Minor	Moderate	Severe
SURFACE FRETTING?	None	Minor	Moderate	Severe

PTO....

N115: TRL Site Visit Form (Visit 2) 6 February 1996

Figure A2 Stage Two visit form

If any of the following are present, please give dimension. Otherwise leave blank.

EDGE DEPRESSION	mm
SURFACE DEPRESSION (SETTLEMENT)	mm
SURFACE CROWNING	mm

OTHER COMMENTS

PLEASE PROVIDE PHOTOGRAPH(S) TO SHOW ANY DEFECTS AND TO ENABLE FUTURE IDENTIFICATION OF THE SITE.

N115: TRL Site Visit Form (Visit 2) 6 February 1996

Figure A2 Continued

MONITORING THE EFFECTIVENESS OF THE NEW ROADS AND STREET WORKS ACT 1991

Utility Questionnaire

	TRL Ref:
UTILITY	
STREET AUTHORITY	Ref:
SITE ADDRESS	National Grid Ref:
	POST CODE
REINSTATEMENT ITEM No	LOCATION

All information above completed by TRL prior to issuing.
Please complete each box below by ringing, as far as knowledge permits.

ROAD CATEGORY	1	2	3	4	Unmade	
ALTERNATIVE CATEGORY	Footway	Cycleway	High Duty f/w	High Amenity f/w	Verge	Unmade
EXISTING CONSTRUCTION	Flexible	Composite	Rigid	Modular	Other	
RECONSTRUCTION METHOD	All Permanent	Interim	Permanent Basecourse	Permanent Road Base	Permanent Sub-base	
RE-USE OF MATERIAL	Class A	Class B	Class C	Class D	None	
IMPORTED MATERIAL	HRA	DBM	DSM	PCSM	Concrete	Finefill
	Granular	CBM	Foamed Concrete	Pavers	Flags	Sand
DEPTH OF EXCAVATION	Up to 400mm	401 - 750mm	751 - 1500mm	1501mm +		
LABOUR UTILISED	Inhouse Work Force	Contractor(s)				
HAUC TRAINING	Supervisor	Supervisor	Operatives	Operatives	Operatives	
	Yes	Not Yet	Yes	Some	Not Yet	
EXCAVATION EQUIPMENT	Roadsaw	Breaker	Hand Tools	Mechanical Excavator	Trench Supports	
COMPACTION EQUIPMENT	Vibrotamper	Vibrating Roller	Vibrating Plate	Percussive Rammer	Hand Rammer	
ADDITIONAL WORK	Vertical Sealing	Tack Coat	Overbanding	Material Sampling	Plastic Membrane	Metal Reinforcement
RECORDED INFORMATION (ring boxes)	Hot Mix Temperature	Weather Conditions	Surface Regularity	Skid Resistance	Texture Depth	

N115: Utility Follow-up Form 22 August 1996

Figure A3 Utility 'follow up' form

Utility:	Authority:

TRL Reference:			
Site Address:	Inspected *(please circle)*	Failed *(please circle)*	Remedial *(please circle)*
Reinstatement Ref:	1 2 3 4 5 N	Y N	Y N
Road Category:			

TRL Reference:			
Site Address:	Inspected *(please circle)*	Failed *(please circle)*	Remedial *(please circle)*
Reinstatement Ref:	1 2 3 4 5 N	Y N	Y N
Road Category:			

TRL Reference:			
Site Address:	Inspected *(please circle)*	Failed *(please circle)*	Remedial *(please circle)*
Reinstatement Ref:	1 2 3 4 5 N	Y N	Y N
Road Category:			

TRL Reference:			
Site Address:	Inspected *(please circle)*	Failed *(please circle)*	Remedial *(please circle)*
Reinstatement Ref:	1 2 3 4 5 N	Y N	Y N
Road Category:			

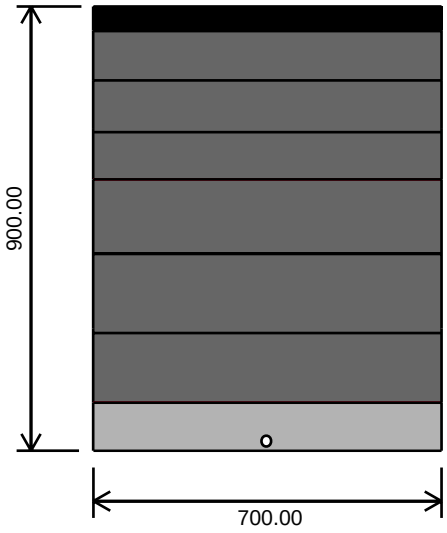
TRL Reference:			
Site Address:	Inspected *(please circle)*	Failed *(please circle)*	Remedial *(please circle)*
Reinstatement Ref:	1 2 3 4 5 N	Y N	Y N
Road Category:			

N115: Highway Authority Follow-up Form 16 July 1996

Figure A4 Highway Authority 'follow up' form

Appendix B: Details of case studies

SITE 006:



Material	Passes	Spec.
DSM: 50mm	4	7
GSB1: 100mm	4	4
GSB1: 100mm	4	4
GSB1: 100mm	4	4
GSB1: 150mm	4	8
GSB1: 150mm	4	8
GSB1: 150mm	4	8
Pea Gravel: 100mm	0	N/A

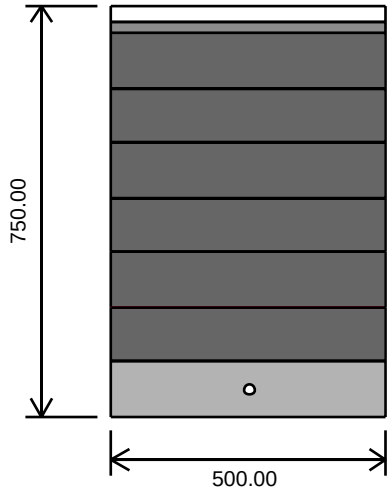
All dimensions in mm

SITE DETAILS			
Date of visit #1	*24/2/95*	**Width of opening**	*700mm*
Road category	*Footway*	**Pipe diameter**	*20mm*
Method	*Interim*	**Compaction plant**	*Vibrotamper*
Local condition	*Good*	**Re-used material?**	*No*
Length of opening	*0.7m*	**Training?**	*Yes*

OTHER SIGNIFICANT DETAILS
Backfill material poorly graded and moisture content too high. Insufficient passes.

REINSTATEMENT PERFORMANCE	**Date of visit #2**	*20/5/96*
7mm edge depression.		

SITE 016:



Material	Passes	Spec.
Flags + Mortar: 50mm	N/A	N/A
GSB1: 100mm	4	4
GSB1: 100mm	4	4
GSB1: 100mm	4	4
GSB1: 100mm	4	4
GSB1: 100mm	4	4
GSB1: 100mm	4	4
Sand: 100mm	0	N/A

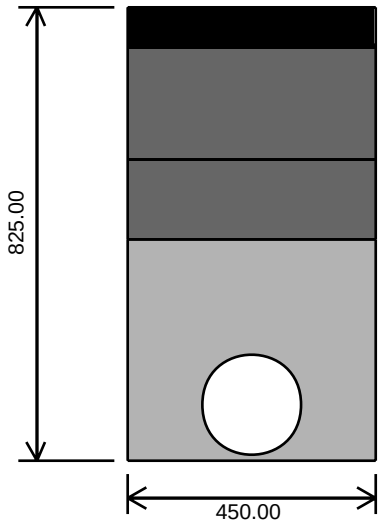
All dimensions in mm

SITE DETAILS			
Date of visit #1	*20/2/95*	**Width of opening**	*500mm*
Road category	*Footway*	**Pipe diameter**	*20mm*
Method	*All permanent*	**Compaction plant**	*Percussive rammer*
Local condition	*Poor*	**Re-used material?**	*No*
Length of opening	*0.7m*	**Training?**	*Yes*

OTHER SIGNIFICANT DETAILS
Moisture content of backfill material marginally too high. Incorrect compaction plant.

REINSTATEMENT PERFORMANCE	**Date of visit #2**	*20/5/96*
10mm edge depression, severe surface cracking, severe edge cracks/gaps and severe fretting.		

SITE 047:



Material	Passes	Spec.
DSM: 75mm	6	12
GSB1: 200mm	0	12
GSB1: 150mm	0	8
Finefill: 400mm	3	N/A

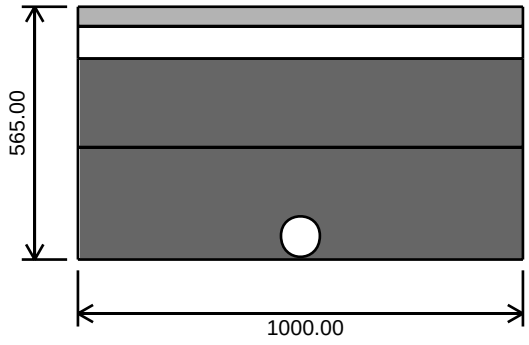
All dimensions in mm

SITE DETAILS			
Date of visit #1	*11/7/95*	**Width of opening**	*450mm*
Road category	*Class 3*	**Pipe diameter**	*180mm*
Method	*Interim*	**Compaction plant**	*VT + Single VR*
Local condition	*Requiring maint.*	**Re-used material?**	*No*
Length of opening	*150m*	**Training?**	*Not operatives*

OTHER SIGNIFICANT DETAILS
Insufficient compaction passes.

REINSTATEMENT PERFORMANCE	**Date of visit #2**	*4/6/96*
3mm edge depression, surface irregularity, minor surface cracking, minor edge gaps/cracks, minor surface fretting.		

SITE 074:



Materials	Passes	Spec.
Flags + Mortar: 115mm	N/A	N/A
GSB1: 200mm	4	12
GSB1: 250mm	N/A	N/A

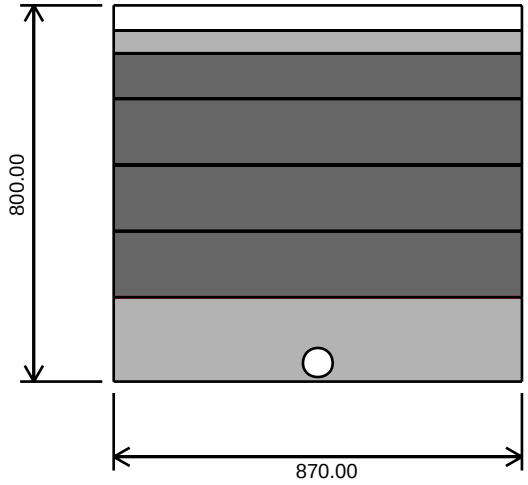
All dimensions in mm

SITE DETAILS			
Date of visit #1	*14/8/95*	**Width of opening**	*1000mm*
Road category	*Footway*	**Pipe diameter**	*90mm*
Method	*All permanent*	**Compaction plant**	*Vibrotamper*
Local condition	*Requiring maint.*	**Re-used material?**	*No*
Length of opening	*3m*	**Training?**	*Yes*

OTHER SIGNIFICANT DETAILS
Insufficient compaction passes.

REINSTATEMENT PERFORMANCE	**Date of visit #2**	*15/5/96*
8mm edge depression, moderate surface cracking.		

SITE 097:



Material	Passes	Spec.
Flag + Sand: 100mm	N/A	N/A
GSB1: 100mm	4	4
GSB1: 140mm	4	8
GSB1: 140mm	3	8
GSB1: 140mm	3	8
Sand: 180mm	1	N/A

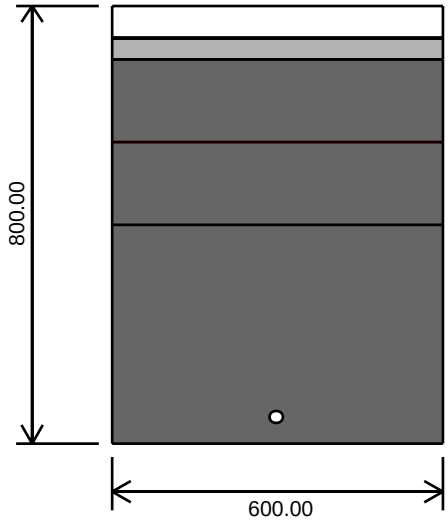
All dimensions in mm

SITE DETAILS			
Date of visit #1	*25/7/95*	**Width of opening**	*870mm*
Road category	*Footway*	**Pipe diameter**	*63mm*
Method	*All permanent*	**Compaction plant**	*Vibrotamper*
Local condition	*Requiring maint.*	**Re-used material?**	*No*
Length of opening	*9.4m*	**Training?**	*Some*

OTHER SIGNIFICANT DETAILS
Insufficient compaction passes.

REINSTATEMENT PERFORMANCE	**Date of visit #2**	*8/5/96*
8mm edge depression, minor surface cracking, minor edge gaps/cracks.		

SITE 155:



Material	Passes	Spec.
Flags + Sand: 100mm	N/A	N/A
GSB1: 150mm	2	8
GSB1: 150mm	3	8
GSB1: 400mm	3	U/S

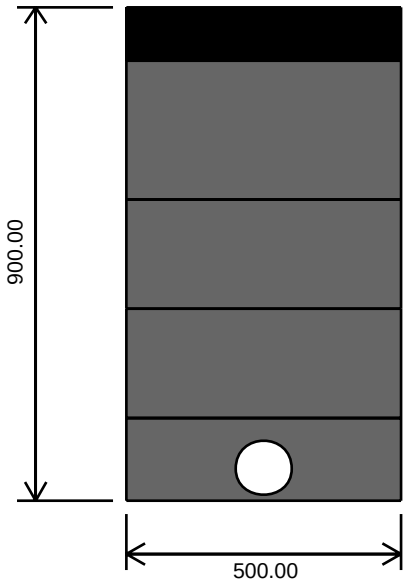
All dimensions in mm

SITE DETAILS			
Date of visit #1	*14/9/95*	**Width of opening**	*600mm*
Road category	*Footway*	**Pipe diameter**	*25mm*
Method	*All permanent*	**Compaction plant**	*Vibrotamper*
Local condition	*Good*	**Re-used material?**	*No*
Length of opening	*1.2m*	**Training?**	*Yes*

OTHER SIGNIFICANT DETAILS
Water present in trench - repair to leaking pipe. Insufficient passes, layer too thick.

REINSTATEMENT PERFORMANCE	**Date of visit #2**	*4/7/96*
Poor condition; 15mm edge depression, 8mm surface depression, severe edge gaps/cracks.		

SITE 157:



Material	Passes	Spec.
DSM: 100mm	4	12
GSB1: 250mm	4	U/S
GSB1: 200mm	4	12
GSB1: 200mm	4	12
GSB1: 150mm	3	N/A

All dimensions in mm

SITE DETAILS			
Date of visit #1	*4/7/95*	**Width of opening**	*500mm*
Road category	*Category 2*	**Pipe diameter**	*100mm*
Method	*Interim*	**Compaction plant**	*Vibrotamper*
Local condition	*Good*	**Re-used material?**	*No*
Length of opening	*2.2m*	**Training?**	*Yes*

OTHER SIGNIFICANT DETAILS
Insufficient compaction passes, layer too thick.

REINSTATEMENT PERFORMANCE	**Date of visit #2**	*4/7/96*
Poor condition; 15mm surface depression, moderate edge gaps/cracks.		

Appendix C: Highway Authority sample data

Table C1 Authority 1 sample data (1/4/93 - 31/3/96)

Authority 1	*1 April 1993 - 31 March 1994*				*1 April 1994 - 31 March 1995*				*1 April 1995 - 31 March 1996*			
Under-taker	*Total notices*	*Inspect-ions*	*Failed inspect-ions (%)*	*Abor-tive site visits (%)*	*Total notices*	*Inspect-ions*	*Failed inspect-ions (%)*	*Abor-tive site visits (%)*	*Total notices*	*Inspect-ions*	*Failed inspect-ions (%)*	*Abor-tive site visits (%)*
Telecom1	3153	1475	17.5	5.5	3066	1664	12.7	9.7	2659	1717	10.6	12.4
Gas	8335	4571	8.5	8.1	6665	3530	11.3	11.8	5907	3724	11.3	14.3
Water1	13646	7490	8.2	8.1	15886	7662	11.6	9.1	17537	7818	11.2	11.4
Electric1	4899	2820	10.7	4.3	4475	2277	14.6	7.6	4285	2475	15.5	9.9
Other1	2	0	0.0	0.0	1	0	0.0	0.0	0	0	0.0	0.0
Telecom2	11	5	24.2	0.0	137	407	26.7	0.0	101	111	16.0	1.1
Cable1	0	0	0.0	0.0	0	0	0.0	0.0	1022	1177	45.0	0.0
HA	29	3	0.0	0.0	10	0	0.0	0.0	76	1	100.0	0.0
Cable2	10	8	22.0	4.0	217	171	32.5	0.0	0	0	0.0	0.3
Cable3	0	0	0.0	0.0	210	480	48.3	0.3	147	106	44.4	2.4
Total	30085	16372	9.6	7.2	30667	16191	13.8	9.0	*31658	*17128	*17.1	*5.8

**HA data not included in totals for 1995/96*

Table C2 Authority 2 sample data (1/1/94 - 30/6/95)

Authority 2	*1 January - 30 June 1994*				*1 July - 31 December 1994*				*1 January - 30 June 1995*			
Under -taker	*Esti -mated notices**	*Random inspec -tions*	*Investi -gatory inspec -tions*	*Defect notices†*	*Esti -mated notices**	*Random inspec -tions*	*Investi -gatory inspec -tions*	*Defect notices†*	*Esti -mated notices**	*Random inspec -tions*	*Investi -gatory inspec -tions*	*Defect notices†*
Gas	1200	180	176	152	800	120	15	496	1527	229	9	397
Water1	1107	166	152	67	1100	165	21	784	1627	244	16	660
Water2	687	103	101	46	560	84	7	167	847	127	7	122
Water3	13	2	0	0	0	0	0	0	0	0	0	0
Water4	160	24	18	9	153	23	2	128	233	35	0	168
Sewerage	40	6	6	3	7	1	2	17	13	2	0	14
Electric1	693	104	205	68	440	66	11	275	773	116	11	232
Electric2	7	1	0	0	0	0	0	1	0	0	3	4
Electric3	13	2	0	0	0	0	0	0	0	0	0	0
Telecom1	867	130	110	69	620	93	4	318	1007	151	10	222
Telecom2	20	3	3	2	20	3	1	16	13	2	0	2
Cable1	27	4	10	0	553	83	35	1247	273	41	25	528
Cable2	1840	276	560	218	0	0	0	2	1247	187	19	527
Cable3	0	0	0	0	0	0	0	0	0	0	0	20
Cable4	0	0	0	0	0	0	0	0	0	0	0	0
Cable5	0	0	0	0	0	0	0	0	0	0	0	0
Other1	20	3	12	7	8	1	1	33	40	6	0	48
Other2	53	8	14	3	7	1	1	40	60	9	0	34
Total	6747	1012	1367	644	4268	640	100	3524	7660	1149	100	2978

**Based on 15% sample rate (sample rate from other Authorities + assumed few Category 5)*
†Each opening can have more than one defect notice

Table C3 Authority 2 sample data (1/7/95 - 30/6/96)

Authority 2	*1 July - 31 December 1995*				*1 January - 30 June 1996*			
Undertaker	*Estimated notices**	*Random inspections*	*Investigatory inspections*	*Defect notices†*	*Estimated notices**	*Random inspections*	*Investigatory inspections*	*Defect notices†*
Gas	627	94	2	78	567	85	6	210
Water1	927	139	4	109	680	102	2	252
Water2	413	62	7	127	353	53	5	243
Water3	0	0	0	0	0	0	0	0
Water4	93	14	0	6	100	15	0	58
Sewerage	0	0	0	0	0	0	0	0
Electric1	320	48	2	56	573	86	3	110
Electric2	0	0	0	0	7	1	0	0
Electric3	0	0	0	0	7	1	0	0
Telecom1	640	96	3	49	293	44	0	146
Telecom2	0	0	0	0	0	0	0	1
Cable1	0	0	0	0	7	1	0	0
Cable2	1627	244	3	327	1087	163	1	701
Cable3	0	0	0	0	0	0	0	0
Cable4	7	1	0	1	13	2	0	0
Cable5	0	0	0	0	0	0	2	15
Other1	27	4	0	2	13	2	0	6
Other2	87	13	0	16	0	0	0	35
Total	4768	715	21	771	3700	555	19	1777

**Based on 15% sample rate (sample rate from other Authorities + assumed few Category 5)*
†Each opening can have more than one defect notice

Table C4 Authority 3 sample data (1994/95)

Authority 3	*1 April 1994 - 31 March 1995*							
Undertaker	*Total notifications*	*Actual inspections units*	*Total inspections*	*Not inspected*	*Unseen*	*Acceptable*	*Defected*	*Defect rate (%)*
Gas	7676	6944	3452	457	365	2511	119	3.5
Telecom1	8057	7563	3504	592	511	2123	277	7.9
Water1	140	135	180	61	46	68	5	2.8
Water2	6101	6040	3478	124	403	2867	83	2.4
Electric1	329	306	149	22	52	71	4	2.7
Telecom2	50	165	593	104	18	447	24	4.1
Water3	7945	6345	2529	422	551	1316	239	9.5
Electric2	1	1	2	0	0	2	0	0.0
Electric3	4454	4341	2363	359	292	159	122	5.2
Water4	1997	1903	988	254	71	647	16	1.6
Water5	7119	7034	4018	567	215	2834	402	10.0
Water6	1659	1592	939	141	249	505	44	4.7
Total	45528	42369	22195	3103	2773	14981	1335	6.0

Table C5 Authority 3 sample data (1995/96)

Authority 3	*1 April 1995 - 31 March 1996*							
Undertaker	*Total notifications*	*Actual inspections units*	*Sample inspections*	*Total inspections*	*Sample defects*	*Total defects*	*Sample defect rate (%)*	*Defect rate (%)*
Gas	7396	6925	3188	4917	126	255	4.0	5.2
Telecom1	7224	6749	2681	3819	140	304	5.2	8.0
Water1	156	153	77	150	5	8	6.5	5.3
Water2	4488	4154	1262	2286	50	123	4.0	5.4
Electric1	322	310	196	229	7	7	3.6	3.1
Telecom2	8	8	9	29	0	4	0.0	13.8
Water3	7768	6637	2023	2929	106	359	5.2	12.3
Electric3	4894	4758	1667	3025	52	196	3.1	6.5
Water4	1897	1891	501	1167	10	117	2.0	10.0
Water5	7284	7162	3060	4619	125	298	4.1	6.5
Water6	1704	1664	1051	1349	26	37	2.5	2.7
Cable1	894	792	796	1526	189	248	23.7	16.3
Cable2	1600	1560	1991	2610	221	524	11.1	20.1
Total	45635	42763	18502	28655	1057	2480	5.7	8.7

Table C6 Authority 4 sample data (1993/94)

Authority 4	April - June 1993											July - September 1993										
					Actual inspections											Actual inspections						
		Inspection units		Sample inspec	Pass		Fail		Not found				Inspection units		Sample inspec	Pass		Fail		Not found		
Under -taker	Notifi -cation	Est.	Act.	-tion results[1]	No.	%	No.	%	No.	%	Further defects	Notifi-cation	Est.	Act.	-tion results[1]	No.	%	No.	%	No.	%	Further defects
Electric1	252	252	466	60	26	86.7	4	13.3	-	-	93	334	334	472	338	221	85.0	39	15.0	78	23.1	166
Electric2	2	2	1	-	-	-	-	-	-	-	-	80	80	55	79	9	34.6	17	65.4	53	67.1	19
Telecom1	75	75	60	20	13	72.2	5	27.8	2	10	98	67	67	60	55	25	62.5	15	37.5	15	27.3	98
Gas	999	999	13	169	92	77.3	27	22.7	-	-	217	1024	1024	519	580	242	61.1	154	38.9	184	31.7	157
Telecom2	0	0	2	1	-	-	-	-	-	-	3	0	0	2	15	5	45.5	6	54.5	4	26.7	9
Water	269	269	7	130	83	80.6	20	19.4	-	-	473	809	809	41	531	155	70.5	65	29.5	311	58.6	436
Total	1597	1597	549	380	214	79.3	56	20.7	2	0.5	884	2314	2314	1149	1598	657	69.0	296	31.0	645	40.4	885

Authority 4	October - December 1993											January - March 1994										
					Actual inspections											Actual inspections						
		Inspection units		Sample inspec	Pass		Fail		Not found				Inspection units		Sample inspec	Pass		Fail		Not found		
Under -taker	Notifi -cation	Est.	Act.	-tion results[1]	No.	%	No.	%	No.	%	Further defects	Notifi -cation	Est.	Act.	-tion results[1]	No.	%	No.	%	No.	%	Further defects
Electric1	463	463	168	424	361	92.1	31	7.9	32	7.5	149	702	702	715	20	14	87.5	2	12.5	4	20.0	158
Electric2	113	113	102	85	51	82.3	11	17.7	23	27.1	21	134	149	85	44	20	55.6	16	44.4	8	18.2	27
Telecom1	157	157	41	83	63	82.9	13	17.1	7	7.4	133	189	194	59	3	2	66.7	1	33.3	0	0.0	221
Gas	1625	1625	1427	411	312	84.3	58	15.7	41	10.0	435	1585	3582	479	331	208	77.3	61	22.7	62	18.7	545
Telecom2	0	0	6	1	1	100	0	0.0	0	0.0	6	1	1	0	0	0	0.0	0	0.0	0	0.0	3
Water	768	768	30	38	24	75.0	8	25.0	6	15.8	777	773	789	490	40	26	81.3	6	18.7	8	20.0	683
Total	3126	3126	1774	1042	812	87.0	121	13.0	109	10.5	783	3384	5417	1828	438	270	75.8	86	24.2	82	17.7	1637

1 For Cable1 no formal sample inspections were made, different sites were inspected after reinstatement was completed

Table C7 Authority 4 sample data (Q1 & Q2 1994/95)

Authority 4	April - June 1994											July - September 1994										
		Inspection units		Sample inspec -tion	Actual inspections: Pass		Actual inspections: Fail		Not found				Inspection units		Sample inspec -tion	Actual inspections: Pass		Actual inspections: Fail		Not found		
Under -taker	Notifi -cation	Est.	Act.	results[1]	No.	%	No.	%	No.	%	Further defects	Notifi -cation	Est.	Act.	results[1]	No.	%	No.	%	No.	%	Further defects
Electric1	770	770	611	449	311	87.9	43	12.1	95	21.2	163	771	818	500	123	86	88.7	11	11.3	26	21.1	102
Electric2	112	134	91	67	33	78.6	9	21.4	25	37.3	22	110	137	44	10	5	55.6	4	44.4	1	10.0	12
Telecom1	163	198	264	2	0	0.0	2	100	0	0.	144	577	611	268	13	7	77.8	2	22.2	4	30.8	71
Gas	1552	8544	296	615	467	90.5	49	9.5	99	16.1	244	986	1037	962	219	162	88.5	21	11.5	36	16.4	148
Telecom2	27	41	2	0	0	0.0	0	0.0	0	0.0	8	15	46	5	0	0	0.0	0	0.0	0	0.0	14
Cable1	230	525	20	199	141	70.9	58	29.1	-	-	158	252	591	179	289	135	46.7	154	53.3	0	0.0	117
Cable2	190	600	-	12	2	16.7	10	83.3	0	0.0	11	66	191	-	12	3	33.3	6	66.7	-	-	12
Water	418	448	333	77	54	76.1	17	23.9	6	7.8	384	700	769	533	17	6	46.2	7	53.8	4	23.5	371
Total	3462	11260	1321	1421	1008	87.4	145	12.6	130	9.1	971	2706	3382	1991	560	318	62.1	194	37.9	45	8.0	745

1 - For Cable1 no formal sample inspections were made, different sites were inspected after reinstatement was completed

Table C8 Authority 4 sample data (Q3 & Q4 1994/95)

Authority 4	October - December 1994											January - March 1995										
		Inspection units		Sample inspec -tion	Actual inspections: Pass		Actual inspections: Fail		Not found				Inspection units		Sample inspec -tion	Actual inspections: Pass		Actual inspections: Fail		Not found		
Under -taker	Notifi -cation	Est.	Act.	results[1]	No.	%	No.	%	No.	%	Further defects	Notifi -cation	Est.	Act.	results[1]	No.	%	No.	%	No.	%	Further defects
Electric1	494	556	559	113	84	98.8	1	1.2	25	22.1	102	691	796	515	358	195	83.7	38	16.3	125	34.9	109
Electric2	87	110	70	11	5	50.0	5	50.0	1	9.1	31	133	177	118	95	62	83.8	12	16.2	21	22.1	34
Telecom1	345	377	325	17	11	91.7	1	8.3	5	29.4	7	623	652	174	141	61	91.0	6	9.0	74	52.5	121
Gas	732	1730	956	267	206	93.6	14	6.4	47	17.6	223	1026	1037	883	597	375	89.1	46	10.9	176	29.5	145
Telecom2	19	51	33	0	0	0.0	0	0.0	0	0.0	7	16	16	16	11	6	60.0	4	40.0	1	9.1	6
Cable1	95	218	1296	282	157	55.7	125	44.3	-	-	167	294	665	609	157	85	54.1	72	45.9	0	0.0	106
Cable2	178	522	195	11	0	0.0	11	100	0	0.0	21	156	448	177	247	67	28.2	171	71.8	0	0.0	601
Water	453	464	917	14	9	100	0	0.0	5	35.7	458	910	944	589	207	73	72.3	28	27.7	106	51.2	443
Total	2403	4028	4351	715	472	75.0	157	25.0	83	11.6	1016	3849	4735	3081	1813	924	71.0	377	29.0	503	27.7	1565

1 - For Cable1 no formal sample inspections were made, different sites were inspected after reinstatement was completed

Table C9 Authority 5 sample data (Defects by inspection category) (1/7/94 - 31/3/95)

Authority 5	*1 July 1994 - 3 September 1994*						*1 October 1994 - 31 December 1994*						*1 January 1995 - 31 March 1995*					
	Category 1	*Category 2*	*Category 3*	*Category 4*	*Category 5*	*Total*	*Category 1*	*Category 2*	*Category 3*	*Category 4*	*Category 5*	*Total*	*Category 1*	*Category 2*	*Category 3*	*Category 4*	*Category 5*	*Total*
Pass	92	134	234	77	0	537	118	125	172	565	8	988	94	83	234	247	144	802
Fail	8	13	21	7	0	49	13	14	12	19	3	61	19	8	13	11	6	57
% Fail[1]	8.0	8.8	8.2	8.3	0	8.4	9.9	10.1	6.5	3.3	27.3	5.8	16.8	8.8	5.3	4.3	4.0	6.6
Total seen	100	147	255	84	0	586	131	139	184	584	11	1049	113	91	247	258	150	859
Unseen	70.0	70	14	0	0	154	74	61	3	18	0	156	105	85	9	18	7	224
% Unseen[2]	41.2	32.3	5.2	0.0	0.0	20.8	36.1	30.5	1.6	3.0	0.0	12.9	48.1	48.3	3.5	6.5	4.5	20.7
Total sample	170.0	217	269	84	0	740	205	200	187	602	11	1205	218	176	256	276	157	1083

1 The Failed results are a proportion of the Total sample seen
2 The Unseen results are a proportion of the Total sample

Table C10 Authority 5 sample data (Undertaker performance) (1/7/94 - 31/3/95)

Authority 5		*1 July 1994 - 30 September 1994*				*1 October 1994 - 31 December 1994*				*1 January 1995 - 31 March 1995*			
Under -taker	*Number of actual inspection units*	*Total sample*	*Failed of inspec -tions*	*Inspec -tions (%)[1]*	*Unseen (%)[2]*	*Total sample*	*Failed of inspec -tions*	*Inspec -tions (%)[1]*	*Unseen (%)[2]*	*Total sample*	*Failed of inspec -tions*	*Inspec -tions (%)[1]*	*Unseen (%)[2]*
Water1	132	21	15	6.7	28.6	41	35	0.0	14.6	33	27	7.4	18.2
Gas	1352	227	184	9.2	18.9	367	316	14.0	13.9	328	260	5.0	20.7
Telecom1	324	80	54	7.4	32.5	107	87	6.0	18.7	98	70	4.3	28.6
Cable1	7	12	10	0.0	16.7	63	52	8.0	17.5	44	34	20.6	22.7
Electric1	545	95	88	5.7	7.4	176	162	11.0	8.0	200	166	8.4	17.0
Telecom2	0	0	0	0.0	0.0	0	0	0.0	0.0	0	0	0.0	0.0
Water2	1757	303	233	9.0	23.1	446	392	22.0	12.1	375	297	5.7	20.8
Electric2	14	2	2	50.0	0.0	5	5	0.0	0.0	5	5	20.0	0.0
Total	4131	740	586	8.4	20.8	1205	1049	5.8	12.9	1083	859	6.6	20.7

1 The Failed results are a proportion of the Inspections
2 The Unseen results are a proportion of the Total sample

Table C11 Authority 6 sample data (1993/94)

Authority 6	*1 April 1993 - 31 March 1994*				
Under -taker	*Notices received*	*Works by under -taker[1]*	*Inspec -tions*	*Defect inspec -tions*	*Defective (%)*
Cable1	300	278	95	0	0.0
Telecom1	2628	3442	1281	21	1.6
Gas	1885	2522	721	29	4.0
Electric1	2499	3270	1078	8	0.7
Telecom2	294	295	59	0	0.0
Water1	4322	4606	1640	64	3.9
Others1	224	250	11	24	218.2
HA1	133	133	-	-	-
HA2	136	136	-	-	-
Others2	217	232	1	1	100.0
Total	12638	15164	4886	147	3.0

1 Includes new works, interim reinstatements, permanent reinstatements and withdrawn notices

Table C12 Authority 6 sample data (Total values for 1995/96)

Authority 6	*1 April 1995 - 31 March 1996*				
	Notices received	*Works by under -taker[1]*	*Inspec -tions*	*Defect inspec -tions*	*Defective (%)*
Total values	12589	-	5938	102	1.7

1 Includes new works, interim reinstatements, permanent reinstatements and withdrawn notices

Table C13 Authority 7 sample data (Gas) (1/4/95 - 31/3/96)

	No. of inspections				*%age of inspections*				*No. of failures*								
	Pass	*Abort*	*Fail*	*Total*	*Pass*	*Abort*	*Fail*	*Pass rate%**	*S&G*	*Excvn*	*Back -fill*	*Trips*	*Depr.*	*Crown*	*Comb.*	*Other*	*Total*
Cat 1	109	79	48	236	46.19	33.47	20.34	69.43	48								48
Cat 2	72	7	19	98	73.47	7.14	19.39	79.12	14		1	1	2			1	19
Cat 3	214	3	7	224	95.54	1.34	3.13	96.83			4	2			1		7
Cat 4	639	4	18	661	96.67	0.61	2.72	97.26			10	1	1		4	2	18
Cat 5	642	5	6	653	98.32	0.77	0.92	99.07			4	1			1		6
Total	1676	98	98	1872	89.53	5.24	5.24	94.48	62	0	19	5	3	0	6	3	98

** Aborted visits not included*

Table C14 Authority 7 sample data (Water1) (1/4/95 - 31/3/96)

	No. of inspections				*%age of inspections*				*No. of failures*								
	Pass	*Abort*	*Fail*	*Total*	*Pass*	*Abort*	*Fail*	*Pass rate%**	*S&G*	*Excvn*	*Back -fill*	*Trips*	*Depr.*	*Crown*	*Comb.*	*Other*	*Total*
Cat 1	203	205	42	450	45.11	45.56	9.33	82.86	42								42
Cat 2	378	26	33	437	86.50	5.95	7.55	91.97	9		2	7	9	1	5		33
Cat 3	430	3	89	522	82.38	0.57	17.05	82.85	2		21	19	14		24	9	89
Cat 4	544	0	105	649	83.82	0.00	16.18	83.82			60	16	12	1	14	2	105
Cat 5	480	0	7	487	98.56	0.00	1.44	98.56			6	1					7
Total	2035	234	276	2545	79.96	9.19	10.84	88.06	53	0	89	43	35	2	43	11	276

** Aborted visits not included*

Table C15 Authority 7 sample data (Water2) (1/4/95 - 31/3/96)

	No. of inspections				*%age of inspections*				*No. of failures*								
	Pass	*Abort*	*Fail*	*Total*	*Pass*	*Abort*	*Fail*	*Pass rate%**	*S&G*	*Excvn*	*Back -fill*	*Trips*	*Depr.*	*Crown*	*Comb.*	*Other*	*Total*
Cat 1	51	38	2	91	56.04	41.76	2.20	96.23	2								2
Cat 2	68	0	5	73	93.15	0.00	6.85	93.15	1		3	1					5
Cat 3	78	0	3	81	96.30	0.00	3.70	96.30			1		2				3
Cat 4	103	0	5	108	95.37	0.00	4.63	95.37			4		1				5
Cat 5	70	0	2	72	97.22	0.00	2.78	97.22			1	1					2
Total	370	38	17	425	87.06	8.94	4.00	95.61	3	0	9	2	3	0	0	0	17

** Aborted visits not included*

Table C16 Authority 7 sample data (Electric1) (1/4/95 - 31/3/96)

	No. of inspections				*%age of inspections*				*No. of failures*								
	Pass	*Abort*	*Fail*	*Total*	*Pass*	*Abort*	*Fail*	*Pass rate%**	*S&G*	*Excvn*	*Back -fill*	*Trips*	*Depr.*	*Crown*	*Comb.*	*Other*	*Total*
Cat 1	163	74	26	263	61.98	28.14	9.89	86.24	26								26
Cat 2	110	8	30	148	74.32	5.41	20.27	78.57	17		8		3			2	30
Cat 3	287	2	34	323	88.85	0.62	10.53	89.41			13	3	4	1	6	7	34
Cat 4	302	3	18	323	93.50	0.93	5.57	94.38			11		1		1	5	18
Cat 5	400	5	5	410	97.56	1.22	1.22	98.77			3	1			1		5
Total	1262	92	113	1467	86.03	6.27	7.70	91.78	43	0	35	4	8	1	8	14	113

** Aborted visits not included*

Table C17 Authority 7 sample data (Telecom1) (1/4/95 - 31/3/96)

	No. of inspections				*%age of inspections*				*No. of failures*								
	Pass	*Abort*	*Fail*	*Total*	*Pass*	*Abort*	*Fail*	*Pass rate%**	*S&G*	*Excvn*	*Back -fill*	*Trips*	*Depr.*	*Crown*	*Comb.*	*Other*	*Total*
Cat 1	84	74	6	164	51.22	45.12	3.66	93.33	6								6
Cat 2	49	2	16	67	73.13	2.99	23.88	75.38	8		2	1	2		3		16
Cat 3	223	6	7	236	94.49	2.54	2.97	96.96			3		2		2		7
Cat 4	238	3	15	256	92.97	1.17	5.86	94.07			6	3			4	2	15
Cat 5	239	6	12	257	93.00	2.33	4.67	95.22			5	1			4	2	12
Total	833	91	56	980	85.00	9.29	5.71	93.70	14	0	16	5	4	0	13	4	56

** Aborted visits not included*

Table C18 Authority 7 core test results (November 1994)

Under -taker	*Total cores*	*No. Pass*	*% Pass*	*No. Fail*	*% Fail*
Telecom1	39	6	15	33	85
Cable1	13	2	15	11	85
Gas	44	12	27	32	73
Electric1	40	10	25	30	75
Telecom2	1	1	100	0	0
Water1	34	6	18	28	82
Water2	12	4	33	8	67
Water3	5	2	40	3	60
Total	188	43	23	145	77

Abstract

With the introduction of the New Roads and Street Works Act 1991, all statutory undertakers became fully responsible for all aspects of excavation and reinstatement of the highway. They are required to reinstate to national performance standards and to comply with minimum guarantee periods in accordance with the new national Code of Practice Specification for the Reinstatement of Openings in Highways. A TRL study, commissioned by the Department of the Environment, Transport and the Regions (formerly Department of Transport) in 1993, was carried out to identify any problems following the introduction of the Specification in relation to compliance with the Specification and standards of workmanship. Sample studies and monitoring programmes were set up in several Highway Authority areas in co-operation with national utility companies comprising Electricity, Gas, Water, Telecommunications and Cable TV. The results showed that the main aspects of reinstatement practice which can cause problems are the number of compaction passes, layer thicknesses, use of suitable compaction equipment and storage of materials on site. Improvements are needed in all these areas if good quality reinstatements are to be achieved consistently. No evidence was found to show that any specific utility company had a higher degree of failure than the others. It is recommended that further monitoring of the study sites and bi-annual monitoring of randomly selected sites should be undertaken by an independent body. If the monitoring identifies deficiencies, measures should be taken to improve compliance with the Specification. It is also recommended that training requirements for supervisors and operatives, in the areas of compaction and materials specification, should be reviewed. It is suggested that the specified reinstatement designs for footways should be reviewed based on the existing construction and the level of trafficking.

Related publications

TRL197 *Trench reinstatement trial at TRL's pavement test facility* by M H Burtwell and D I Blackman. 1997 (price code L, £50)

AG26 *Footways design and maintenance guide. Part 1: new construction. Part 2: maintenance*. 1997 (price code P, £50)

TRL134 *A study of footway maintenance, edited* by M H Burtwell. 1995 (price code C, £20)

PR95 *Footway maintenance, Part 1: a review of profile monitoring techniques* by C C Spong. 1994 (price £10)

PR96 *Footway maintenance, Part 2: an assessment of profile monitoring equipment* by C C Spong and D R C Cooper. 1994 (price £10)

PR97 *Footway maintenance, Part 3: footway profilometer end product/performance specification* by C C Spong and D R C Cooper. 1994 (price £10)

CT34.1 Streetworks and reinstatement update (1993-1996) *(Current Topics in Transport: selection of abstracts added to TRL library's database)* (price £15)

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