Support to UKTram Activity Group 1
Protection and Diversion of Apparatus

Phase 1b

Analysis of Responses to Questionnaires Sent to UK Tramway Promoters and Operators, Continental Operators and Utility Companies

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1 Introduction

UKTram is an organisation that represents the promoters and operators of tramways and light railways in the United Kingdom. It is a limited company owned in equal parts by Transport for London, the Passenger Transport Executives Group, the Confederation of Passenger Transport and the Light Rapid Transit Forum. Its main purpose is to carry out research into a variety of aspects of light railway design, construction and operation. It publishes the results in the interests of improving understanding of the factors involved in the development of light railways and uniformly raising standards throughout the industry. It is supported in its activities by the Department for Transport.

This aim is achieved by the establishment of Activity Groups consisting of practitioners having considerable experience in the field of interest. Twelve such groups have been established, and the subjects they cover are listed in Appendix 1. The purpose of Activity Group 1 is to review the various approaches that have been adopted by promoters and operators in the UK to the task of protecting and diverting utilities' apparatus, and to compare this to the methods adopted on the continent, where there is a much greater pool of knowledge. An attempt has been made to obtain a representative view from the utility companies themselves. The present report summarises the responses to the questionnaires and represents a stage in the process of devising guidelines for general application by all parties involved in the process of diversion of apparatus.

The work of this Activity Group has been separated into three phases. Phase 1 has been concerned with the collection and analysis of data provided by the promoters and operators of current and potential tramway schemes in the United Kingdom, UK utility companies and tramway promoters and operators on the continent. Phase 2 will lead on to the production of guidelines based on the work carried out in Phase 1, while Phase 3 will consider how to ensure that the findings of Phase 2 will be adopted, through changes to relevant legislation and co-operation with the Highway Authorities and Utilities Committee ("HAUC") and National Joint Utilities Group ("NJUG") to obtain general acceptance of the proposals.

Phase 1, which has now been completed, was divided into parts 1a and 1b. Part 1a comprised the production of a scoping report identifying additional information requirements. Part 1b required additional research through the use of questionnaires. This document is a summary of the findings, and includes a summary of the principal features of risk-based utilities management strategies.

2 Questionnaires

Three separate questionnaires were developed for the following targets:

- Promoters and operators of tramways in the United Kingdom;
- UK utility companies;
- Continental tramway operators.

These are included in Appendices 7 to 9 respectively.

All questionnaires were developed in both hard copy format and as a form that can be filled in on line. The questionnaire sent to **UK promoters and operators** contains 21 questions in five different sections. These were arranged generally into questions aimed at experience gained during planning and construction of a tramway, and those aimed at experiences during the operation of the tramway. As not all recipients of the questionnaires have established an operable tramway, there were cases where only a proportion of the questions were relevant.

Part A contained two questions designed to establish the general philosophy adopted by promoters when considering whether to move or protect apparatus. The alternatives presented as possible approaches were to:

- move everything to avoid future disruption to light railway operations;
- move as little as possible to minimise the construction costs, and accept costs of disruption during future operations;
- rely solely on utilities' assessments of what needed to be moved.

It was also considered to be important that the utility companies supported the approach adopted, as this would have a significant impact on the straightforwardness of the diversions project as a whole. The respondents were asked to comment on their level of satisfaction with the utilities' approach in this area, how uniform the approach was, and whether the philosophy was modified as a result of achieving a better understanding of the utilities' needs.

Part B of the questionnaire considered the operation of the New Roads and Street Works Act 1991, particularly sections 84 (England and Wales) and 143 (Scotland). The sections call for the transport authority (i.e. the body having responsibility for the control or management of a transport undertaking) and the utility companies to "identify the measures necessary" to allow the tramway to be built, or that might follow as a consequence of its construction or operation. The first question of this part seeks to establish whether the utilities saw this as a co-operative exercise, or whether they considered they had the sole right to determine what action was to be taken in relation to their own apparatus.

The Act and the associated Diversionary Works Code call for the provision of information at various stages of the development of a scheme. Respondents were asked to comment on the completeness of the information supplied, and whether and at what stage they were charged for its provision. For those schemes where it had relevance, respondents were asked whether the outcome of the court case brought by BT against Gwynedd County Council had affected the utilities' approach to charging for the provision of estimates[1]. In this case, it was established that the utility companies are entitled to charge for any estimates of the cost of carrying out diversions following the C3 stage, as set out in the Diversionary Works Code.

Further questions in this part asked whether information was provided within a reasonable time, what steps were taken by the utility companies to establish the position and depth of their apparatus, whether the utilities were willing to hold

[1] In the Court of Appeal, Gwynedd Council and British Telecommunications PLC [2004] EWCA Civ 942

discussions at appropriate intervals during the project, and whether any of the apparatus was encapsulated in the tramway infrastructure in preference to moving it.

Part C of the questionnaire considered issues of planning, programming and implementing the diversion and protection works. The first question in this section concerned the experience and knowledgeability of the advisers to the promoter, and their confidence in challenging possible preconceptions of the utilities about the need for diversion of apparatus. Respondents were asked who developed and maintained the project programme, and whether the promoter played a role in supervising the works as it was being carried out. Agreement of final accounts has sometimes proved difficult on past projects, and comments were asked for on this in relation to the various credits to be allowed by the utility to the promoter. Finally in this section, information was requested on the way in which the estimates of the cost of diversions varied through the duration of the project

Part D refers to the experiences of the operator where the tramway has come into operation, and seeks to establish whether the decisions made to move apparatus or otherwise have proved to be generally correct. The questions ask whether any periods of disruption of services have been experienced, what has been the mean time between requests by utility companies to take possession of the tracks, whether in the operator's view the correct decisions were taken in respect of diversions, and what aspects of the current legislation might be improved, and how. Section 93 (152 in Scotland) of the New Roads and Street Works Act 1991 provides safeguards to the tramway operator by requiring utility companies who are planning to carry out work that might affect the tramway to provide details of their proposed works. A question relates to whether this provision gives adequate protection to the tramway operator.

Finally, the respondents were asked in **Part E** to comment on the adoption of any innovative solutions in the process of planning and carrying out the diversion works, which might usefully be adopted by promoters planning future tramways.

The questionnaire sent to **Utility Companies** contains 14 questions in five parts, generally designed to obtain the point of view of the utilities to counterbalance that of the promoters and operators. The first question of **Part A** asks the utility company's about the availability within their industry of information that would allow for the adoption of a risk-based approach to diversion. Further questions seek to understand the utility's approach to the provision of information which the Diversionary Works Code calls on them to provide at various stages of a project, to ascertain whether the utility distinguishes between tramways that are authorised and those that are still seeking authorisation when deciding how much help to give to the project and to establish whether the utility considers that the identification of the necessary measures is a matter for co-operation between the utility and the tramway promoter, or an exercise that is essentially the prerogative of the owner of the apparatus.

Part B aims to determine the factors taken into account by the utility company when developing their ideas about the need for diversion or protection of apparatus. Some considerations are suggested, including the age of the apparatus, reaching an agreement to halt tramway operations to allow maintenance to be undertaken, the dangers inherent in leaving apparatus beneath or close to the tracks, the way in which costs would be shared between the utility and the tramway operator in the event of

disruption of services or destruction of tramway infrastructure and the availability of data within the utility company's industry to allow assessment of the risks of failure of the apparatus. A particular consideration referred to is the effect of section 82 of the New Roads and Street Works Act 1991 (section 141 in Scotland) which provides for compensation to be paid to a tramway company if its infrastructure or operations are affected as a result of the failure of utilities' apparatus. A separate question asks whether and to what extent the utility takes into account the requirements of section 65 (section 124 in Scotland) of the Act. The Code of Practice *Safety at street works and road works* issued under these sections has implications for acceptable clearance between an operational tramway and plant or excavations associated with repair or maintenance of utilities' apparatus, so that it would be appropriate for it to be considered at the same time as diversions are being planned.

Part C asks questions about cost, programme and implementation. The first question concerns the cost sharing provisions, betterment and deferment of the time for renewal, and whether the utility company has experienced disagreements with promoters over their interpretation. A second question concerns the payment of fines under section 74 of the Act (section 133 in Scotland) which are payable if the utility occupies the highway for longer than a period that the highway authority considers to be reasonable. The question asks whether, in the view of the utility, payment of such fines forms part of the allowable costs of carrying out the work of diverting apparatus.

The following two questions ask who, of the utility and the promoter, is better placed to maintain the project and individual programmes of work, and whether the promoter has a role to play in the supervision of the utilities' works. The latter question focuses on the requirement set down in section 81 (section 140 in Scotland) that the utility company should maintain its apparatus to the satisfaction of a tramway authority (amongst others) to ensure that it does not affect the integrity of the tramway infrastructure.

The remaining questions in this section seek the utility company's views on the correct way to manage traffic during the diversionary works, and the management of public relations.

Part D asks about the experience of the utility in maintaining apparatus after the tramway becomes operational, and in particular about the operation of the provisions of sections 93 and 152 of the New Roads and Street Works Act 1991. The utility is asked to comment on whether the sections provide a fair and satisfactory mechanism, working in the best overall interests of the tramway operator, the utility and the general public.

As with the questionnaire addressed to UK promoters and operators, **Part E** asks the utility to comment on any innovative solutions used by them which could be employed on other schemes.

The third questionnaire was sent to operators of **European tramways**. This consists of 14 questions. Whereas in the case of the first two questionnaires the legal background is well understood, and the questions are targeted at its practical application, this questionnaire seeks to understand how Continental practise differs from our own. The first question asks whether utility companies have automatic rights

to place apparatus in highways, and if so, whether they must pay to exercise the right. Respondents are asked if there is overarching legislation governing the placing of apparatus in highways (comparable to the New Roads and Street Works Act 1991) and if so, what its main purpose is. If there is legislation, is it of national application, or does it apply only to the railway in question? In the UK, the legislation is framed in such a way as to make the promoter of the tramway and the utility companies jointly responsible for identifying the measures that need to be taken to permit the tramway to be built and to safeguard the utility's apparatus. The next question asks if the same applies in relation to the tramway for which the respondent is responsible.
An important question asks to what extent decisions to move apparatus are made on the basis of a risk assessment, and whether there are publicly available statistics on the failure rates of different types of apparatus.

Two questions seek to establish how the costs of moving apparatus are shared between the operator of the tramway and the utility company, and particularly whether there are equivalent cost share and deferment of the cost of renewal requirements. In the case of deferment, the respondent is asked how the benefit to the utility company is calculated.

A further risk-related question asks about the philosophy adopted when deciding on the need for diversion of apparatus, and whether it is more normal for all apparatus to be moved clear of the railway or to leave it within the railway when it is considered safe to do so.

The remaining questions relate to experience of utilities requiring access to their apparatus while the railway is operating. The first asks whether the tram operations stop while work is undertaken on apparatus, whether the work is carried out between the passage of trams, or whether access to apparatus is not allowed during operational hours of the tramway. The following question asks what procedures are adopted when work has to be carried out near to the railway (the equivalent of a section 93 procedure). Two questions consider the issue of compensation, whether payable to the utility companies in respect of additional difficulty associated with the maintenance of their apparatus, or to the railway operator in respect of disruption to services or the destruction of infrastructure. The final specific question asks whether steps have been taken in the design of the trackform to simplify access to apparatus left beneath it. There is then a general question for comments on any other aspects of the relationship between light railways and utilities that the respondent feels might be helpful.

3 Distribution of questionnaires

The questionnaires were distributed to the organisations listed in Appendix 2. Initially no date for their return was given, but subsequently a deadline of 28th September 2007 was set. At that date, replies to the UK promoters' and operators' questionnaire had been received on behalf of Centro in respect of the operating Line 1 between Wolverhampton and Snow Hill, South Yorkshire Supertram, Nottingham Express Transit, Merseytram, Croydon Tramlink, Cross River Tram and West London Tram; replies to the continental operators' questionnaire had been received from France, Greece and Dublin; and no replies had been received to the utilities' questionnaire.

Since the deadline passed, responses have also been received in respect of Manchester Metrolink Phases 1 and 2, and Midland Metro Line 1 Extensions.

4 Preliminary presentation of questionnaires

On 28th June 2007 a seminar was held at the Engineering Employers' Federation offices in London to present details of the progress of the group's activities to interested members of the industry. The itinerary of the meeting is attached at Appendix 3.

5 Analysis of the responses to the questionnaires

Promoters' and Operators' Questionnaire

Of the respondents to the UK promoters' and operators' questionnaire, Manchester Metrolink, Midland Metro Line 1, Nottingham Express Transit, Croydon Tramlink and Sheffield Supertram are operational tramways. Merseytram and West London Tram are not currently progressing, while development work is continuing for Cross River Tram and the Midland Metro Phase 1 Extensions. The last four could provide no information from the operator's point of view. Two separate responses were received from Nottingham Express Transit: one of these covered only the operator's perspective, while the other considered mainly the development and construction of the tramway. A summary of the responses to the questionnaire is contained in Appendix 4.

Part A concerned the philosophy adopted in deciding what apparatus to divert, and the utility companies' attitude to the decision. A range of approaches was adopted: whereas Sheffield, Manchester and Croydon opted to provide a clear corridor for the tramway, Nottingham, Merseytram, Midland Metro and current TfL projects preferred to move as little as possible, while wishing to avoid major disruptions to future operations. Midland Metro Line 1 also relied to a significant extent on the preferences of the utility companies, while encouraging them towards leaving apparatus in place as far as possible. The level of co-operation by the utilities varied from completely unsatisfactory in Sheffield, to generally satisfactory on Merseytram, while Manchester and Nottingham considered that they received a high level of co-operation. Within individual schemes the attitude of the utilities varied from one company to another. ***It is possible that co-operation is improving as time progresses and there is a better understanding by the utility companies of the factors involved in accommodating a tramway.*** The timing of the diversion works might also be a factor in the philosophy adopted, so that where the diversions are planned and

implemented by the promoter of the scheme before the Concessionaire becomes involved, the scope of the diversions is likely to be greater to reduce the likelihood of claims for delays as a result of the presence of apparatus impeding the construction process. Conversely, while less works may be carried out when the Concessionaire controls the extent of the diversions, the contract cost is likely to include a higher risk premium. ***It appears that, with the passage of time and the greater understanding of tramways gained by the utility companies, they have been more inclined to leave apparatus in situ where possible, provided it is protected.***

Part B concerned the application of section 84 of the New Roads and Street Works Act 1991. In Sheffield the utility companies considered that decisions about the movement of their apparatus should be taken by them alone. A similar situation applied in the case of Midland Metro Line 1, possibly because the promoter did not feel himself to be in a position to disagree. In the case of Merseytram and the London schemes, there was a more consensual approach, although disagreements arose over some issues on Merseytram which led to entrenched positions being adopted. In both Manchester and Nottingham the promoters were satisfied that a consensual approach was arrived at through the mechanism provided by the establishment of working parties.

There was general satisfaction with the production of information by the utility companies, in accordance with the requirements of the Diversionary Works Code. In Sheffield, however, the Code came into operation too late to have a significant impact on the scheme, and at the first stage of the works in Manchester work on the street was still controlled by the Public Utilities Street Works Act 1950. Despite this, the Manchester promoter considered that there was a good level of co-operation with the utilities. Nottingham were very satisfied with the amount of information provided by the utility companies, and considered that it exceeded the requirements of the Diversionary Works Code. ***The important factor in obtaining satisfactory levels of information appears to be active engagement between the promoter and the utilities, through regular meetings and working parties.***

The right of the utility companies to charge for information has recently been clarified by the court case of BT and Gwynedd County Council. The respondents were asked whether they were charged for the provision of information at various stages of the project, and whether the court case had made a difference to the approach of the utility companies. In the case of Manchester Metrolink Phase 1 and Midland Metro Line 1, no overt charges were made for information at any stage, although the costs may have been recovered through charges for the diversionary works. For Metrolink Phase 2, BT charged for the provision of C4 estimates (this occurred some time before the court case). Merseytram were charged by all utility companies for the provision of information at C4 stage, while for Sheffield, no information was provided without a charge, and such information as was provided was limited in scope. In Croydon, some companies charged, while the other TfL projects had not yet reached the stage of requesting C4 estimates from the utilities, preferring to make their own estimates. However, BT and Thames Water had been given funding to carry out some work to help to validate the promoter's own estimates. In the case of Nottingham, the development of the scheme was carried out jointly by the promoters and the utilities, and the costs of preparing estimates, production of the programme and so on lay where they fell. Money was given to four utility companies in the case

of the Midland Metro Line 1 Extensions scheme for the production of detailed (C4 level) estimates. There was no experience amongst any of the promoters of a change in attitude following the court case, because in the case of the operating tramways all diversionary works had been completed before this became relevant, while the majority of the work of the other schemes has taken place since.

All respondents, with the exception of Sheffield, were generally satisfied with the time taken to provide information, although Midland Metro Line 1 Extensions experienced delay in the production of some cost estimates. Where problems were experienced in Croydon, special measures were taken to resolve them. Midland Metro and Nottingham emphasised the importance of establishing a good working relationship between the promoter or contractor for the scheme and the utility companies.

Paragraph C1.4 of the Diversionary Works Code provides that utility companies should, if necessary, take steps to establish "the general nature and position" of their apparatus if they are not confident of it. This would be carried out at their own expense, although a more detailed investigation might be necessary during the main diversionary works programme. In this case, the costs would form part of the allowable costs of the scheme, and would be shared between the promoter and the utility company. Respondents were asked about their experience in relation to this matter. The general approach was for the promoter to carry out any necessary survey work during the planning stage, either by excavation of trial holes or through ground probing radar (gpr) surveys. In Manchester, closed circuit television surveys were made of the sewers affected by the Phase 2 route, and sewers in a less than acceptable condition were refurbished before the tramway construction was carried out. In the case of Midland Metro Line 1 there were joint site visits to establish the positions of apparatus. Gpr surveys have been carried out in Birmingham City Centre in preparation for the Midland Metro Line 1 extensions. In Nottingham MEB and Transco carried out trial holes to locate critical apparatus, while the promoters carried out a gpr survey of the whole route, and trial holes in one particularly congested street.

In all cases there was a general willingness on the part of the utility companies to discuss proposals for diversion with the promoters or contractors for the tramway. In the case of Sheffield there was an initial reluctance to be involved, but the position improved as the scheme progressed and relationships developed.

An important means of reducing the overall cost of diversions is by incorporation of apparatus into the tramway infrastructure, suitably protected. The respondents were asked about the utility companies' attitude to the adoption of such an approach. In the case of those schemes where no physical work has been undertaken, there had been suggestions of the adoption of such an approach, which had generally been agreed with the utilities. Merseytram had contemplated incorporation of some shallow apparatus into the track slab, and retaining manholes within the swept path. TfL and the designers of Midland Metro Line 1 Extensions had explored similar approaches and believed that the utilities were willing to adopt the idea. The approach had been adopted and put into practice in Croydon and on Midland Metro Line 1. Nottingham promoters had considered solutions of this kind, although they preferred alternatives where at all possible, and were unsure whether they had been implemented by the

Concessionaire, who reached the final agreements with the utility companies. Manchester Metrolink had cast some apparatus into the overhead line support poles, although the concept was only reluctantly accepted by some of the utility companies involved. Only Sheffield had not used the approach, although it is not clear whether this was a result of objections from the utility companies.

Part C was concerned with the planning of the works once the scope had been established. The initial question related to the relevant experience of the promoter's or Concessionaire's staff and their ability to question proposals by the utilities to ensure that the most cost-effective solutions were found. With the exception of Manchester Phase 1 and Sheffield, who were early in the field and in the case of the latter felt that they lacked appropriate experience for this reason, the respondents were happy that they had enough understanding of the issues to challenge the utilities if necessary. Croydon benefited from the transfer of knowledge gained in Sheffield, while Nottingham benefited from the involvement of Carillion, one of the members of the consortium formed to become the Concessionaire.

In all cases the promoter or its contractor took responsibility for production of the master programme of diversions. In general this was based on individual programmes provided by the utility companies. Nottingham benefited from the expertise of Carillion in this respect also, once they became involved through the Concessionaire's organisation. When it came to the supervision of the diversionary works programme, the picture is mixed. In Manchester, for Phase 1 of Metrolink, work was observed by a clerk of works appointed by the promoter to ensure that apparatus was placed clear of the line of the tracks. In the case of Phase 2, the diversion works were supervised by the Concessionaire. No supervision was provided in Sheffield, except of highway reinstatements. In the case of Midland Metro, the utilities were left to supervise their own works under the direction of the contractor when working within the site boundary. Croydon took a higher degree of responsibility, including appointing a principal contractor for the project. In Nottingham the Concessionaire supervised the works, with much of the civil elements of the work being carried out by Carillion, who were already an approved contractor for all of the major utility companies. Merseytram proposed to have the works supervised by a consultant, who would be responsible for recording the progress and as-built positions of diverted apparatus.

The remaining questions in this section related to the final agreement of costs and the way in which cost estimates had varied throughout the project. Since the introduction of the New Roads and Street Works Act 1991, the utility companies have been required to credit the transport authority with a percentage of the total cost of diversion works. The percentage is set down in the Sharing of Cost of Works Regulations. In the original (1992) version of the regulations, the contribution was 18%. This was reduced to 7½% when the regulations were amended in 2000, for diversions that were only made necessary by the presence of the tramway. However, where the diversion was necessary because of some modification to the highway to accommodate the tramway, the contribution remains at 18%. Both phases of the Manchester scheme were carried out before the change to the regulations, and in the case of Metrolink Phase 1, before the cost sharing regulations first came into force. Sheffield experienced difficulties with reaching agreement on the utilities' contribution to the scheme, probably because the work was carried out very soon after

the cost share provisions were introduced. Midland Metro was entitled to an 18% contribution, as their works were carried out before 2000 when the Regulations were altered. Where Merseytram carried out advance works, they had no particular difficulties in obtaining the discount and agreeing where they were entitled to the higher discount of 18%. Croydon experienced some variability in the ease with which final accounts were agreed. The other London projects had not reached the stage of agreeing final costs. In Nottingham the Concessionaire was responsible for agreeing costs with the utility companies, and appears to have agreed a fixed level of contribution with them, although the details are not known. In respect of the variance between initial estimates and outturn costs, Sheffield experienced a great increase due to under-estimation of initial costs by the utility companies, a greater scope of works than initially anticipated and inadequate checking and provision of information. The picture in Manchester was mixed, with Phase 1 costs increasing over time, while the final costs of diversions for Phase 2 were less than the original estimates, mainly due to a reduction in the scope of the works, and a higher than expected deferment value on the BT apparatus. Merseytram appeared to have been satisfied with their costs, finding savings arising as well as increases in cost. Savings in cost generally resulted from factors in the control of the promoter, while the majority of cost increases were outside the control of both the promoter and the utility companies. Midland Metro found that the costs for gas diversions were lower than initially anticipated, while the cost of electricity diversions were significantly above and other costs were about the same or somewhat higher. Nottingham were unable to provide this information, since the initial estimating was carried out by the promoters, and the final costs, which are commercially sensitive, were met by the Concessionaire.

Part D of the questionnaire looked at the level of disturbance experienced by the system operators and sought to relate this to the extent of the diversionary works. Neither Midland Metro nor NET had needed to suspend services to allow utilities to repair or maintain their apparatus since the tramways came into operation. No track possessions had been sought by utility companies in either case. Croydon were unsure whether possessions had been required, but if so, it would have been at the rate of less than one per year.

Sections 93 and 152 of the New Roads and Street Works Act 1991 gives power to the tramway operator to require undertakers and others who work in close proximity to the tracks to provide details of the work they wish to undertake and their proposed method of working. Question 18 asked how well this provision had worked in practise. Nottingham, Manchester and Midland Metro recorded that they had produced documents that regulate work in proximity to the tracks. In the case of Midland Metro this has so far not been used by statutory undertakers although there was no information from Nottingham on the need to use theirs. Croydon also has a code of practice for the same purpose, but also rely on the provisions of section 63 of the Act (section 122 in Scotland) which allows a street to be designated as being one of special engineering difficulty due to the presence of the tramway infrastructure. The effect is much the same in either case, although section 63 is concerned with the possible effects on the structure of the tramway, while section 93 is concerned with the safety of operations.

Respondents were asked whether the scope of the diversions project had been established at the correct level. Manchester considered that the amount of diversion

had been correctly established for both Phases completed to date. Midland Metro considered the scope had been correct, with the exception of electricity cables. In their view, the lack of subsequent disruption to services, leading to a very high operational reliability, indicates that enough plant was diverted, with the possibility that the level of diversions was too great. Nottingham's view was similar, in that subsequent disruption of services had so far been avoided. However, in the view of the Nottingham promoters, too much apparatus had been moved in order to mitigate stray current problems. The feature common to both Midland Metro and Nottingham is the presence of apparatus belonging to (as it then was) Midlands Electricity Board, who took a probably unwarranted view of the implications of stray current effects in relation to diversion of apparatus. The view of both Croydon and Sheffield was that more apparatus had been moved than was strictly necessary, possibly as a result of their reliance on the utilities' proposals to dictate the scope of the works.

Finally in this section, respondents were asked to propose areas of the legislation, codes of practice and so on that could be changed or improved. Manchester would like to see the ***Diversionary Works Code amended so that it adequately considers issues relating to tramway schemes as well as highway schemes.*** They also want to see the ***definition of a relevant authority, so far as it relates to tramway authorities, to be clarified.*** Midland Metro considered that the ***cost sharing provisions should revert to an across-the-board 18% to bring tramways back into line with highway schemes.*** NET considered that ***standard clearances for utilities' apparatus should be adopted.*** The Nottingham promoters would like to see ***further development of the Diversionary Works Code to provide clearer guidance on a number of aspects, the establishment of compulsory working parties, clarification of the sharing of costs regulations, and better guidance on the evaluation of overheads, with limits established if possible.*** Sheffield would seek ***greater partnering with the utilities, and felt there should be a general principle that a policy of minimal diversion of apparatus should be adopted.*** In terms of specifics, they would look for an ***agreement on the principle of providing spare capacity,*** and look for ways of ***allowing trams to operate adjacent to or above excavations.***

Part E consisted of a single question, asking for innovative solutions that could be applied elsewhere. All schemes adopted or proposed to adopt ***side entry manholes to give access to sewers left beneath the tracks.*** Manchester used ***plastic sleeves inside existing gas pipes, encapsulated the joints and introduced medium pressure mains to supplement existing gas supplies.*** Rationalisation of gas and water networks reduced the need for diversions, and use of ***kerb channels increased the amount of space available for other apparatus.*** TfL looked at the ***protection of apparatus rather than diverting it, including the use of standard and split ducting.*** By early involvement of the utility companies, and obtaining a detailed understanding of the nature and position of the utilities' apparatus in relation to the tramway alignment, they sought to make a realistic assessment of the diversion requirements. Sheffield used ***spare ducts at junctions to avoid future disruption of services.*** Centro's Concessionaire for Midland Metro provided ***common temporary facilities for utilities e.g. a temporary bridge while the existing bridge was demolished and rebuilt.*** Merseytram stressed the need for the ***early establishment of forums involving the key personnel from the utility companies, the promoter, local authorities and emergency services.*** By early planning making use of ***trial holes and surveys, and co-***

ordinating their works with the utilities' own planned renewal programmes, they sought to reduce the scope of their own works.

NET monitor touch potential twice a year to establish the levels of stray current, and have adopted motorised isolators to simplify isolation of sections of overhead line. The Nottingham promoters suggested a range of approaches, including ***network reconfiguration, or rationalisation, where this was possible; slewing of cables in preference to diversion; and the adoption of joint trenching, where a single trench accommodates two or more items of apparatus,*** generally under the ownership of different utility companies.

Continental tramways

The main purposes of this questionnaire were to compare the legislative regime in European countries with that operating in the United Kingdom, to clarify attitudes to the risk of leaving apparatus beneath or close to the tracks, and to understand what procedures are adopted when apparatus needs to be worked on. A summary of the responses to the questionnaire is contained in Appendix 5.

Questionnaires were distributed through three channels: four hard-copy forms were distributed at a UITP Urban Track event in Brussels on 31 May 2007 to representatives from Dresden, Prague, Karlsruhe and the University of Hasselt who are leading a utilities diversion review for the Urban Track project. However, none were returned by the deadline requested. Fillable forms were distributed by UITP to several operators. An individual approach was made by UKTram to RPA in Ireland. To date, only four responses have been received, these being from Dublin, Karlsruhe, Athens and Keolis, responsible for operating a number of tramways in France. It is anticipated that a further response will be received from Asstra in Italy.

The first three questions sought to establish the legislative position. The utilities do not have an automatic right to place their apparatus in highway in France, Germany or Greece. In France and Greece they need to make a submission to the authority having control of the highway, setting out what they propose to do. Their proposal could be rejected under certain circumstances, for example if there is an intention to carry out major development in the area. In France the licence granted by the highway authority must be paid for, while in Greece the only payment is for the reinstatement of the highway. In Ireland, the utilities do have a statutory right to place apparatus in highway. In Germany, placing apparatus in streets is subject to reaching agreement locally.

Co-ordination of utilities' works with the construction of a tramway is achieved in France by referring proposed utilities works to the local transport authority, using local legislation. A similar arrangement exists in Dublin, where the legislation authorising the construction of the tramway also serves to define the relationship with the utilities. There is no similar arrangement in Greece, where light railways have only just begun to be developed. As the utilities in Germany are often publicly owned, co-ordination of works is assured. However, because the Länder each have their own laws governing the relationship between utilities and tramways, there is no guarantee of consistency between them.

All respondents confirmed that the decision to move or retain apparatus was made jointly by the promoter and the utility companies. In Athens the initial proposal comes from the promoter, but must be approved by the utility company. In France and Germany it is normal to move all apparatus clear of the tracks to ensure reliability of service, while in Athens most apparatus was moved. An assessment of the risks was made in Dublin, where each piece of apparatus was individually assessed. The promoters had little or no information regarding failure rates of apparatus on which to base a risk assessment.

Concerning payment for the diversion works, the rule in France is for the utilities to pay for moving apparatus above ground, while the promoter pays to move the underground apparatus. In Athens and Dublin the cost of diversions is met by the light rail project. It appears there is no provision to compensate the light rail promoter for the fact that they provide new apparatus in replacement for old, although a formula is used in Dublin to account for the provision of apparatus of a larger capacity than the apparatus that is being replaced. In Germany, the apportionment of the cost of diversion is related to the age of the equipment being replaced. The promoter might contribute between 40% and 100% of the cost, although it is unusual for completely new apparatus to have to replaced, as the tramway will have been planned for some time before construction begins and new apparatus will normally have been kept clear of the route. The formula used to calculate the division of costs is normally complex, and subject to local negotiations.

In all cases, where there was a choice between moving apparatus and leaving it in place while risking future disruption, the preference was to divert and ensure continuous availability of tram services. The exception noted by Dublin was to leave deep services in place.

In three cases, access to apparatus beneath or close to the tracks for purposes of maintenance or repair is restricted to outside operational hours except in the case of emergency, or where it is unavoidable. In the case of Karlsruhe, the question should not arise because apparatus will have been moved to avoid the need to halt operations. In some older systems, maintenance and repair works would be expected to be carried out with the trams still operating, but at reduced speed if necessary. All parties have procedures or codes of practice determining the methods to be adopted when working near the tracks. Work close to the tracks can be permitted while trams run slowly past the site in Dublin, Karlsruhe and France (and probably also in Athens).

No provision is made in any of the schemes for compensation to be paid to utility companies if their maintenance works are made more complicated by the presence of the tram. Similarly operational losses incurred by the tramway are absorbed by the tramway operator in France and Athens. Dublin charges the utility for the possession of the tramway. Karlsruhe considered there might be local agreements on other German tramways making provision for penalties to be applied.

Question 12 envisaged a situation where it was necessary to demolish part of the tramway infrastructure to gain access to utilities' apparatus, and enquired about the responsibility for carrying out and paying for the work. In France, if such a situation arose, the work of demolition would be carried out by the Public Transport Authority and recharged to the utility company concerned. In Athens each party would bear its

own costs. In Dublin, the issue had been (at least in part) provided for where, in two locations, agreement had already been reached that the utility company might have to move apparatus in the future at its own expense. Karlsruhe were unaware what provisions might exist in Germany.

In Athens, the track design allows for the possibility of there being a need to excavate beneath it, and the slab is capable of spanning 3 metres over an excavation. France also confirmed that provision was generally made for access to apparatus. In Dublin, one of the stops was specially designed to allow repair work in the future on a 220kV cable left beneath it, but otherwise provision for access to apparatus beneath the tracks is not normally made. In Karlsruhe no special provision was made in the trackform, but apparatus left beneath the track must be accessible from a road running alongside.

Utility Companies

A questionnaire for utility companies was developed as a companion to the one sent to UK promoters and operators, seeking responses to similar questions. They were initially sent to three representative bodies: the Energy Networks Association, representing mostly gas transporters and electricity distributors, Next Generation Networks UK, representing telecommunications companies, and Water UK representing water and sewerage undertakers. The questions were referred by these bodies to the National Joint Utilities Group, an umbrella organisation representing the majority of utility companies in the UK. NJUG provided a single composite response to the questionnaire on behalf of their members. The response to the questionnaire is contained in Appendix 6.

The first question concerned the possibility of carrying out an assessment of the risks associated with leaving apparatus close to the tracks. It was confirmed that in the case of water, gas and electricity, there were statistics relating to rates of failure of apparatus.

An attempt was made to clarify utilities' view of the right to charge for the provision of information. The formal response was that authorities applying for records at C2 stage were entitled to receive them free of charge, and that bodies empowered by Act of Parliament were similarly entitled to a free budget estimate at C3 stage. ***Utilities would charge for provision of C4 stage detailed estimates, and the cost would form part of the allowable costs (and therefore fall within the provisions for sharing of costs of works).***

Utilities felt it was essential that a co-operative approach was adopted when it came to identifying the need to divert apparatus, as this was the means by which the need for diversions could be minimised. The processes of discussion and reaching agreements on the scope of the works would generally start at C3 stage, but the ***utility would always keep in mind its overriding duty to ensure a safe environment, and the need to maintain quick access to the apparatus.***

NJUG members noted their general reluctance to leave apparatus beneath the tracks of a tramway due to the need for quick access for maintenance purposes and to allow them to extend their networks. Their commitment to ensuring the safety of their systems, and particularly to meeting their obligations under health and safety legislation was emphasised in response to question 6.

Questions 7 and 8 concerned aspects of sharing of the costs of the works. NJUG were not able to give a single opinion on differences of opinion between utilities and transport authorities on the application of the various mechanisms for cost sharing, but appeared to consider that penalties incurred by the utilities under section 74 of NRSWA should be included in the allowable costs of the works.

During the implementation phase, NJUG considered that the preparation and maintenance of the master programme of works should be the responsibility of the transport authority, based on individual programmes prepared by the utility companies. While there was a role for the authority in the supervision of the work undertaken by the utility, once the specification for the work had been agreed, it would then be the responsibility of the utility to meet the required quality standards.

NJUG considered that the transport authority would generally be best placed to implement the traffic management for the scheme, and to manage public relations, while sharing responsibilities with the utilities as appropriate.

NJUG declined to comment on the experiences of utilities who have carried out repair and maintenance works in proximity to tramways, as they considered this to be utility- or industry-specific.

Finally, NJUG commented on the approach being adopted jointly by utilities and the promoter in connection with the Crossrail scheme, where there is a possibility that a single contractor will be appointed to carry out all utilities' diversion works. This is expected to show cost savings, better co-ordination and environmental benefits, among other things.

APPENDIX 1

UKTram Activity Groups

Activity 1 – Protection and Diversion of Apparatus

Activity 2 – Tram Design Standards and DDA/RVA Issues

Activity 3 – Signing and Highway Interface

Activity 4 – Noise and Vibration

Activity 5 – Network Rail Interface

Activity 6 – Trackform Design

Activity 7 – Benefits included in the Appraisal Process

Activity 8 – Commercial Structure

Activity 9 – Operational Performance Measures

Activity 10 – Tender Documentation

Activity 11 – Wheel/Rail Interface

Activity 12 – Traction Power Supplies

APPENDIX 2

Questionnaire distribution list

Questionnaire A – UK Promoters and Operators

Blackpool Borough Council
Blackpool Transport Services Limited
Centro
Cross River Tram
GMPTE
Merseytram
Nottingham City Council
Nottingham Express Transit
Serco Metrolink
South Yorkshire Passenger Transport Executive
South Yorkshire Supertram
Tramtrack Croydon Limited
Transport Initiatives Edinburgh
Travel Midland Metro
West London Tram

Questionnaire B – UK Utility Companies
Energy Networks Association
National Joint Utilities Group
Next Generation Networks UK
Water UK

Questionnaire C – European Operators
Dublin
UITP
Veolia Transport Ireland Limited
Lausanne
Paris
The Hague
Karlsruhe
Nordhausen
Barcelona
Malaga
Seville
Athens
Prague
Dresden
University of Hasselt, Belgium
General enquiries to Switzerland and Italy and to other parts of France,

APPENDIX 3

Itinerary for Seminar on 28th June 2007 at Engineering Employers Federation

1.00pm-1.30pm	Buffet lunch
1.30pm	Welcome + Scope of Work for Activity 1 (Phil Hewitt – chair)
1.35pm-2.00pm	Presentation of work undertaken by Activity Group 1 to date (David Rumney)
2.00pm-2.20pm	Summary of findings of UITP Light Rail Group (Chris Chatifield)
2.20pm-2.35pm	General discussion on utility management philosophy and lessons learned from UK light rail schemes (led by Phil Hewitt and Chris Chatfield)
2.35pm-2.55pm	Stray Current – "It's All Relative" (Nico Dekker – RSC)
2.55pm-3.15pm	Utility management philosophy in Dublin (Marian Regan – RPA)
3.15pm-3.30pm	Feedback from attendees and general discussion (Phil Hewitt)

APPENDIX 4

TABLE OF RESPONSES TO

UK PROMOTERS' AND OPERATORS'

QUESTIONNAIRE

	Question 1: What philosophy was adopted in deciding whether to divert or leave apparatus: **a) move everything to avoid future disruption to light railway operations** **b) move as little as possible to minimise the construction cost, and accept costs of disruption during future operations** **c) Rely solely on utilities' assessments of what needed to be moved**
Manchester Metrolink Ph 1	The main concern was to move apparatus to avoid future disruption to services as far as possible. The policy had to take into account the fact that diversions were undertaken by the client in advance of the main detailed design and construction, carried out by the DBOM Concessionaire. It had therefore to predict the likely scope of the works that would have been carried out by the Concessionaire to avoid incurring any delays to the main construction.
Manchester Metrolink Ph 2	Generally to seek to avoid disruption to future tram services. However, at the last moment the responsibility for diverting apparatus was passed to the Concessionaire, whose philosophy, which ultimately dictated the scope of the diversion works, may have differed somewhat from that developed by GMPTE.
Merseytram	Move as little as possible to both minimise construction cost and avoid MAJOR future disruption to tram operations.
Midland Metro Line 1	A combination of b) and c), relying primarily on utilities' assessments of what needed to be moved, whilst encouraging them to minimise the diversion work. In practice this is a continuous spectrum & promoters and utilities will have different expectations of the intended approach.
Midland Metro Line 1 Extensions	No work has yet been carried out on the construction of this project. The philosophy behind the design of the diversions project is the avoidance of interruption to tramway services in the future, while seeking to minimise the scope of diversions to essentials only.
Nottingham Promoter	The initial planning for the Utility diversions by the Promoters (jointly Nottingham City Council & Nottinghamshire Council) commenced in parallel with deposit of the parliamentary bill for the works around 1992. The philosophy evolved over time. Initially the Promoters 'philosophy'/ expectation was to divert all apparatus. However, in order to ease the passage of the bill through parliament, and in the absence at that time of a diversion code of practice under Section 84 of NRASWA, a memorandum of understanding was entered with the main utility companies, which provided the bed-rock for the collaborative working approach that subsequently followed. Such parliamentary agreements are binding and therefore took precedence over the diversionary works code once that came into effect. The memorandum established an all-party Working Party. The Working Party remit was in line with Section 84 aims (i.e. identifying the necessary measures, settling the scope and specification, and coordinating the works). The Philosophy adopted by the Working Party was to 'contain cost' whilst taking cognisance of the responsibility of the utilities to protect and have ready access to their equipment, and the need to minimise disruption. The scope of the Utility diversions were minimised by adopting a cost and risk managed approach, with diversions eliminated where appropriate alternatives or mitigation measures were available to maintain the utilities services and/or to minimise disruption.
Nottingham Express Transit	-

TfL Major Projects	b) but by ensuring that access can be achieved through provision of side access, split ducting and with a limited amount of tram operation disruption. TfL (WLT/CRT) experience to date shows that co-operation on the above strategy varies across utilities. But generally all utilities accept the need to avoid diversions and associated disruption where possible by innovation in resolving conflicts and whilst ensuring their access is maintained for inspection, maintenance and renewal.
Croydon Tramlink	Requirement was to provide a clear corridor for the tramway. This was driven by both the utility companies' desire for access and the Concessionaire's desire to derisk the operations at public expense.
Sheffield Supertram	Move everything - ensure tram reliability.

	Question 2: How satisfied were you with the utility companies' level of co-operation with the chosen philosophy? Was the co-operation uniform across all utilities? Was the philosophy modified in any instances as a result of clarification or discussion of the utilities' needs or obligations, or by the provision of further information?
Manchester Metrolink Ph 1	There was an initial reluctance on the part of the utilities to engage in the process, due to the relatively recent scrapping of the Picc-Vlc line (an underground network) for which some diversions had been carried out in advance. Once it became clear that the tramway was a definite scheme, the utilities became very willing partners and remained committed to a co-operative approach to the end. The philosophy remained unaltered throughout the project, although all parties were open to the opportunity to reduce the scope of diversions.
Manchester Metrolink Ph 2	Very satisfied. The system of communication adopted between GMPTE, the Concessionaire and the utility companies was inherited from the work carried out on Phase 1 of Metrolink, and relationships remained very good as a result of the success of the previous work. As to modification of the philosophy, see the answer to question 1.
Merseytram	Generally, fairly satisfied but co-operation by individual utilities companies varied considerably. Diversion philosophy was modified in some instances following consultations with the utilities companies and through design development.
Midland Metro Line 1	A complete spectrum of responses was encountered, from gas (leave it where it is - we'll only move it if and when we have to in the future) to electric (where the announcement to commence the light rail work seemed to trigger an area-wide complete cable renewal project that it was difficult to believe was wholly resulting from the Metro proposals). To support this aspiration MEB were very vocal on the stray current issue and sought to influence the wider utility community to strengthen their argument. The individual utilities were not particularly influenced and ultimately "made their own decision".

Midland Metro Line 1 Extensions	The majority of utility companies have been open to suggestions for modification to the scope of their works in keeping with the overall philosophy, with the result that millions of pounds of potential savings have been identified and agreed. While the philosophy has not altered through discussions with the utility companies, there are areas where opposing ideas have been resolved in favour of the utilities after discussions.
Nottingham Promoter	By virtue of the Memorandum of Agreement, the main utility companies were legally obliged to attend the Working Party, and other affected utility owners were also invited. This ensured necessary attendance. The Working Party was established before any preliminary enquiries regarding apparatus were made by the Promoters to the utility companies. The Promoters ensured that the Working Party was attended by the engineering representatives on all sides, and so adopted a pragmatic engineering-led approach. The Working Party helped develop the Philosophy, in the absence of a formal code, and promoted cooperation, collaboration and consistency.
Nottingham Express Transit	-
TfL Major Projects	Yes, in some cases detailed utility technical requirements lead to modification. Depending on apparatus type, depth, material and criticality (i.e. apparatus attributes).
Croydon Tramlink	No involvement in the planning stage. It appears that utilities generally co-operated but that the level of knowledge and skill applied was variable. Consequently some proposals required radical on site revision well after c4s had been agreed. Extensive use of GPR and trial holes was made to reinforce utilities' information and assist all utilities to plan their works.
Sheffield Supertram	Disastrous - utilities not interested - resistance to using NRSWA, wanted to work under PUSWA. T.M. philosophy changed as a result of discussions with borough etc. avoid too many short term changes to traffic management. BT etc. wanted all kit moved long way off but latterly agreed to leave closer to the tram.

Question 3: Did the utility companies adopt a co-operative approach, where both parties have an equal right to a view on what action should be taken, or did they consider they should make the decision unilaterally?

Manchester Metrolink Ph 1	The general principles for identifying the apparatus to be moved were established by GMPTE, while in general the apparatus affected as a result was identified by the utilities, who generally decided what needed to be done to overcome the conflict. GMPTE were active in looking for possible cost savings, and establishing the most efficient way of carrying out the works.
Manchester Metrolink Ph 2	The utilities were generally open to alternative proposals. This was particularly the case with British Gas, who were prepared to consider and implement a cheaper scheme than they had originally proposed, to the financial benefit of Metrolink.

Merseytram	In the main, there was a very co-operative approach from the utilities companies but some issues instigated inflexibility from some companies and, in isolated instances, a defiant stance.
Midland Metro Line 1	Utilities generally took a unilateral decision, which we were not in a strong position to dispute.
Midland Metro Line 1 Extensions	The majority of utilities have adopted a co-operative approach. Having made an initial proposal, they are generally ready to consider, and if appropriate, agree to a reduced scope.
Nottingham Promoter	In general all parties were cooperative. It must be recognised that individual parties will have had particular concerns or issues, but these were, where it was appropriate to do so, addressed openly with the Working Party, avoiding the need for unilateral action.
Nottingham Express Transit	-
TfL Major Projects	A position of mutual acceptance and agreement in principle was pursued, and largely achieved. Reasonable solutions to conflicts were identified to satisfy utility access requirements for inspection, maintenance and renewal, generally avoiding tram system disruption.
Croydon Tramlink	In general during the implementation phase, co-operation was good and improved as trust was built. Once clear that we were prepared to pay to have proposals modified (in order to facilitate overall savings) utilities worked with us well. All utilities required their standards to be adhered to but some were more willing to look at derogations than others.
Sheffield Supertram	Stats thought all decisions were theirs.

Question 4: Please comment on the completeness of the provision of information called for by S.84/143 of NRSWA, as amplified by the Diversionary Works Code.

Manchester Metrolink Ph 1	The work pre-dated the New Roads and Street Works Act 1991, and was carried out under the Public Utilities Street Works Act 1950, so this question is not relevant to Metrolink Phase 1. However, GMPTE was satisfied with the amount of information provided by the utilities, and their reasonable requests for information were generally satisfied.
Manchester Metrolink Ph 2	The required information was generally provided to an acceptable level to allow cost estimates to be made and programmes to be prepared.
Merseytram	Initially, scope of information provided by individual utilities companies varied considerably but, through regular dialogue, utilities forums and progress meetings, most of the required information was satisfactorily gathered and documented.
Midland Metro Line 1	The contractor worked very closely with the utilities to ensure that the information provided was suitably complete.

Midland Metro Line 1 Extensions	Records have been readily supplied free of charge by all utilities, although the standard of the information provided can be variable. All but two minor utilities provided C3 cost estimates. Development of a programme of works has so far only been carried out in house. Much of the work undertaken by the utility companies was carried out before Centro had obtained orders under the Transport and Works Act, meaning that they were under no obligation to provide the information requested of them.
Nottingham Promoter	By virtue of the Memorandum of Agreement with the main utility companies, and the negotiated and collaborative arrangements established through the Working Party, we believe the completeness of the information provided by the Utility companies was excellent and beyond what could be expected through the strict interpretation of the Diversionary Works Code.
Nottingham Express Transit	-
TfL Major Projects	The "measures necessary" were identified by the client's utility consultant and confirmed by active and extensive engagement with all utility companies to produce a co-ordinated design pre-Powers.
Croydon Tramlink	-
Sheffield Supertram	N/A NRSWA only just came in.

Question 5: Charging for estimates—what information was provided at C2, C3 and C4 stages? Was it free of charge?

Manchester Metrolink Ph 1	Not relevant to this work - see response to question 4.
Manchester Metrolink Ph 2	All information was provided free of charge, with the exception of estimates by BT who required payment for the production of C4 cost estimates. It should be noted that much of the development work was carried out before GMPTE had obtained an order under the Transport and Works Act, hence there was no obligation on the utilities to provide any information required by section 84 of NRSWA. Some of the design work was carried out in association with other developments going on in the same area, particularly in Salford Quays (e.g. Trafford Road Widening Scheme).
Merseytram	Information provided at C4 stage was charged for by all utilities companies. Details of ages of apparatus were provided by very few utilities companies. Detailed breakdown of overhead charges was provided by very few companies. Work durations were provided, in varying degrees of detail, when requested. Programmes were agreed as the tram construction programme was developed.
Midland Metro Line 1	No payment was made for information at any of the stages, although the utilities may have included their preparation costs within the main scheme costs.
Midland Metro Line 1 Extensions	The majority of information was provided free of charge. However, payments were made to BT, Central Networks, Cable and Wireless and Severn Trent (in respect of sewer investigation works) for the production of cost estimates.

Nottingham Promoter	By virtue of the Memorandum of Agreement and the Working party arrangements, we did not follow the C2, C3 and C4 approach, however the information indicated above was made available to the Promoters. Records of apparatus were made available from the outset, these were compiled by the Promoters into coordinated plans. Through the Working Party, the scheme alignment and the scope of the diversion were collaboratively and iteratively developed taking into account the engineering scope, cost and duration of each diversion, and the associated risks to both the utility apparatus and the tramway. The Promoters prepared in parallel a diversionary works programme which defined the programme constraints available for each street and diversionary package. As a result, final estimates provided to the Promoters of the engineering cost were based on an agreed scope, cost and duration for each activity. In terms of an engineered solution, we believe the end output went beyond that of the typical C2/C3/C4 process. The Working Party agreed that the costs for provision of information at this stage should simply lie where they fall, which was in line with the Memeorandum. The final estimates did not, however, include commercial allowances for deferment of renewals, betterment and recovery of materials. Responsibility for the utility diversion was transferred fully to the Concessionaire, and they would have been required to account for these factors in their orders and diversion accounts.
Nottingham Express Transit	-
TfL Major Projects	Enhanced C3 equivalent level information was effectively produced by the client's utility consultant with active and extensive input from the utilities companies. The quality of the utility design and associated cost estimates is between a C3 and C4 level and is based upon a co-ordinated set of design proposals and a high quality of information which includes GPR survey work. In two cases (BT/Thames Water) additional funding was provided to utilities to agree additional validation based upon sample work.
Croydon Tramlink	As far as I can recall all works up to C4 were provided free of charge. However some organisations (BT?, TWUL?) required prepayment of C4 costs which prepayment was subsequently deducted from the final account. Overheads were not in general disclosed at C4 stage and only emerged, reluctantly, at C9. Programmes were provided and incorporated into co-ordinated zonal programmes.
Sheffield Supertram	No info provided free of charge. Little or nothing provided, secretive approach.

Question 6: Did the approach differ pre- and post-BT vs Gwynedd County Council (if relevant)?

Manchester Metrolink Ph 1	Not relevant
Manchester Metrolink Ph 2	Not applicable
Merseytram	The majority of the process took place post-2003 and there was no noticeable effect.

Midland Metro Line 1	Midland Metro Line 1 diversionary works completed prior to this ruling.
Midland Metro Line 1 Extensions	The effect of the court case is not yet known.
Nottingham Promoter	Not applicable
Nottingham Express Transit	-
TfL Major Projects	Not known at this stage of development.
Croydon Tramlink	N/A
Sheffield Supertram	N/A

	Question 7: Was information provided in a timely manner (i.e. in a timescale consistent with the complexity of the request, not necessarily within the periods quoted in the Diversionary Works Code)?
Manchester Metrolink Ph 1	Although the work preceded the Diversionary Works Code, information was generally provided as it was required.
Manchester Metrolink Ph 2	Generally the timeliness of the responses was acceptable, particularly in view of the large scope of the works.
Merseytram	Generally, information was provided within timescales requested to suit the tram project programme
Midland Metro Line 1	Overall yes, although this was due to the working relationship established with the utilities at both an informal and formal level, both individually and through a monthly utilities meeting. As the project was very large and high profile it was the source of key focus for the utilities.
Midland Metro Line 1 Extensions	Not in all cases. Records were generally forthcoming quickly, but in many cases cost estimates had to be chased over a lengthy period. All but two minor utilities eventually responded.
Nottingham Promoter	The Working Party helped oversaw that information was provided in a timely manner to support the development of the project. The majority of the information indicated in Question 5 above was collaboratively developed from the Autumn 1995 to mid-1997.
Nottingham Express Transit	-
TfL Major Projects	Yes
Croydon Tramlink	In general yes. However, problems emerged with TWUL who struggled to provide work plans, programmes and traffic management details sufficiently in advance of works. TWUL's management worked with us to resolve these problems.
Sheffield Supertram	No - n/a under NRSWA very difficult to get commitment to programme, delivery dates, provision of info.

	Question 8: What steps, if any, did utility companies take to establish the position and depth of their apparatus? Were the necessary steps taken by you as promoter?
Manchester Metrolink Ph 1	Trial holes were carried out on behalf of GMPTE by the highway authority before the final decision on the extent of the diversions in areas where it was considered there was insufficient information.
Manchester Metrolink Ph 2	A number of trial holes were excavated by the Concessionaire in areas where the existing positions of apparatus was critical. GMPTE funded cctv surveys of all sewers crossing the route to establish the condition, and where necessary refurbishment works were carried out before trams began operating.
Merseytram	Trial holes and surveys were undertaken by the promoter at an early stage prior to placement of orders with utility companies. Utilities carried out additional trial holes at commencement of diversion works.
Midland Metro Line 1	Jointly organised site visits. Different utilities have different quality of existing plant and apparatus information.
Midland Metro Line 1 Extensions	Centro has so far carried out a GPR survey of approximately a third of the Birmingham City Centre route and is currently out to tender for approximately the same again. Trial holes have been excavated in some areas, but the results were of limited use due to the presence of mass concrete underlying much of the highway surfacing. Severn Trent have investigated their sewers on both routes, while BT have carried out a survey of some of their manholes.
Nottingham Promoter	High quality historical records of most of the 'traditional' utility apparatus were available, mainly by virtue of the fact that most of these had been former municipal utilities owned by the Corporation of Nottingham. These records survived and in general the later owners of the apparatus had maintained records (to varying quality) of more recent apparatus. The previous practical experience of the utility companies gave them a high level of confidence in the records. Nonetheless the Midland Electricity and British Gas did undertake trial holes to locate critical apparatus. The Promoters also validated the records using GPR of the full route, and trial holes in one particularly congested street.
Nottingham Express Transit	-
TfL Major Projects	The client carried out GPR surveys. The utilities companies provided some asset-specific attribute information including depth as part of validation exercise
Croydon Tramlink	Site investigation in general was undertaken by the joint promoters. Unaware that utilities were willing to do any site investigation in planning stage.
Sheffield Supertram	• very little up front, some later on • utilities not aware of own lack of knowledge • promoters did slit trenches, etc.

	Question 9: Were the utility companies willing to discuss proposals for diversion or protection of apparatus at appropriate intervals during the planning process?
Manchester Metrolink Ph 1	Yes. Work was controlled through a Working Party comprising GMPTE, the utilities, the highway authority and the police. This met on a six-weekly basis throughout the planning and implementation stages, and provided an ideal forum for the necessary discussions.
Manchester Metrolink Ph 2	Yes. The diversion works were managed by the Concessionaire through the Working Party, which was initially set up by GMPTE to control the works in Metrolink Phase 1 (the city centre). Various minor changes were made to the scheme during this stage to suit the conditions found as works were undertaken.
Merseytram	Yes. All companies participated in utilities forums organised by the promoter.
Midland Metro Line 1	Yes.
Midland Metro Line 1 Extensions	Yes. A Working Party was set up to oversee the project, but due to delays resulting from lack of government commitment to eventual funding of the scheme, this has been allowed to lapse for the time being. The few meetings of the Working Party that were held were well attended.
Nottingham Promoter	Yes. This was formed part remit of the Working Party, and the utility companies were, in the main, willing.
Nottingham Express Transit	-
TfL Major Projects	Project(s) are pre-Powers Proposals were discussed. Validated in principle by utilities and incorporated into the scheme design.
Croydon Tramlink	Not involved at the time but would appear to have been the case based on minutes of meetings, correspondence and level of detailed planning ahead of site works starting.
Sheffield Supertram	Initially no but improved as relationships developed. Later stages planning worked better (project and utilities had better knowledge).

	Question 10: Was any utilities' apparatus encapsulated within the tramway infrastructure—either cast into the track slab (as designed or specially thickened), run between the underside of the track slab and the crown of the trackside ducts, cast into foundations of overhead line support poles, or in some other way? Was there any resistance to this approach, either from the utility companies, or from the railway designer or constructor?
Manchester Metrolink Ph 1	Some apparatus was cast into the foundation bases of the overhead line poles. Due to inexperience of tramways, the need to introduce bases and the space they would absorb was largely overlooked. The overhead line designers were also unnecessarily inflexible in their positioning of the bases, with the result that a choice had sometimes to be made between diverting apparatus for a second time, or building it in to the bases. The latter option was generally adopted, although British Gas in particular were unhappy, while going along with it. The original design of the track slab envisaged that some small diameter utilities apparatus might be cast in transversely, but in the final scheme use was not made of this option.
Manchester Metrolink Ph 2	Not to my knowledge. The final details of the work carried out were agreed between the utilities and the Concessionaire. The majority of the overhead line supports were in the form of augured piles, where there was no scope for incorporation of apparatus. Some gravity bases were used, but these were constructed beneath the apparatus.
Merseytram	No such trackslab construction was undertaken prior to suspension of works but proposals for certain protection works to shallow apparatus and incorporation of manholes within swept path were agreed with utilities companies, designers and construction contractor.
Midland Metro Line 1	Yes. HV cables serving a private electricity generating company were left beneath the track slab, with concrete protection and provision made for future replacement (emergency and/or routine). The remaining plant was lowered or moved outside of the swept path. There was no resistance.
Midland Metro Line 1 Extensions	Not applicable as the project has not yet been carried out. However, there are proposals to encapsulate some cable ducts transversely in the track slab. Due to the method of procurement proposed for the works, where the operational risk will remain with Centro, there are not expected to be any grounds for objection from the Concessionaire.
Nottingham Promoter	The approach was to avoid such interfaces in favour of alternatives, but where necessary all of the techniques described were proposed where no reasonable alternative existed. As the diversionary solutions were engineered collaboratively, there was no resistance from the utilities companies as they would have been well aware of the justification for considering and using such alternatives. We are, however, unaware whether or not the Concessionaire experienced any resistance to such techniques during the implementation stage and the final extent to which these solutions were or were not used.
Nottingham Express Transit	-

TfL Major Projects	This approach has been explored with the utility companies but not accounted for at this stage of the project. These types of solutions could provide further benefits and disruption resolution. Potential willingness. This approach presents a further opportunity to TfL.
Croydon Tramlink	Trackslab, gas, BT cables and electricity cables were all built into the slab. This was generally to avoid high costs and delays and utility companies were in general co-operative. "Risk" based approach emerged as a sensible way of managing during the works. Main resistance was from the Concessionaire. Many items of apparatus were cast into pole foundations. No problems once the mechanism for access and means of protection were agreed.
Sheffield Supertram	Not on this project.

Question 11: Did the client's staff (promoter or Concessionaire as appropriate) have sufficient experience of dealing with utilities to express a knowledgeable opinion on the practicality of leaving apparatus in its original position? In other words, were they able to challenge the assumption that all apparatus within a certain distance of the swept path had to be moved?

Manchester Metrolink Ph 1	As the first generation new style tramway in the country, there was no experience to draw on. It was therefore necessary to develop an understanding of the issues very quickly. It was always necessary for GMPTE to guide the process, as the utilities were also in the position of not understanding all the implications of tramways in relation to their apparatus, and would undoubtedly have moved more apparatus than necessary without GMPTE's guidance.
Manchester Metrolink Ph 2	Yes. A considerable amount of experience was gained from the work carried out on Phase 1.
Merseytram	Yes. Consultants with specific utilities diversion works experience were appointed by the promoter to plan, programme and implement the works.
Midland Metro Line 1	Yes, staff were sufficiently experienced, but not in a strong position to refute/contradict utilities' proposals. The contractor vigorously challenged the electricity board's swept path clearance requirement. All other utilities took a pragmatic approach to 450mm outside of the swept path, to allow signing and guarding of future works without impacting on tram operations.
Midland Metro Line 1 Extensions	Yes.
Nottingham Promoter	During the extended procurement process, the preferred bidder for the NET Line One Concessionaire became closely involved with the Working Party as a means of better understanding and reducing the perceived risks associated with the utility diversions. This provided a unique opportunity for proposed Concessionaire to not only understand the utility diversions, but to also establish a relationship with the utility companies and to challenge or eliminate assumptions made to date. This had significant benefit on the conduct of the utility diversion programme once the Concession was let. The Concessionaire did have staff with sufficient experience of working with the utility

	companies' diversionary works, as Carillion , who formed part of the Concessionaire's consortium, had established working relationships as an approved contractor for all of the main utility companies.
Nottingham Express Transit	-
TfL Major Projects	Yes they were knowledgeable
Croydon Tramlink	Yes - client team (LRT) had previously worked with utilities on M11, A40 and Sheffield Supertram.
Sheffield Supertram	No - tram industry was naïve and lacked appropriate knowledge.

Question 12: Who was responsible for generating and maintaining the diversions project programme—promoter, Concessionaire, highway authority or the utility companies, individually or together?

Manchester Metrolink Ph 1	The utility companies provided initial programmes of their identified works. All the programmes were then adapted into a master programme prepared, maintained and updated by GMPTE. The overall programme, and all modifications to it, were discussed and agreed with the utility companies at the Working Group meetings.
Manchester Metrolink Ph 2	The initial development was carried out by GMPTE, based on individual programmes supplied by the utilities, but the responsibility for maintaining the programme was taken over by the Concessionaire when he was appointed to carry out the main works.
Merseytram	The promoter's project team in consultation with utilities companies and local authorities
Midland Metro Line 1	The diversionary schedule was developed by the contractor with input from all of the utilities. The contractor acted as Highway Authority for the duration of the street running construction works.
Midland Metro Line 1 Extensions	Up to the present time, all programming work has been carried out by Centro inhouse. At a later stage, individual programmes will be obtained from each utility company, and these will be built into a master programme by Centro.
Nottingham Promoter	A composite programme was initially developed by the Promoters based on duration information prepared by the utility companies, the overall project programme, and practical constraints (e.g. traffic management, resource availability). This was then progressively developed and refined in collaboration with the utility companies. The programme was developed iteratively with the scope and cost estimates, such that the resulting engineering solutions were optimized to contain costs whilst reflecting the scope of the necessary works and the available duration and programme constraints and implications. In some case the available duration was the key driver to the engineering solution adopted and therefore influenced the scope and cost of the necessary works. Once the proposed Concessionaire became involved in the Working Party, it was identified that time, cost and risk reductions could be achieved by utilising Carillion's expertise to undertake joint trench working and for civil

	works. Carillion were already approved contractor for all of the main utility companies and undertook and coordinated the civil works for many of those parties. The responsibility and risks associated with the utility diversion were fully passed to the Concessionaire. During the implementation, the Concessionaire and the utility companies jointly maintained the programme utilising the continuing Working Party.
Nottingham Express Transit	-
TfL Major Projects	Promoter managed co-ordination design development
Croydon Tramlink	The promoter (LRT) took full responsibility for production of the co-ordinated programme. Highway Authority established zonal rules and utilities provided works package programmes.
Sheffield Supertram	Promoter held master programme and co-ordinated - stats provided micro programmes for work packages.

	Question 13: Did either the promoter or the Concessionaire play a role in supervising the diversions project? What was the extent of the role and the powers given to supervisors? Was the role agreed with, or otherwise acceptable to, the highway authority and the utility companies?
Manchester Metrolink Ph 1	The majority of the diversion works were carried out before the appointment of the Concessionaire, and remained the responsibility of GMPTE. GMPTE appointed an experienced Clerk of Works to observe the works being undertaken. However, there is no contractual relationship between the transport authority and the utility companies, so the CoW was not in a position to directly influence the works carried out. His main role was to record progress and ensure that replacement apparatus was located away from the future line of the tracks. Under PUSWA the utility companies could only make temporary reinstatements of the highway after excavating a trench, the permanent reinstatement being carried out by the highway authority, or very often in this instance, by the tramway contractor. Consequently the role of the CoW was very limited.
Manchester Metrolink Ph 2	The Concessionaire supervised the works to the extent that this was consistent with the statutory right of the utilities to work on their own apparatus within the framework of the New Roads and Street Works Act. The role adopted was acceptable to both the utilities and the highway authority, and was not intended to overlap with the street authority's rights of inspection of reinstatement.
Merseytram	Specialist utilities consultants were appointed by the promoter to plan, programme and supervise the diversion works. The consultants role was to programme co-ordinate and supervise the works including attending planning meetings with designers, utilities companies and local authorities and on-site recording of progress and as-built apparatus
Midland Metro Line 1	The utilities supervised their own work under the direction of the contractor when the works were within the boundary of the site.

Midland Metro Line 1 Extensions	Not applicable.
Nottingham Promoter	The Promoters passed the procurement and implementation of the utility diversion works and all associated risks to the Concessionaire. The Concessionaire's contractor (Bombardier Carillion Consortium) were ultimately responsible for procuring and supervising the diversionary works. The Working Party, however, continued with the Concessionaire and BCC attending. BCC utilised the Working Party to continue to coordinate and monitor the overall diversionary programme permitting a forum in which issues and delays could be resolved or mitigated across parties.It is also worth noting, as Carillion were also coordinating and undertaking the vast majority of the associated civil works (including joint trenching) on behalf of the main utility companies, they were much more closely involved in the delivery and supervision of the works than may otherwise have been the case.
Nottingham Express Transit	-
TfL Major Projects	Not known at this stage of development
Croydon Tramlink	The promoter supervised the works through a team of engineers, planners and site inspectors. This team managed the overall programme and instructed utilities re: timing of works and changes to plans/programmes. In addition LRT agreed with the HSE to appoint a principal contractor reporting to LRT. The approach was agreed with all stakeholders and worked well.
Sheffield Supertram	Only at programme level - no technical or quality work. Did oversee reinstatements.

Question 14: What difficulties, if any, were experienced in agreeing the final costs, and the way in which costs were to be shared, referring in particular to standard sharing of costs of works, deferment of the time of renewal, betterment, and overheads percentage? Comment on phasing of advance payments for lengthy projects, and recognition of the distinction between cost share at 7½% for railway-related works, and 18% for highway-related works.

Manchester Metrolink Ph 1	There were no cost sharing provisions under PUSWA. Agreement of the utilities' invoices did not present a problem.
Manchester Metrolink Ph 2	At the time work was carried out, there was no distinction between railway- and highway-related works: the utilities' contribution was then a uniform 18%. The final costs were audited by an independent consultant to GMPTE, the latter having made the initial orders and remained responsible for payment for the works, despite handing the job of controlling the works to the Concessionaire. All final accounts were agreed, with the exception of that for Transco, where the level of overheads was disputed by the consultant. This led to Transco withdrawing their co-operation with GMPTE during the initial stages of preparation for Metrolink Phase 3. The majority of accounts were paid on an interim basis, as phasing of advance payments was agreed between GMPTE and the utilities due to the duration of the project.

Merseytram	No particular difficulties. All diversion projects undertaken were subject to 75% advance payment. Almost all work undertaken was tram related subject to cost share at 7.5%. Cost sharing at 18% was agreed for the small amount of work which was purely highway-related.
Midland Metro Line 1	18% contribution retained for Midland Metro Line 1 works which took place in 1995-98. Corderoy consultants were appointed by the Concessionaire (Altram) to audit utilities' accounts, but not all accounts paid were finally agreed and legal action has not been taken to reclaim possible overpayments.
Midland Metro Line 1 Extensions	Not applicable.
Nottingham Promoter	The Promoters are unaware of the precise arrangements made by the Concessionaire/ BCC with respect to the final costs and cost sharing. We are aware, however, that BCC adopted an open book arrangements with the utility companies, with individual accounts for each major diversion, and for each street for more minor diversions. These appear to have contributed to a progressive approach to final accounting. The Promoters were aware that the cost sharing arrangements was an area of extensive negotiation between BCC and the utility companies. We were aware that BCC favoured an approach of agreeing with each utility company the application of a fixed percentage (presumably somewhere between 7.5% and 18%) which could be applied to all that utilities diversions for that company. We are, however, unaware of the outcome of these discussions.
Nottingham Express Transit	-
TfL Major Projects	Not known at this stage of development
Croydon Tramlink	A lessons learned paper was prepared and is available if required. Agreement of final accounts was variable particularly w.r.t. agreement of rates (some used "minor works" rates which could have been cheaper) and overheads which utilities were reluctant to disclose.
Sheffield Supertram	• Extreme difficulties - utilities did not accept NRSWA cost sharing provisions. • Approach to recovery was very crude - unaware of rights to info at the time. • Early estimates done by highway designers - were inadequate.

Question 15: Costs of the diversions work will have varied throughout the life of the scheme. How did the final outturn costs compare with the initial estimates, business case estimates and C4 estimates? What steps were taken to reduce costs by reducing the scope? To what extent was the increase due to inflation?

Manchester Metrolink Ph 1	Initial cost estimates were carried out by GMPTE's consultants some years before the scheme was constructed. These were very low. Initial estimates were received from the utility companies as the scheme progressed, and these were exceeded at outturn by approximately 20%. This was partly due to an increased scope of works, related to modifications to highway layouts not initially allowed for, and partly to inflation. In general the utilities' cost estimating was considered to have been satisfactory.

Manchester Metrolink Ph 2	The outturn cost of the diversions showed a significant reduction against earlier estimates, largely due to a reduction in the scope of works undertaken by Transco, and a large deferment of renewal contribution from BT which was not initially anticipated.
Merseytram	Final out-turn costs varied from the initial and C4 estimates for many reasons. Some final costs were significantly under the estimates due to value engineering and tram alignment adjustment. This was achieved by early engagement of the utilities consultants' team with the utilities companies, local authorities and tram design consultants together with the advanced trial holes and survey programme resulting in identification of preferred diversion route alternatives, elimination of diversions, protection measures, shared trenches and traffic management, etc. Final costs for projects which exceeded the estimates were in almost all cases due to unpredictable events such as underground obstructions, delays in obtaining local authority approvals and, to a lesser extent, late design changes. Very little increase was due to inflation due to the ability to provide indicative programmes at C4 stage. A small inflation cost was incurred due to increases in commodity prices, e.g. copper cables
Midland Metro Line 1	Advance estimates provided to Centro from utility companies (including Railtrack/Network Rail) for the estimated costs of their protection/renewal/diversion works amounted to £3.65M. The Concession Deed made a number of provisional sum allowances totalling £3.65M for these items, and also established a jointly-funded contingency sum of a further £4.7M, contrbuted to by both Centro (£1.7M) and the Concessionaire (£3M), to meet possible cost over-runs. In the event that cost over-runs were contained within this contingency sum the concessionire was able to retain the balance of the contingency sum. If costs had exceeded £8.35M (ie £3.65M + £4.7M) then further cost over-runs would have reverted to Centro. Whilst the cost of the works remained between £3.65M and £8.35M the concessionaire was therefore incentivised to minimise the cost of the works, and it is understood that the final outturn cost was under £8M, providing a benefit for the concessionaire and endorsing the efficacy of the approach taken. Over £1M of the cost increase was attributable to Railtrack/Network Rail cost increases (the single largest increase over estimate) and all provisional sum utility costs were further increased by the construction joint venture adding a 10% "attendance charge" and a further 2.5% concessionaire's "overheads" charge to the actual outturn costs. The C4 estimates had been obtained by the construction joint venture, and although copied to Centro have now been archived and are not readily retrievable. From memory, they were a reasonable guide to the outturn costs of the works, the C4 estimates being (largely) higher and more accurate than the pre-tender estimates supplied to Centro. It should be noted that only 2km of the 20km route of Midland Metro Line 1 is situated in highway, so utility costs per km for the route as a whole would be at the low end of the scale, the only utility costs on the segregated seactions of the route relating to plant alterations at bridge locations and power supplies to sub-stations and tram stops.
Midland Metro Line 1 Extensions	The final cost is expected to be less than intermediate estimates at a consistent base date. It is not possible to estimate at present how the outturn costs will compare.
Nottingham Promoter	The Promoters were not responsible for procuring the diversions, and are unaware of the final outturn costs.
Nottingham Express Transit	-

TfL Major Projects	Not known at this stage of development
Croydon Tramlink	-
Sheffield Supertram	Outturn costs massively over budget due to the lack of info, poor estimation by utilities, quality of checking, extent of works not directly associated with clearing swept path alignment.

Question 16: Has the railway experienced any periods of disruption to services or maintenance periods as a result of a need to maintain or repair utilities' apparatus? If so, what has been the average period of suspension of services

Manchester Metrolink Ph 1	Interruption of service for maintenance of utilities' apparatus is practically unknown. An exception occurred at Piccadilly Station entrance where water main was left within the swept path and burst. GMPTE claimed against United Utilities Water for operational losses, since which time they have been very reluctant to leave any plant within the swept path.
Manchester Metrolink Ph 2	Not known
Merseytram	N/A
Midland Metro Line 1	No disruption caused since opening (May 1999).
Midland Metro Line 1 Extensions	Not applicable.
Nottingham Promoter	We are not aware of any such disruption. We understand that Clive Pennington has already provided you with a response to this question on behalf of Arrow's operator (Nottingham Tram Consortium)
Nottingham Express Transit	No we have been able to either arrange work to be carried on outside operational hours or set up working methods that allow the tramway to continue to operate.
TfL Major Projects	Not known at this stage of development
Croydon Tramlink	Not aware of any issues arising with respect to utilities. There have been issues with gas mains (leaks or repairs) in areas adjacent to the tramway and as a result of congestion arising from sewer works in adjacent streets.
Sheffield Supertram	-

Question 17: What has been the mean time between requests to take possession of the track (i.e. the frequency with which utilities require to take possession of the tracks for the purposes of repairing or maintaining their apparatus)?

Manchester Metrolink Ph 1	Not known
Manchester Metrolink Ph 2	Not known
Merseytram	N/A

Midland Metro Line 1	N/A
Midland Metro Line 1 Extensions	Not applicable.
Nottingham Promoter	See response to Q16.
Nottingham Express Transit	No track possessions have been taken by utilities in three years of operation.
TfL Major Projects	Not known at this stage of development
Croydon Tramlink	Not available but probably less than 1 per year.
Sheffield Supertram	-

Question 18: Does section 93/152 provide adequate safeguards for the light railway operating on street against avoidable disruption to railway operations? Is there a standard set of conditions attached to work in the vicinity of the railway, and is this accepted by all utilities affected? Has it been necessary for any utility company to carry out emergency works affecting the railway?

Manchester Metrolink Ph 1	Standard conditions for access to the tramway for maintenance of apparatus were developed jointly by the Concessionaire and the utilities, before section 93 came into force. The conditions effectively set out the requirements of s.93. It is not known whether any emergency works have been carried out by utilities.
Manchester Metrolink Ph 2	A standard set of conditions for working near to the tramway was developed in association with Phase 1 in Manchester City Centre, and these were adopted for use on the Phase 2 line. It is believed that this has worked satisfactorily on the few occasions when it has been used. It is not known whether it has been necessary for any utility company to carry out emergency works affecting the tramway.
Merseytram	N/A
Midland Metro Line 1	Travel Midland Metro (the operator for the Concessionaire) has a document that regulates works in proximity to the tramway by third parties. However, to date, this has not needed to be used by utility companies.
Midland Metro Line 1 Extensions	Not applicable.
Nottingham Promoter	The parliamentary Memorandum of Agreement entered into with the main utility companies required the Working Party to develop a code for the safe working on or near the operating tramway, which the utility companies were required to comply. This code was developed and a draft incorporated into the Concession Agreement. The Concessionaire's operator continued to develop the code further. The final code as implemented applied to utility companies as well other third party working on or near the tramway. We understand that the operator has already provided you with further information on this question.
Nottingham Express Transit	-
TfL Major Projects	Not known at this stage of development

Croydon Tramlink	Need view from TOL on NRSWA. Tram streets are defined in Croydon as streets with special engineering difficulty. As such all streetworks are referred to the Concessionaire. TCL have a code of practice which details what can/cannot be done in the vicinity of the tramway. Not aware of any emergency repairs.
Sheffield Supertram	-

Question 19: What is your opinion, in retrospect, of the correctness of the scope of the diversions project carried out on your railway:- too much, too little or generally correct?

Manchester Metrolink Ph 1	Probably correct, to satisfy the original philosophy of minimal interruption to tram services.
Manchester Metrolink Ph 2	Generally correct.
Merseytram	N/A
Midland Metro Line 1	Electricity cable diversions appeared to be excessive, but other diversions were reasonable. The lack of subsequent disruption to tramway operation would appear to indicate that enough (possibly even too much) plant was re-located/protected at initial project work stage.
Midland Metro Line 1 Extensions	Not applicable.
Nottingham Promoter	All things being equal, we believe the scope of the diversions undertaken was generally correct. We do believe, however, that the issue of stray current makes a disproportionate influence on the scope of the utility diversions both as a result of perceived direct affect and the indirect affect on the size of the trackform.
Nottingham Express Transit	Generally correct given the negligible level of disruption we have experienced.
TfL Major Projects	Not known at this stage of development
Croydon Tramlink	Overall I would say that more work was done than was necessary. This is particularly true of cable crossings and water/gas main crossings many of which were below slab depth but were lowered or diverted. Very few utilities were directly in conflict with the trackslab.
Sheffield Supertram	Could have left more in place and protected. Spare capacity, ducts etc to avoid diversions.

	Question 20: In the light of your experiences, what aspects of the current legislation, codes of practice and existing guidelines should UKTram seek to change, and how could they be improved?
Manchester Metrolink Ph 1	The Diversionary Works Code does not satisfactorily address issues related to tramways, having been written for the guidance of highway authorities and not transport authorities. There should be a more accurate linkage between the Code and the Sharing of Costs of Works Regulations. The definition of a ""relevant authority"" in NRSWA is ambiguous in relation to transport authorities, making it unclear what compensation would be appropriate if a tramway was prevented from running by failure of utilities' apparatus.
Manchester Metrolink Ph 2	See response to questionnaire in connection with Metrolink Phase 1.
Merseytram	N/A
Midland Metro Line 1	The 7½% contribution by utilities should revert to 18% as previously.
Midland Metro Line 1 Extensions	Revision of the Diversionary Works Code to make it applicable to transport works. Review of the Sharing of Costs of Works Regulation to increase the contribution to diversionary works made by utilities. Clarification of the definition of relevant authority in NRSWA to remove ambiguity in its application to transport authorities. Revision of the notional rate of inflation used in the calculation of deferment of the time of renewal. Revision of Appendix E of the Diversionary Works Code to include agreed design lives of more types of apparatus.
Nottingham Promoter	By virtue of the obligations in the Memorandum of Agreement and in particular the compulsory Working Party we were not obliged to follow the code. Our approach to Section 84 of NRASWA was a collaborative and pragmatic one, in which the scope, costs, programme and risks were iteratively considered and developed by engineering led teams. This resulted in engineered solutions and levels of cooperation and coordination that we believe were beyond what can be reasonably achieved under strict adherence to the existing diversionary works code. We believe the code could usefully be developed by: a) establishing a set of clear common objectives for the diversionary works relevant to all stakeholdersb) adoption of a collaborative approach. We would suggest that this requires the establishment of a compulsory engineering-led Working Party with a clear remit to work towards the common objectives, and established prior to initial enquiries and continuing through to completion of the works.c) adoption of an iterative development process, based on composite and coordinated utility and tramway plans and programme.d) adoption of a process that better integrates scope, cost, programme and risk (e.g. a full-life cycle risk and value engineered approach) from the outset and at each stagee) further guidance on cost sharing principlesf) further guidance, and perhaps limits, on overheads and other on-costs (particularly to avoid double counting between corporate and project overheads) - a predetermined overhead rate could help focus minds and costs!
Nottingham Express Transit	Standard clearances around light rail tramway systems such that any utility company or contractor will apply the same rules.

TfL Major Projects	Not concluded at this stage of development
Croydon Tramlink	-
Sheffield Supertram	• greater partnering with utilities • agree principle of working to minimal diversion strategy. • agree principle of provision of spare capacity • acceptance of principle of allowing tram to operate adjacent or above excavations.

Question 21: Please comment on any innovative solutions adopted to the problem of conflicts between the railway and utilities' apparatus, which you feel could usefully be employed on other schemes. Examples might be reconstructing communications manholes to move the access clear of the tracks while avoiding moving the associated cables; inserting plastic sleeves in gas and water pipes; provision of spare ducts across the tracks; or constructing side access manholes rather than move sewerage pipes.

Manchester Metrolink Ph 1	Side access manholes used extensively, avoiding the need for diversion of sewer pipes. Spare ducts provided at track crossings for future expansion of electricity network. Some apparatus built into ohle bases. Gas pipes sleeved with plastic inserts avoiding need for diversion. Alternative access provided into BT manhole to maintain ability to draw in cables, allowing manhole to be preserved rather than demolished and rebuilt. Use of kerb channels rather than gullies to provide extra space for Metrolink ducts. Rationalisation of gas and water pipes reduced the extent of the replacement pipe network.
Manchester Metrolink Ph 2	Use of side access manhole in connection with sewers, including in one case, construction of a single large manhole to replace two affected manholes. Insertion of plastic sleeve into gas pipe to avoid need for diversion. Encapsulation of joints of 36"" gas pipe to avoid the need for diversion. Occasional replacement of piled overhead line pole foundation by gravity base to underpin apparatus and avoid diversion. Boosting of gas supplies by introduction of medium pressure gas, as a quid pro quo for a reduction in the size of low pressure pipes needing to be replaced, with a net overall saving to the project.
Merseytram	1. Early utilities forums involving key personnel from utilities companies, promoters consultants, local authorities, emergency services, etc 2. Advanced trial hole and survey programme 3. Co-ordination of diversion works with planned renewal programmes by utilities companies 4. Identification of alternative solutions to diversion works e.g. potential redundant manholes and chambers, potential side-entry manholes, protective measures, manholes retained within swept path with out-of-hours access agreement, provision of single track running arrangements for potentially rare apparatus access requirements
Midland Metro Line 1	Side access manholes were used to give access to blanked off sewer manholes which were subsequently enabled to remain in situ beneath the track/swept path.

Midland Metro Line 1 Extensions	The project is expected to include: Demolition and reconstruction of BT manholes, moving the point of access outside the swept path, as an alternative to replacing cables. Encapsulation of some ducted cables in the track slab. Construction of side entry manholes as access to sewers. Reduction of capacity of gas pipes in Broad Street (rerouted into a parallel street) with the lost capacity compensated for by introduction of medium pressure supplies at the west end of the street. Rerouting of large water mains in parallel with the gas pipes, and the adoption of joint trenching to reduce excavation and reinstatement costs. Temporary or permanent service bridges to accommodate apparatus during the reconstruction of railway overbridges.
Nottingham Promoter	All of the solutions referred to in the question were used and are useful. In particular, side entry manholes were extensively used on NET to reduce the scope of diversions. We would also suggest the following may also be of use elsewhere: a) Network reconfiguration. In some cases, minor changes to the utility companies network can result by down-rating the affected apparatus, permitting alternative low-cost solutions to its replacement. This is particularly effective for 'piped' services such as gas and water. For example, on NET a diversion of a high pressure gas main was removed from the programme by up-rating an existing main clear of the tramway to balance capacity. The works required were relatively minor adjustments to the gas regulator apparatus, and in abandoning the affected main. The net affect was actually an increased in network capacity. Utility companies are not, however, forthcoming will potential low cost solutions such as this, as the initial perception is that it will result in a loss of network capacity.b) Slewing. Some 'cabled' apparatus can be effectively slewed, avoiding the cost and time of re-cabling and jointing, and in sometimes avoids downtime on critical service network and associated long lead-in times and charges. This is particularly effective for cables that are in relative good condition and for fibre-optic cables. This technique was used on both NET and Croydon. For example, on Croydon this technique had significant time and cost savings when diverting critical trunk fibre optic bundles at Kent Gateway from the path of the tramway with minimal disruption to the network service.c) Joint trenching. Experience in Nottingham is that the adoption of joint trenching undertaken by Concessionaire's contractor realised cost and time savings, and had the added benefit of improving overall coordination of the works.We also believe that in addition to innovative diversionary solutions, consideration needs to be given to innovative solutions to stray current, including alternative methods of incorporating stray current protection into the trackform. Innovative solutions for trackforms itself should also be considered, such as the use of sleeper-track type solutions, which do not use continuous load-bearing trackslabs, as this would create greater opportunity for passing utility through or in closer proximity to the trackform.
Nottingham Express Transit	• Monitoring of touch potential /rail voltages over a six month period i.e. at each tramstop for 1 week twice a year to protect tramway against claims related to stray current. • Motorised isolators making isolation of OHL circuit easier and safer

TfL Major Projects	We have discussed a wide range of proposals to avoid moving apparatus with the utility companies. These include alterations to existing manholes for access and inspection purposes, protection of apparatus, use of standard and split ducting. We have also looked at access requirements, the condition of apparatus, depth material and precise locations from survey work in order to make realistic assessments of diversion requirements. We have developed this approach with the utility companies and have referred to it as a balanced risk approach. We have developed a standard framework and process for development of diversion requirements at the pre-powers stage of a project which can be progressed into the full life time of the project. Results to date have been favourable.
Croydon Tramlink	George Street West: BT manholes reconstructed as major side entry chambers to avoid diversion of 18 way fibre optics. George Street East, Tamworth Road: trackslab modified to step down around mains ensuring load transfer to ground below mains. Numerous locations off highway: spare ducts laid for future cable or pipe laying. NLA Tower: Construction of major side entry manholes to avoid wholesale reconstruction of deep sewers. Other trenchless techniques, pipe lining, pipe bursting etc. were relatively new to the market in 1996/97 and were therefore not favoured by the utilities. Transco did agree to line some mains to avoid major excavations. TWUL constructed pipe manifolds to retain capacity of mains where diverted across buried structures.
Sheffield Supertram	• side entry manholes to sewers - first tram project to adopt this. • provision of HV backup supplies to local residential substation (non tram) • spare ducts to provide capacity at junctions

APPENDIX 5

TABLE OF RESPONSES TO

CONTINENTAL OPERATORS'

QUESTIONNAIRE

	Question 1: Do utility companies (those supplying gas, electricity, water, sewerage and communications services) have automatic rights to place their apparatus in highways? Do they pay for this right, and if so, who to?
France	No, utility companies have no rights to place their apparatus in highways. They don't pay for this right. They should prepare a dossier and present it to the local Council who activates than the local Transport Public Authority to analyse and decide if it's possible or not. I think there is a registration right for the dossier which should be paid to the local Council in charge of streets and highways.
Athens	The authorities request from the Ministry of Public Works (for highways) or Municipalities (for local roads) to place their apparatus and they normally get the permission unless in the near future a major project is to change the whole area, so in order to avoid reconstruction the permission is not given. The utility companies pay only for the rehabilitation of the road.
Dublin	Utility companies have rights granted by specific legislation. They do not pay for this right, but may incur costs for specific works where required by local authority.
Germany (TTK) Karlsruhe	No automatic right - Subject to local agreements In Germany often highway and gas/electricity belong to public bodies, in this case co-ordination is in one hand

	Question 2: Is there overarching legislation governing the placing of apparatus (both utilities and light railway) in highway? If so, what is its main purpose (e.g. to co-ordinate work in the highway so as to minimise its impact on other users)?
France	Yes, I think so (see above).Main purpose is to plan and to coordinate work in the highway so as to minimise its impact on other users of the streets.
Athens	Light railway has been just recently installed in Athens in 2004, in a network of 25 Kms. There is no other prior experience to this issue and no relevant overarching legislation has been set.
Dublin	Generally no specific legislation - but as all works need permission/licence from local authority, the local authority may impose special conditions, in addition to usual guidelines.
Germany (TTK) Karlsruhe	No

	Question 3: Is the relationship between utilities and light railways governed by national or local (i.e. specific to the railway) legislation?
France	It's governed by local legislation not specific to railway.
Athens	There in no legislation concerning the relationship between utilities and light railways.
Dublin	The light railway is built under powers granted by a railorder, which also permits the moving of services. Specific legal agreements have been set up between RPA and major utilities - known as diversionary works contracts (DWC)
Germany (TTK) Karlsruhe	Not national, based on the local laws/regulations of the 16 Länder (counties); is different in all of them, not consistent
	Question 4: Who is empowered to identify the actions needing to be taken to protect utilities' apparatus? Is this a joint exercise?
France	It's a joint exercise with the Public transport Authority from which decisions are taken to allow works to be carried on
Athens	Concerning the existing network of utilities below a railway, the light railway company has to propose actions in order to protect the apparatus. In some cases the actions have to be proved by Utilities Company before these are applied.
Dublin	This a joint exercise - project managed by RPA
Germany (TTK) Karlsruhe	Normally joint exercise from the beginning on. During TWA process, proposals where to put utilities are coming normally from the public side and will the be evaluated by the utility companies and is subject to intensive discussion/negotiation
	Question 5: To what extent is the decision to move apparatus determined by an assessment of the risk of the apparatus failing? Are there publicly available statistics on the rates of failure of different types of apparatus?
France	In France, the common rule which is enforced by the Transport Public Authority is to move apparatus and technical rooms underground out of the light rail line trackwork before line construction starts. Certainly but you should adress your request to Utilities companies
Athens	In the 25 Km network, TRAM SA. tried to move most of the apparatus. No publicly available statistics on the rates of failure have been used in the context of the project.
Dublin	Each service is assessed on its own merits. Areas of weakness are not deliberately left under the track. Limited amount of failure statistics.

Germany (TTK) Karlsruhe	Normally not risk based normal approach is to remove ALL utilities Not aware of any stats
	Question 6: Who pays for the diversion and protection of apparatus when it is moved for the benefit of a light railway? If the cost is shared, how is the proportion borne by each party calculated?
France	When the Public Enquiry has been achieved, the rule is the following: * all open air installations pertaining to a Utility Public company: gas, power, water; are removed and paid by each Utility company * all underground and private Utility equipment are removed by each Utility company but paid by the Transport Public Authority
Athens	The light railway company pas for the diversion and the protection of an apparatus needed to be relocated or protected before the construction of the railway.
Dublin	The cost is borne by the light rail project, save where network is improved or new works are constructed. Such works are paid for by the utility company. New works are paid for from BoQ from utility contractors - i.e. actual costs. Improvements are as per 7
Germany (TTK) Karlsruhe	Utilities movement is often part of whole LRT measure and get public funding depends on the the age of utilities. In general terms for older pipes the companies get about 40 % of the cost for new ones. If the utilities are new, they might get up to 100 % of their cost, but this will not happen so often because LRT lines will not be built from one day to the other and therefore normally nobody will place new utilities in roads where in the near future a tramway might come.
	Question 7: Is there an allowance made to the railway authority because of the provision of new apparatus for old? How is the benefit to the utility company calculated?
France	I can't answer. But I don't think so
Athens	There is no allowance made to the tram authority because of the provision of new apparatus for old.
Dublin	% formula = (Capacity of new - capacity of old)/(capacity of old) * 100 However it is often difficult to establish this, and improvement is not applicable if old capacity services are no longer available.
Germany (TTK) Karlsruhe	Yes, but this is often a complex formula and subject to local negotiations.

	Question 8: Is it more normal to move all apparatus clear of the railway, or to seek to leave apparatus within the tram-way when it is considered safe to do so?
France	In France, our Public Transport Authority prefer to move all apparatus clear of the light railway.It is not a question of safe to do so (leave apparatus within the tramway) but of unavailability of the line operation in case of works needed on the Utility apparatus following failure for example. To avoid this breakdown situation the best choice is to take out of the trackwork all utility equipment
Athens	If there is enough time, it is more normal and safe to move all apparatus clear of the railway to avoid problems later on.
Dublin	It is more usual to move, but deep services (e.g. drainage) are usually left insitu.
Germany (TTK) Karlsruhe	Normal is to remove everything.

	Question 9: What is the normal procedure when apparatus beneath the tracks needs to be repaired or extended by a new connection?
France	No work is allowed on the apparatus during railway operational hours unless it is a safety question.
Athens	It depends on the damage. If it is a serious one, the tramway stops operating. Otherwise work is allowed on the apparatus during night hours when tramway stops operation.
Dublin	Code of Practice has been developed jointly by RPA and utility companies, and has recently been reviewed with operator - see copy attached, also www.luas.ie
Germany (TTK) Karlsruhe	Normally this question is not a problem because everything is removed. If in older networks this is not the case works should normally be carried out under operation.

	Question 10: What procedures are adopted when utility companies require to work in the vicinity of the railway?
France	There is a specific information to the drivers Headlights are lit on. Horn is blown when approaching the work place. Low speed is enforced on the work area A safety coordinator is watching the environment of the work area, and warns workers when a train is approaching
Athens	There is a certain procedure established by TRAM S.A., that is followed in cases when utility companies require to works in the vicinity of the tramway. A few days prior to the planned date of works the utility company (or the contractor working for the utility company) fills out a form which is submitted to TRAM S.A. explaining the characteristics of the work. An engineer of TRAM S.A. is charged to handle the case and make the necessary arrangements to guarantee safety. The permission to work in the vicinity of the tramway is provided to the utility company along with the measurements that have to be taken during works.
Dublin	As per 9
Germany (TTK) Karlsruhe	All work has to be co-ordinated with the tramway operator. Safety personnel on the tracks must be present. The v max is often reduced in these areas for a given time. But this is again subject to local agreements.

	Question 11: What provisions are made for compensation to be paid to either the utility for inefficient working on their apparatus close to the tracks, or to the railway operator for delays to or cessation of services?
France	Delays and operational losses are accounted and charged to the Public Transport Authority. Inefficient working consequences are in responsibility of the Utility company
Athens	There is not such provision made.
Dublin	None to utilities. Charge for possession - www.luas.ie
Germany (TTK) Karlsruhe	Nothing known, but from case to case there might be penalties defined in separate contracts.

	Question 12: Do circumstances ever arise where railway infrastructure must be destroyed and rebuilt to allow work on utilities' apparatus? If so, who carries out the work of demolition and renewal, and who is responsible for meeting the costs?
France	No at my knowledge. If so, the work is done under the cover of the Public Transport Authority and the Utility Company is charged for this work.
Athens	The demolition and the renewal of the tramway are undertaken by the tramway company and the works needed for the apparatus are carried out by the utility company.
Dublin	Not to date. Provision is made in 2 specific locations for infrastructure to be moved at operators cost. If this occurs (1) - 220kV cable under stop (2) - large water mains at depot
Germany (TTK) Karlsruhe	No, not known

	Question 13: Is the track form designed to allow for ease of access to apparatus beneath it? If this is the case, please explain how this is achieved
France	Yes, it is generally the case. Access to technical rooms and equipment are reorganised before building the light railway line, and specific civil works or environmental layout reorganisation is implemented by the Public Transport Authority and paid by the Utility Company
Athens	The study and the construction of the railway over an apparatus has taken into account the need to excavate under the railway (in a width of 3 meters) in order to make restoration of the utility.
Dublin	Not usually. Apparatus is placed in ducts under track and spares can be provided where required. Particular stop design used over 220kV cable to permit potential future repairs
Germany (TTK) Karlsruhe	No special trackform. If utilities have to stay under tramway tracks access from the side (road) must be guaranteed (installed in order not to interrupt tramway services for normal maintenance).

	Question 14: Please comment on any other aspects of the relationship between light railways and utilities that you feel might be helpful.
France	No comment. Only remember that it could be needed for the Public Transport Authority to pay for the works to be done as to meet the light rail works planning, then, the Utility company is charged by the Public transport Authority.
Athens	The experience of the relationship between light railways and utility is limited in Greece since the Athens tram project was constructed making use of the legislative provisions made for the Athens Olympic Games 2004 in order to accelerate decision making. Please note that, in Greece, the Ministry of Public Works could further provide information on this questionnaire since highways are under its responsibility (www.minenv.gr, for information please contact: www2.minenv.gr/Contact/press_gr.html).
Dublin	See presentation to Activity 1 seminar
Germany (TTK)	-
Karlsruhe	-

APPENDIX 6

TABLE OF RESPONSES TO

UTILITIES'

QUESTIONNAIRE

Question 1: Light railway promoters are increasingly seeking to plan diversions of apparatus based on an assessment of the risk of not moving them. What information is available within your industry that might assist this process (e.g.failure rates for apparatus of various materials and capacities)?

Water	The industry compiles and retains failure rate data with particular regards to their networks and the periodic review capital investment programmes in order to verify and justify identified replacement renewal or repair budgets within the next determination period.
Gas	The replacement of gas distribution assets is based on a risk-profiling method agreed with, and required by the HSE as part of the long-term asset replacement of all cast-iron mains within 30 metres of any building. Programmes of investment are agreed for each five year Regulatory Price Control Period.
Electricity	The industry is required to report annually to the industry economic regulator, overall reliability and availability figures. Analysis of types and frequency of equipment failure is undertaken in order to prioritise replacement within each five year Regulatory Price Control Period.

Question 2: Sections 84, or 143 in Scotland, in conjunction with the Diversionary Works Code, provide for the transport authority and the utility companies to identify necessary works resulting from the construction and operation of the railway. What is your approach to the provision of information to the transport authority on -
• Positions of apparatus (Code appendix C2);
• C3 estimates and note of special requirements;
• A description of your view of the necessary measures and a C4 cost estimate based on the detailed scheme, including details of ages of apparatus, allowances for deferment, betterment and credit for recovered apparatus, detailed specification, breakdown of percentage of overheads to be applied to direct costs, anticipated durations of work stages and provisional programme?

NJUG common response	C2: Utilities supply free of charge plant details to NRSWA authorities (highway, bridge and transport) as well as other utilities. Indeed anyone with a licence to operate in the highway. C3: Upon request from the transport authority, utilities will provide a budget estimate free of charge, provided the transport authority has been granted a licence or empowered by act of Parliament. Otherwise they reserve the right to charge, sometimes in advance. C4: Upon provision of full details of the scheme and a programme by the transport authority, utilities will provide a detailed estimate in order to agree a specification for any necessary diversionary works, this can include deferment, betterment etc as detailed. There is a charge for this information, which becomes part of a utility's allowable costs under the regulations.

	Question 3: Do you differentiate in your response to queries from light railway promoters between those having been granted powers, and those seeking them?
NJUG common response	No, a transport authority under NRSWA is the only recognition required. If part of a Transport and Works Act scheme, NRSWA diversionary sharing of costs regulations invariably apply.

	Question 4: Do you see the identification of the measures necessary as a co-operative exercise, or one that is essentially the prerogative of the utility owning the apparatus concerned?
NJUG common response	Totally cooperative as utilities prefer that their apparatus is not affected. The C3 Budget estimate should be the driver for discussions as to the nature and extent of any required works allowing for both transport scheme and utility proposals to be amended and to arrive at an agreed specification, however, the safety of personnel and apparatus, including the need for speedy access in the event of failure, is always paramount.

Question 5: Where apparatus is nearing the end of its design life, it may be quite vulnerable, but the costs of diverting it could easily be shared in nearly equal proportions between the promoter and the utility company. An obvious way to reduce the costs of diverting apparatus is to divert less of it, by leaving apparatus in place closer to, or even beneath the tracks. What are your views on the feasibility of this in respect of the following considerations?

• Reaching an agreement with the railway operator to halt operations, or run vehicles under supervision on the railway while maintenance or repair work is undertaken on the utility's apparatus;

• The inherent dangers in leaving your apparatus beneath or close to the track slab;

• The division of responsibility for bearing additional costs associated with supervised operation of the railway, and possible destruction and repair of track slab. Is your view dependent in any way on the age of the apparatus?

• Sections 82 and 141 (England and Wales, and Scotland respectively) of NRSWA provide for compensation to be payable to various people in the event of damage caused to their apparatus as a result of a failure of your own. Do you take these provisions into account when considering whether apparatus should be moved?

• The availability of data within the industry to allow a reasonable assessment to be made of the risks of failure associated with leaving apparatus in place beneath or close to the tracks.

NJUG common response

NJUG members cannot support leaving apparatus under the tracks as regardless of the age of the apparatus, full access for maintenance or repair of service and new customer connections is required, and in particular on a 24/7 basis for emergencies or loss of supply.

NJUG would have reservations concerning use of potential residual life in determining any responsibility for bearing additional costs. Non-destructive testing has improved and with increasingly sophisticated pressure control systems, and greater reluctance to shut systems down, shocks to net works are fewer and the failure rate of older systems reduces by careful management, so extending the useful residual life.

This is a notoriously inexact science and the asset value is partly the route in the ground as well as the pipe / conduit itself. Regardless of the age of an asset, because of the safety reasons above, utility assets could not remain in situ if a tram route was to cross above. Indeed the implications for a tram operator's customers in terms of unplanned delays in the event of the need for emergency or urgent access by utilities would be clearly disruptive and potentially lead to disputes. However, NJUG members would of course always look to work with tram developers to find alternative solutions to minimise costs.

Given that the general practice is to divert apparatus, NJUG are not aware of any data on the risks of leaving apparatus in the ground.

Question 6: To what extent do you take into account s.65/124 of NRSWA (Safety measures) and the code of practice Safety at street works and road works when considering what apparatus should be moved?

NJUG common response

AS above, NJUG and its members view safety as their number one priority (as outlined in the NJUG Vision for Street Works **http://www.njug.org.uk/uploads/NJUGVisionforStreetWorks.pdf**, with an objective to apply the highest standards to all activities all of the time. Section 65 and the associated code of practice are principally concerned with the safety of other highway users during works not the positioning of apparatus.

Finally, in addition to our commitments to safety under the Vision, the utility industry is obliged by law to be fully cognisant of, and comply with, the Health and Safety legislation applicable to the maintenance and operation of its networks and that of the travelling public.

Question 7: Have you experienced any differences of opinion between yourselves and railway promoters on the interpretation of the cost provisions of NRSWA (betterment, deferment of renewal, cost share and overheads)? If so, have these ultimately been resolved to your satisfaction? How do the interpretations differ?

NJUG common response

This would require an industry based audit and response to answer accurately. However, it is known that there have been differences of opinion and that is why the utility side wishes to renegotiate these sections of the Diversionary Works Code of Practice when the next wave of work is undertaken.

Question 8: Do you consider costs incurred through the operation of s.74/133 of NRSWA to be part of the allowable costs of the diversion works?

NJUG common response

Any efficient costs imposed by a highway authority will be passed onto the works promoter as allowable costs. Section 74 charges do not normally apply to highway authority diversionary works.

Question 9: Who, of the utility and the promoter, is better placed to maintain
a) the overall programme of works and
b) the programme of the utility as severance of service, reconnections and customer requirements are unique to each utility company's own works?
How do you see the two being reconciled?

NJUG common response

a) The overall programme of works for the scheme must be the works promoter who will monitor utility progress.

b) The utility's own works remain the responsibility of the utility but regular discussions with the works promoter are required to facilitate (a) above.

The two programmes must be reconciled through negotiation as they generally cannot be carried out in total isolation from each other

Question 10: Does the promoter have a role to play in supervision of the utilities' diversionary works? How should the promoter best ensure that the quality of any works carried out by the utilities close to the future position of the tracks is consistent with s.81/140 of NRSWA, and will not adversely affect the railway after it comes into operation?

NJUG common response

No specification should be agreed after the C4 detailed estimate has been submitted without taking into account every consideration both of the transport authority and the utility. No agreement of specification will mean that there will be no works.

Having agreed a specification it is the responsibility of the utility to meet the required quality standards. The promoter may wish to closely monitor certain phases of the works and advise the utility accordingly as the supervision of overall site progress is the responsibility of the works promoter in close discussion with the utility as works progress. However, the utility is responsible for the progress of its own works, but progress must be regularly reconciled with overall site programming However, discussions are ongoing with Crossrail around the possibility of using a single contractor to undertake all diversionary works in a particular vicinity, the benefits of which include enhanced co-ordination, reduction of costs and environmental consequences (possible single reinstatement after all diversions completed / less movement of spoil etc). The safety, operational, commercial, legal and practical consequences of such an approach are still being worked through, but such an approach may work for development of light railways and trams too.

Question 11: What is your view on the correct way to manage traffic during the diversions project - should it be centrally managed by the promoter, or individually by the utility companies concerned?

NJUG common response

Traffic diversions are best managed by the works promoter as they may be applicable to their own works as well as various utility companies. Of course, individual site safety and any associated local traffic management is the responsibility of the utility as part of the overall site safety.

Question 12: Who, of the promoter and the utility company, is best placed to manage public relations? Does there need to be a division of responsibilities, and if so, in what way?

NJUG common response

The promoter is best placed to undertake macro public relations regarding the scheme proposals and objectives. Local management is best shared, but in all cases a collaborative approach is beneficial, with expertise of specifics around differing type of works being shared as appropriate.

Question 13: Have you had experience of repair and maintenance of apparatus in the presence of light railways? If so, what are your views on the operation of s.93/152 of NRSWA, concerning the execution of works affecting a tramway or level crossing? Does the section provide a satisfactory mechanism? Do you consider it to have been operated fairly
in the best overall interests of the light railway operator, the utility and the general public?

NJUG common response

Experiences are utility/industry specific with differing views resulting from different experiences.

Question 14: Please comment on any innovative solutions adopted to the problem of conflicts between the railway and utilities' apparatus, which you feel could usefully be employed on other schemes.

NJUG common response

Discussions are ongoing with Crossrail around the possibility of using a single contractor to undertake all diversionary works in a particular vicinity, the benefits of which include enhanced co-ordination, reduction of costs and environmental consequences (possible single reinstatement after all diversions completed / less movement of spoil etc). The safety, operational, commercial, legal and practical consequences of such an approach are still being worked through, but such an approach may work for development of light railways and trams too.

Equally Crossrail have worked with utilities to avoid their infrastructure wherever possible including the use of innovative technical solutions, and a constructive partnership approach.

APPENDIX 7

LIGHT RAIL PROMOTERS'

AND OPERATORS'

QUESTIONNAIRE

ORGANISATION:
CONTACT NAME:
TEL:
E-MAIL:

Activity Group 1 - Protection and Diversion of Utilities
Light Rail Promoters and Operators
Questionnaire

Introduction

UK Tram is an organisation that represents the majority of promoters and operators of light railways and tramways in the United Kingdom. It is a limited company sponsored in equal parts by Transport for London, the Passenger Transport Executives Group, the Confederation of Passenger Transport and the Light Rapid Transit Forum. It carries out research into a variety of aspects of light railway design, construction and operation and publishes the results in the interests of improving understanding and uniformly raising standards throughout the industry. It is supported in its activities by the Department for Transport.

Activity 1 relates to a subject which is perceived to have a highly significant impact on the viability of light railway schemes, particularly where they are constructed in highways, namely the protection and diversion of utilities' apparatus. The cost of this work represents a high proportion of the total cost of schemes completed to date, and the prospects of introducing further light railways will be greatly enhanced by the provision of guidelines showing how such costs can be minimised and properly controlled.

An important method of establishing best practice is by the distribution of questionnaires to the people best placed to provide useful guidance based on their experience. We would be very grateful if you could spare the time to answer the questions below, in any way which you feel would assist the process of improving understanding and implementation of light railway schemes in the future.

PART A—General approach to treatment of utilities' apparatus

Question 1: What philosophy was adopted in deciding whether to divert or leave apparatus:

a) move everything to avoid future disruption to light railway operations
b) move as little as possible to minimise the construction cost, and accept costs of disruption during future operations
c) Rely solely on utilities' assessments of what needed to be moved

Response:

Question 2: How satisfied were you with the utility companies' level of co-operation with the chosen philosophy? Was the co-operation uniform across all utilities? Was the philosophy modified in any instances as a result of clarification or discussion of the utilities' needs or obligations, or by the provision of further information?

Response:

PART B—Operation of principles of S.84/143 of New Roads and Street Works Act 1991

Question 3: Did the utility companies adopt a co-operative approach, where both parties have an equal right to a view on what action should be taken, or did they consider they should make the decision unilaterally?

Response (including exceptions to general position):

Question 4: Please comment on the completeness of the provision of information called for by S.84/143 of NRSWA, as amplified by the Diversionary Works Code.

Response:

Question 5: Charging for estimates—what information was provided at C2, C3 and C4 stages? Was it free of charge?

- Records (C2) ☐
- Note of special problems (C2) ☐
- Preliminary details of the effect of the scheme on the utility's apparatus (C3) ☐
- Budget estimates C3 ☐
- Indication of special requirements (C3) ☐
- Description of necessary measures based on the detailed scheme (C4) ☐
- Details of the ages of apparatus (C4) ☐
- Detailed specification of the required works (C4) ☐
- Detailed cost estimates including allowances for deferment, betterment (where appropriate) and recovery of materials (C4) ☐
- Detailed breakdown of overhead charges included in cost estimates (C4) ☐
- Work durations and a provisional programme (C4) ☐

Exceptions to general situation described above:

Question 6: Did the approach differ pre- and post-BT vs Gwynedd County Council (if relevant)?

Response:

Question 7: Was information provided in a timely manner (i.e. in a timescale consistent with the complexity of the request, not necessarily within the periods quoted in the Diversionary Works Code)?

Response:

Question 8: What steps, if any, did utility companies take to establish the position and depth of their apparatus? Were the necessary steps taken by you as promoter?

Response:

Question 9: Were the utility companies willing to discuss proposals for diversion or protection of apparatus at appropriate intervals during the planning process?

Response:

Question 10: Was any utilities' apparatus encapsulated within the tramway infrastructure—either cast into the track slab (as designed or specially thickened), run between the underside of the track slab and the crown of the trackside ducts, cast into foundations of overhead line support poles, or in some other way? Was there any resistance to this approach, either from the utility companies, or from the railway designer or constructor?

Response:

PART C—Planning, programming and implementation

Question 11: Did the client's staff (promoter or Concessionaire as appropriate) have sufficient experience of dealing with utilities to express a knowledgeable opinion on the practicality of leaving apparatus in its original position? In other words, were they able to challenge the assumption that all apparatus within a certain distance of the swept path had to be moved?

Response:

Question 12: Who was responsible for generating and maintaining the diversions project programme—promoter, Concessionaire, highway authority or the utility companies, individually or together?

Response:

Question 13: Did either the promoter or the Concessionaire play a role in supervising the diversions project? What was the extent of the role and the powers given to supervisors? Was the role agreed with, or otherwise acceptable to, the highway authority and the utility companies?

Response:

Question 14: What difficulties, if any, were experienced in agreeing the final costs, and the way in which costs were to be shared, referring in particular to standard sharing of costs of works, deferment of the time of renewal, betterment, and overheads percentage? Comment on phasing of advance payments for lengthy projects, and recognition of the distinction between cost share at 7½% for railway-related works, and 18% for highway-related works.

Response:

Question 15: Costs of the diversions work will have varied throughout the life of the scheme. How did the final out-turn costs compare with the initial estimates, business case estimates and C4 estimates? What steps were taken to reduce costs by reducing the scope? To what extent was the increase due to inflation?

PART D—Experience of operational issues

Questions to be answered where the railway has subsequently come into operation.

Question 16: Has the railway experienced any periods of disruption to services or maintenance periods as a result of a need to maintain or repair utilities' apparatus? If so, what has been the average period of suspension of services

Response:

Question 17: What has been the mean time between requests to take possession of the track (i.e. the frequency with which utilities require to take possession of the tracks for the purposes of repairing or maintaining their apparatus)?

Response:

Question 18: Does section 93/152 provide adequate safeguards for the light railway operating on street against avoidable disruption to railway operations? Is there a standard set of conditions attached to work in the vicinity of the railway, and is this accepted by all utilities affected? Has it been necessary for any utility company to carry out emergency works affecting the railway?

Response:

Question 19: What is your opinion, in retrospect, of the correctness of the scope of the diversions project carried out on your railway:- too much, too little or generally correct?

Response:

Question 20: In the light of your experiences, what aspects of the current legislation, codes of practice and existing guidelines should UKTram seek to change, and how could they be improved?

Response:

PART E—Other information

Question 21: Please comment on any innovative solutions adopted to the problem of conflicts between the railway and utilities' apparatus, which you feel could usefully be employed on other schemes. Examples might be reconstructing communications manholes to move the access clear of the tracks while avoiding moving the associated cables; inserting plastic sleeves in gas and water pipes; provision of spare ducts across the tracks; or constructing side access manholes rather than move sewerage pipes.

Response:

THANK YOU FOR YOUR TIME AND PATIENCE!

Space provided for overflow responses:

APPENDIX 8

CONTINENTAL OPERATORS'

QUESTIONNAIRE

ORGANISATION:

CONTACT NAME:

TEL:

E-MAIL:

Activity Group 1 - Protection and Diversion of Utilities Continental Operators' Questionnaire

Introduction

UK Tram is an organisation that represents the majority of promoters and operators of light railways and tramways in the United Kingdom. It is a limited company sponsored in equal parts by Transport for London, the Passenger Transport Executives Group, the Confederation of Passenger Transport and the Light Rapid Transit Forum. It carries out research into a variety of aspects of light railway design, construction and operation and publishes the results in the interests of improving understanding and uniformly raising standards throughout the industry. It is supported in its activities by the Department for Transport.

Activity 1 relates to a subject which is perceived to have a highly significant impact on the viability of light railway schemes, particularly where they are constructed in highways, namely the protection and diversion of utilities' apparatus. The cost of this work represents a high proportion of the total cost of schemes completed to date, and the prospects of introducing further light railways will be greatly enhanced by the provision of guidelines showing how such costs can be minimised and properly controlled.

An important method of establishing best practice is by the distribution of questionnaires to the people best placed to provide useful guidance based on their experience. We would be very grateful if you could spare the time to answer the questions below, in any way which you feel would assist the process of improving understanding and implementation of UK light railway schemes in the future.

Question 1: Do utility companies (those supplying gas, electricity, water, sewerage and communications services) have automatic rights to place their apparatus in highways? Do they pay for this right, and if so, who to?

Response:

Question 2: Is there overarching legislation governing the placing of apparatus (both utilities and light railway) in highway? If so, what is its main purpose (e.g. to co-ordinate work in the highway so as to minimise its impact on other users)?

Response:

Question 3: Is the relationship between utilities and light railways governed by national or local (i.e. specific to the railway) legislation?

Response:

Question 4: Who is empowered to identify the actions needing to be taken to protect utilities' apparatus? Is this a joint exercise?

Response:

Question 5: To what extent is the decision to move apparatus determined by an assessment of the risk of the apparatus failing? Are there publicly available statistics on the rates of failure of different types of apparatus?

Response:

Question 6: Who pays for the diversion and protection of apparatus when it is moved for the benefit of a light railway? If the cost is shared, how is the proportion borne by each party calculated?

Response:

Question 7: Is there an allowance made to the railway authority because of the provision of new apparatus for old? How is the benefit to the utility company calculated?

Response:

Question 8: Is it more normal to move all apparatus clear of the railway, or to seek to leave apparatus within the tram-way when it is considered safe to do so?

Response:

Question 9: What is the normal procedure when apparatus beneath the tracks needs to be repaired or extended by a new connection?

- The railway stops operating while the work is carried out on the utility's apparatus:
- No work is allowed on the apparatus during railway operational hours:
- Work is carried out on the apparatus between the passage of trains, with trains operating at reduced speed as necessary:
- Or some other arrangements.

Response:

Question 10: What procedures are adopted when utility companies require to work in the vicinity of the railway?

Response:

Question 11: What provisions are made for compensation to be paid to either the utility for inefficient working on their apparatus close to the tracks, or to the railway operator for delays to or cessation of services?

Response:

Question 12: Do circumstances ever arise where railway infrastructure must be destroyed and rebuilt to allow work on utilities' apparatus? If so, who carries out the work of demolition and renewal, and who is responsible for meeting the costs?

Response:

Question 13: Is the trackform designed to allow for ease of access to apparatus beneath it? If this is the case, please explain how this is achieved

Response:

Question 14: Please comment on any other aspects of the relationship between light railways and utilities that you feel might be helpful.

Response:

In case of a need for clarification of any of the issues raised, please contact David Rumney by e-mail on:- drumney@clara.co.uk

THANK YOU FOR YOUR TIME AND PATIENCE!

APPENDIX 9

UTILITY COMPANIES'

QUESTIONNAIRE

ORGANISATION:
CONTACT NAME:
TEL:
E-MAIL:

Activity Group 1 - Protection and Diversion of Utilities
Utility Companies' Questionnaire

Introduction

UK Tram is an organisation that represents the majority of promoters and operators of light railways and tramways in the United Kingdom. It is a limited company sponsored in equal parts by Transport for London, the Passenger Transport Executives Group, the Confederation of Passenger Transport and the Light Rapid Transit Forum. It carries out research into a variety of aspects of light railway design, construction and operation and publishes the results in the interests of improving understanding and uniformly raising standards throughout the industry. It is supported in its activities by the Department for Transport.

Activity 1 relates to a subject which is perceived to have a highly significant impact on the viability of light railway schemes, particularly where they are constructed in highways, namely the protection and diversion of utilities' apparatus. The cost of this work represents a high proportion of the total cost of schemes completed to date, and the prospects of introducing further light railways will be greatly enhanced by the provision of guidelines showing how such costs can be minimised and properly controlled.

An important method of establishing best practice is by the distribution of questionnaires to the people best placed to provide useful guidance based on their experience. We would be very grateful if you could spare the time to answer the questions below, in any way which you feel would assist the process of improving understanding and implementation of light railway schemes in the future.

PART A—General approach to treatment of utilities' apparatus

Question 1: Light railway promoters are increasingly seeking to plan diversions of apparatus based on an assessment of the risk of not moving them. What information is available within your industry that might assist this process (e.g. failure rates for apparatus of various materials and capacities)?

Response:

Question 2: Sections 84, or 143 in Scotland, in conjunction with the Diversionary Works Code, provide for the transport authority and the utility companies to identify necessary works resulting from the construction and operation of the railway. What is your approach to the provision of information to the transport authority on –

- Positions of apparatus (Code appendix C2);
- C3 estimates and note of special requirements;
- A description of your view of the necessary measures and a C4 cost estimate based on the detailed scheme, including details of ages of apparatus, allowances for deferment, betterment and credit for recovered apparatus, detailed specification, breakdown of percentage of overheads to be applied to direct costs, anticipated durations of work stages and provisional programme?

Response:

Question 3: Do you differentiate in your response to queries from light railway promoters between those having been granted powers, and those seeking them?

Question 4: Do you see the identification of the measures necessary as a co-operative exercise, or one that is essentially the prerogative of the utility owning the apparatus concerned?

PART B—Scope of diversions

Question 5: Where apparatus is nearing the end of its design life, it may be quite vulnerable, but the costs of diverting it could easily be shared in nearly equal proportions between the promoter and the utility company. An obvious way to reduce the costs of diverting apparatus is to divert less of it, by leaving apparatus in place closer to, or even beneath the tracks. What are your views on the feasibility of this in respect of the following considerations?

- Reaching an agreement with the railway operator to halt operations, or run vehicles under supervision on the railway while maintenance or repair work is undertaken on the utility's apparatus;
- The inherent dangers in leaving your apparatus beneath or close to the track slab;
- The division of responsibility for bearing additional costs associated with supervised operation of the railway, and possible destruction and repair of track slab. Is your view dependent in any way on the age of the apparatus?
- Sections 82 and 141 (England and Wales, and Scotland respectively) of NRSWA provide for compensation to be payable to various people in the event of damage caused to their apparatus as a result of a failure of your own. Do you take these provisions into account when considering whether apparatus should be moved?
- The availability of data within the industry to allow a reasonable assessment to be made of the risks of failure associated with leaving apparatus in place beneath or close to the tracks.

Response:

Question 6: To what extent do you take into account s.65/124 of NRSWA (S*afety measures*) and the code of practice *Safety at street works and road works* when considering what apparatus should be moved?

Response:

PART C—Cost, programme and implementation

Question 7: Have you experienced any differences of opinion between yourselves and railway promoters on the interpretation of the cost provisions of NRSWA (betterment, deferment of renewal, cost share and overheads)? If so, have these ultimately been resolved to your satisfaction? How do the interpretations differ?

Response:

Question 8: Do you consider costs incurred through the operation of s.74/133 of NRSWA to be part of the allowable costs of the diversion works?

Response:

Question 9: Who, of the utility and the promoter, is better placed to maintain a) the overall programme of works and b) the programme of the utility company's own works? How do you see the two being reconciled?

Response:

Question 10: Does the promoter have a role to play in supervision of the utilities' diversionary works? How should the promoter best ensure that the quality of any works carried out by the utilities close to the future position of the tracks is consistent with s.81/140 of NRSWA, and will not adversely affect the railway after it comes into operation?

Response:

Question 11: What is your view on the correct way to manage traffic during the diversions project – should it be centrally managed by the promoter, or individually by the utility companies concerned?

Response:

Question 12: Who, of the promoter and the utility company, is best placed to manage public relations? Does there need to be a division of responsibilities, and if so, in what way?

Response:

PART D—Post operational experience

Question 13: Have you had experience of repair and maintenance of apparatus in the presence of light railways? If so, what are your views on the operation of s.93/152 of NRSWA, concerning the execution of works affecting a tramway or level crossing? Does the section provide a satisfactory mechanism? Do you consider it to have been operated fairly in thebest overall interests of the light railway operator, the utility and the general public?

Response:

PART E—Other information

Question 14: Please comment on any innovative solutions adopted to the problem of conflicts between the railway and utilities' apparatus, which you feel could usefully be employed on other schemes.

Response:

THANK YOU FOR YOUR TIME AND PATIENCE!

Space provided for overflow responses:

Space provided for overflow responses:

APPENDIX 10

SUMMARY OF PRINCIPAL FEATURES OF

RISK-BASED UTILITIES

MANAGEMENT STRATEGIES

Introduction

Construction and operation of a tramway is not without its risks. These might range from a road traffic accident involving a tram and another vehicle or a pedestrian, to a failure of the power supply which causes tram operations to cease while a repair is carried out. The probability of the risk materialising may be high or low, and the consequences can vary from multiple fatalities, through severe damage to trams, to minor inconvenience to passengers. The financial consequences may also cover a very wide range of losses.

Risks also attach to the design process, and good design will aim to eliminate or minimise many of the risks that might be encountered during both construction and operation of the tramway. As an example, the design might seek to separate the movement of trams from the movement of other road traffic to make collisions less likely. A cheaper alternative that might achieve a partial reduction in the probability of collisions, at least with pedestrians, might be the use of deterrent paving. Provision of redundancy in the power supply system might help to lessen the probability of power failures.

Whatever steps are taken to reduce the probability of some perceived risk happening, there will invariably be a cost associated with them. Regarded as a purely financial transaction, spending money on eliminating a risk, or reducing the probability of it materialising, will have as a corollary cost savings resulting from never, or less frequently, having to pay for its consequences. In financial terms the risk reduction measures should be taken if the benefit outweighs the cost. Frequently, however, the benefit to cost ratio will not be the main consideration.

During the design of a tramway it is essential to ascertain the locations of utilities' apparatus in the highway and establish its position in relation to the tramway infrastructure. The relationship will often determine whether the apparatus must be moved away from its current position ("diverted"), because for example it will be destroyed in the process of constructing the tramway. Other apparatus in the street may be some distance away from the tramway infrastructure and will clearly not need to be diverted. Between these two categories there will be items of apparatus that are not directly affected by construction but will be difficult or impossible to get to for repair or maintenance once the tramway has been constructed. These items of apparatus represent a risk to the tramway as, if they must be worked on in the future, the work will have an impact on the tramway which could result in trams having to stop running for an extended period, or worse, could require part of the tramway infrastructure to be demolished, and rebuilt after the work has been completed.

This Appendix considers the principles underlying the risk assessment associated with utilities' apparatus in relation to tramways.

Nature of risk

Firstly, it is as well to ask what kinds of risks are envisaged or anticipated. Who takes the risk and who pays if a risk, whether foreseen or unforeseen, materialises? Is what is looked for simply sound commonsense engineering, and not risk-assessment at all? Do we have enough information to carry out meaningful risk assessments, or must they of necessity always be empirically based?

All engineering design is based on an assessment of the risk inherent in the design process, but risk cannot sensibly be built into a philosophy of design without a secure knowledge and understanding of the probability of an event occurring. In the case of civil or structural engineering, an understanding of risk is used to ensure that the probability of failure of a structural element is acceptably small. The strength of the material used is thoroughly investigated and the range of strengths likely to be encountered is established. In the design of structural units using the material, a factor of safety is applied to take account of the possibility of use of substandard material. The factor of safety applied to concrete is greater than that applied to steel because the control exercised in the manufacture of steel, thereby ensuring that its strength is consistent from one batch to another, is generally greater than that applied to the manufacture of concrete. The forces to be applied to the units are also thoroughly assessed, and a factor of safety is applied to them, so that the total structure can almost be guaranteed never to fail. Nevertheless they occasionally do. A greater factor of safety built into the design means more material is used to counter the forces applied to it, so that the higher the factor of safety the smaller is the risk of failure of the structure, but the higher the cost of producing it.

Structures can fail in a variety of ways, some more catastrophic than others. If a block of flats, or a highway bridge, collapses there is likely to be a substantial loss of life. However, if an individual column bends more than it should for aesthetic reasons, or a concrete slab cracks so that the cracks are visible to the naked eye, witnesses to these events may be alarmed even though they have no significance where the strength of the overall structure is concerned. It is appropriate when designing these aspects of a structure to apply a lower safety factor. To apply the same standards as for critical aspects of the design will generally result in an over-designed, and therefore over expensive, structure.

The assessment of a business risk follows the same general principles, although the outcome will normally be less critical than the failure of a structure. When a choice has to be made between two or more actions (one of which may be to take no action), the standard process is to estimate the cost of taking the action, estimate the most likely benefit from taking the action, and estimate the probability that the benefit assumed will materialise in practice. The alternative actions can be compared as to their expected net benefit, and a logical choice of action can then follow.

These processes have in common the assessment of the consequences of a course of action using the probability of an outcome. In the case of a structural element, the probability of failure is reduced to the lowest degree possible, by understanding the materials to be used and the forces likely to be encountered, and applying safety factors so that the probability of exceeding the capacity of the materials to resist the forces applied is negligible. In the case of a business decision, the probability of an event occurring is used to choose the most beneficial course of action.

If risk assessment is to be seriously considered in relation to diversion and protection of apparatus, it will require the same standard of rigorous analysis of the issues, and above all, will need data on which the analysis can be based.

Types of risk associated with utilities' apparatus

What is the range of risks that needs to be considered in the context of diversion of utilities' apparatus? First and foremost is the safety of the people involved: the safety of utility company workers working on apparatus near the tracks, the safety of tramway employees and passengers, and the safety of other users of the highway. Next come the risks of overloading apparatus left beneath the tracks to the point of failure, of failure of apparatus causing damage to the tramway infrastructure, and of having to demolish part of the tramway infrastructure to get access to apparatus to repair, maintain or extend it. Finally there are the operational issues leading to the need to halt or slow tramway services, or for the utilities to have to maintain their apparatus outside tramway operational hours. It can be seen then, that the risks, as well as having implications for people's safety, will also have financial consequences for one or more parties.

Who bears the risk?

From the perspective of the tramway operators and promoters, this will depend on the form of procurement of the tramway, which will have an influence on the calculations. In some arrangements, the operator will have a direct interest in the continuity of operations, and will lose income or suffer a financial penalty when trams are not running. He may or may not have a say in what apparatus is diverted, and may in consequence attach a large risk premium to his tender for the operating franchise if he does not consider that a sufficient amount of apparatus has been diverted to guarantee continuity of operation. If on the other hand the operator and the constructor of the tramway are the same body, or are in some way linked, they may price for a greater scope of diversion works than would be envisaged by the promoter acting by himself. The operator will probably look for a different outcome from the financier of the construction (which may not be the promoter), who may have as his main aim the containment of capital costs. These conflicting interests need to be reconciled before serious consideration of risk can be undertaken and acted upon. In particular, promoters and operators need to establish their policy on interruption of service. If interruption is unacceptable, then the great majority of apparatus will need to be moved. In general, interruption of service is unlikely to be considered acceptable by the utility companies.

Utilities may require access to their apparatus to repair, maintain, renew or extend it. If a new development takes place alongside the tracks, new apparatus may need to be fed from the existing, which could be beneath or on the other side of the tracks.

By virtue of section 82 of the New Roads and Street Works Act 1991 (or section 141 in Scotland) utilities are required to pay compensation to a transport authority in the event that failure of their apparatus, or carrying out street works, interferes with the tramway. Promoters, if they wish to adopt a risk-based approach, must be prepared to consider foregoing their right to this compensation in exchange for a smaller capital expenditure, which must be balanced against a possible increase in revenue expenditure. It would be unreasonable of promoters to insist on the utilities giving up their current standards of access, then expecting to be able to penalise them when their apparatus fails, or they need access to maintain or extend their networks. At the same time, it would not be in the utility companies' interests to agree to such an arrangement. Such an agreement might not even be possible, bearing in mind that utilities have statutory and contractual obligations to provide services. It may only be

possible for them to meet these obligations if they have easy and continuous access to their apparatus.
It is clear that negotiating a satisfactory agreement between utilities on the one hand, and the promoters and operators of tramways on the other, will only be possible given a good deal of co-operation and like-mindedness.

The other group of people who need to be considered in any risk assessment is the travelling public, who will have come to rely on the tramway, and will consequently suffer at times when it is no longer available to them. The desire to ensure continuity of operation may outweigh considerations of savings in capital cost, and this appears to be the general position on the continent.

Considerations when assessing the risks

Given that risk-based strategies will, by their very nature, result in a reduction in the degree of accessibility to utilities' apparatus, it will be essential to take into account the importance of the apparatus. In the case of a large trunk main, there may be many thousands of people dependent on it for a supply of gas, water or electricity. They will expect that the service will be reinstated at the earliest possible opportunity. What are the worst consequences of failure? The consequences of a leak from a large gas pipe, particularly one operating at a high pressure should be evident when combined with the possibility of arcing being created between the overhead power supply and the tram pantograph. The failure of a water main may result in an erosion of the ground supporting the tramway and collapse of the track slab. Leakage of a sewer may have the same consequences over a longer timescale, particularly if the erosion of ground support eventually leads to failure of a water main.

Does the apparatus in question serve hospitals, old peoples' homes or emergency services for example, and could they manage without it for any length of time? Light, power and heating will be particularly necessary where people are ill and being operated on. Communications systems may be most important to the emergency services, which will not be able to operate effectively without them. The need for speed of repair of apparatus serving such sensitive operations will generally outweigh cost savings made by not diverting the apparatus to a position where access can be guaranteed.

For apparatus where the reduction in accessibility is less critical, and there is less importance attached to maintaining uninterruptible supplies, financial considerations may be allowed to dictate whether or not a diversion is carried out. It will be necessary to make an assessment of probability of failure of the particular type of apparatus under consideration. This will require the collection of statistics, which are not generally available. The statistics will in any case be skewed by introduction of the tramway. On the one hand, apparatus left beneath the tramway might be weakened by the construction process, and therefore made more likely to fail before the end of its normal design life. However, if it survives the construction period intact, the risk of it being damaged by street works carried out by other utilities will be greatly reduced. On the other hand, if it is damaged or fails for other reasons, the consequences of the damage may be masked until there is a critical build-up of, say, gas or water.

Towards a strategy

- The first, and most essential, step is for the promoter to decide from the outset on the policy that will be adopted in dealings with the utility companies and their apparatus. It must be remembered that the utilities have an equal say in the measures to be taken under section 84 (s.143 in Scotland). The choices are likely to be either to move all apparatus where the access to it will be prevented or restricted, so as to ensure that tram operations will never be affected by the need for access, or to seek to move as little apparatus as possible at the outset and accept the consequences by way of interruption to tram services as and when the utility companies require access. The halfway house philosophy would require all affected apparatus to be assessed to establish whether it would be cheaper to move it at the beginning of the project than to accept the costs associated with interruption of services because of the frequency with which it might need to be worked on, or vice versa. This is the true risk-based strategy, but requires a considerable database of information about failure rates of apparatus of all kinds.

  Whichever policy is adopted, it will be important to bear the purpose of the tramway in mind, which is to provide a reliable means of transport. It is becoming increasingly important to provide alternatives to the private car, and reliability of service is an essential factor in persuading people to change their preferred mode of transport. The evidence of the responses to the questionnaire directed to continental operators is that they consider it is more important to ensure integrity of services than to save money initially on diversions. This approach may however be influenced by the fact that the promoter of a tramway on the continent generally contributes a smaller percentage to diversion costs than UK promoters due to the difference in legislative backgrounds. Utilities on the continent generally do not have automatic rights to install apparatus in the highway, so have less protection for their apparatus.

  It is noticeable that there is an element of inconsistency in the responses to different questions contained in the UK promoters' questionnaire. Those that sought to apply risk assessment principles, presumably with the intention of minimising whole-life costs, nevertheless congratulated themselves on having chosen the correct scope of diversions because operations had not been halted. Clearly in a whole-life context, this could mean that the balance of diversions is wrong and too much apparatus has been moved.

- In seeking to compare the future costs associated with disruption to tram services with the initial capital cost of diversion, it will be necessary to take into account consequential losses over an extended period, as it is unlikely that patronage of the tramway will recover immediately to the levels existing before a lengthy period of closure.

- Issues of safety should weigh more heavily than purely financial consequences. There are potentially severe consequences for the tramway resulting from failure of piped services, due to explosion or collapse of infrastructure. It must be possible for utility companies' workers to work safely on apparatus, and this may require a temporary suspension of tramway

operations, particularly where large items of apparatus are involved. The police and local authority may choose to become involved with the process of repair where there is a clear danger to the public at large, for example from a gas leak, and this may result in the tramway operations being suspended while repair work is carried out. Such a closure may not necessarily be anticipated in any agreement reached between the operator and the utility company concerned.

- It might be possible to take steps reduce the risk involved with leaving apparatus close to the tramway while avoiding the need for diversions, and all such options should be considered as part of a risk-based strategy. Examples are:
    - Construction of side access manholes to provide access to sewers. If the original manhole is within the swept path of the tramway, a new manhole is constructed at an appropriate distance away, and a tunnel is driven to connect the new and old manholes. The original manhole can then be capped below the zone affected by the construction of the tramway.
    - A simpler solution may be possible if the slab sealing the manhole and supporting the entrance shaft can be rotated so that the shaft can be moved clear of the tramway without rebuilding the main structure.
    - Telecommunications cables are jointed at regular intervals. Many older copper cables, generally those belonging to BT, were laid deep enough to need to be jointed in manholes. The jointing of large copper cables is very labour-intensive and therefore expensive. Where it is a practicable proposition, it is likely to be cheaper to demolish the manhole and reconstruct it so that the access shaft is located clear of the tramway.
    - Gas and water mains may sometimes be over large for the flows that they carry due to a reduction over the years of the number of consumers (particularly in the case of gas). In these instances it may be possible to insert a slightly smaller plastic pipe inside the existing pipe, making it effectively maintenance-free. A related technique is pipe-bursting, where the existing pipe is shattered by drawing through an oversized mandrel. At the same time a new, normally plastic, pipe is drawn into the hole created.
    - The weak point in pipelines is generally at the joints, where the jointing material may eventually dry out and crack. It is sometimes possible to encapsulate the joints in resin, so that they effectively become leak, and therefore maintenance, free.
    - Consideration may be given to providing empty ducts beneath or alongside the tracks. Where apparatus crosses the tracks and might need to be augmented in the future, provision of additional empty ducts may reduce the amount of disturbance to the tramway while the work is being carried out. There may also be occasions where empty ducts laid parallel to the tracks could provide a future route for cables replacing other failed cables left initially beneath the tracks.

- If the promoter considers that it is in the best interests of the tramway to reduce the capital cost of construction, at the expense of a level of interference

with the operation, he must consider the consequences for the compensation provisions of section 82 of the New Roads and Street Works Act 1991. This will be best dealt with through an undertaking or agreement prior to the inquiry to consider an order under the Transport and Works Act 1992. By leaving apparatus beneath or close to the tracks, the promoter will have an expectation of gaining a financial benefit as a result of having carried out a statistical analysis of the benefits and costs of acting in this manner. The utility company will need to be persuaded to forego its rights to unrestricted access, and is likely to require as a quid pro quo to be relieved from the duty to compensate the tramway operators if the apparatus fails or access is needed to it for maintenance or repair. Clearly the apparatus should be in good condition to begin with, so that the probability of it failing during the lifetime of the tramway is minimised.

Two conclusions

1. Each tramway authority needs to establish their policy on diversion of apparatus, which considers what level of interruption of services is acceptable. This will need to take into account, as far as possible, the conflicting requirements of the promoter, the operator and the financier. The diversion policy adopted must be consistent with the manner of operation of the tramway.

2. Without the statistics that will allow a risk assessment to be made, it will not be possible to make informed decisions about which apparatus should be moved and which simply left in place.