Utility Diversions

Utilities are an integral part of the present city infrastructure and substantial numbers are likely to have to be diverted away from the route of the tram. In many cases service routes are long and may not follow the tram corridor. The cost of this work forms a substantial part of the overall cost of the project and these costs need to be mitigated wherever possible. The full extent of the diversionary work required will depend on the final route of the alignment and the exact position and depth of the services. Diversion works are likely however to be the cause of considerable disruption.

Earthworks

Earthworks activities will generally consist of existing excavated material being removed from site and suitable imported material being unloaded and compacted by vibrating rollers. There will consequently be a steady flow of lorries to and from the areas of construction during the course of the earthworks together with the attendant noise from the compaction process.

The condition of the existing highway sub-grade is unknown as is the strength of the sub-grade for the off carriageway sections of the alignment. These will need to be determined for detailed design purposes, as will the acceptability of excavated materials for reuse as engineering fill. It is only possible at this juncture therefore to provide estimates as to the extent of the earthworks activities required for the construction of the scheme.

At detailed design stage, excavated materials will also need to be tested for contamination as well as to establish engineering properties, and suitable sites will need to be identified for the disposal of material. Access to and egress from the areas of construction for lorries and plant will require careful consideration.

Generally, the sides of excavations will only require support where they extend significantly below the formation level for track construction (for example for the construction of drainage, ducts and overhead line equipment (OLE) support foundations). Where space is limited, however, and buildings and /or other structures may be affected, support measures for the general earthworks may be required. The degree of support required will depend on the depth of excavation, the nature of the ground, the proximity of adjacent structures and the nature of their foundations. It is likely that the foundations for the OLE supports will be auger bored wherever possible which will avoid any problems in this respect.

Provision of adequate drainage during the construction period will also need to be considered and appropriate measures taken if necessary.

Drainage and Ducting

Surface water draining from the tram tracks will be collected either via a series of purpose made drainage units or a series of drainage slots, both of which will connect into the existing drainage system via a system of gullies or a collector drain. New gullies and associated pipework will also be required where existing roads are realigned/ re-levelled or the tram alignment runs segregated off-street and drains independently of the adjacent highways.

The tram tracks incorporate extensive ducting beneath the base slab and this will be laid concurrently with the drainage. Connecting ducts/pipes across the tram tracks above the base slab will normally follow laying of the rails (see typical detail below).

Figure C.11: Slab Beneath Rails Lowered Locally to Enable the Installation of Ducts and Pipes

Track and OLE Foundation Construction

On- Street Track Construction

Over the majority of the proposed route, the alignment runs on-street and shares the carriageway with vehicular traffic. Construction of on-street tram track will follow completion of the service diversions, earthworks, drainage and ducting and, depending on the location, will be constructed either over their full width or, where space is limited, in two sections. Where possible the supports for the OLE will be attached to adjacent properties. Where this is not possible, the foundations for the OLE supports will also be constructed at this stage unless construction problems exist which prevent it, i.e. the proximity of buildings with unsuitable foundations.

For on-street sections of track, the general construction sequence is given below and is based on the Nottingham Express Transit (NET) Line 1 Contract:

- Sub-base material is laid and compacted prior to the positioning of the reinforcement mesh.

- Reinforcement mesh is placed and the concrete base slab cast to the underside of rail level. Reinforcement is laid in discreet bays to facilitate the stray current protection system.

- The rails are clipped to the base slab, set in position and welded together. The clips are required for fixing only and have no structural purpose. The rails are pre-coated with a polymeric insulating material that incorporates a layer of stone chippings on the running surface to improve skid resistance. Track drainage, ducting and stray current protection is completed following installation of the rails.

- A second layer of concrete is poured around the rails to a level that allows for road surfacing to be laid.

- Road surfacing is laid around the rails.

- New kerbs, parking bays and OLE base supports will be constructed following completion of the slab construction.

Off-Street Construction

The tram is located 'off-street' where it runs along the existing Railway embankment between Haymarket Station and Telford Road. On this section of the route "Grass Crete" or approved equivalent material will be used around the rails in order to avoid the use of ballast and to enable the track to blend in with the surroundings.

Ballast track for off-street construction will not be used to prevent the ballast material being used as missiles by vandals.

On structures it is likely that the track foundation will form part of the structure and the rails will be connected directly.

Construction of Junctions and Crossings

It is not envisaged that significant additional disruption will be caused by the construction of the tram alignment at minor junctions. It is likely that in the majority of cases construction can be achieved either by using conventional traffic management techniques or, in more difficult areas where space is limited, by the use of temporary road closures, provided acceptable alternative routes can be provided and accesses can be maintained.

Construction of the tram alignment at major junctions and road crossings, however, will be far more difficult. The use of conventional construction techniques is likely to produce significant congestion, and special construction methods may have to be adopted so that disruption can be minimised. For example, out of hours working and weekend closure/possession coupled with the use of prefabricated track elements may provide one solution. Before a construction method can be adopted, however, the impact on traffic flows will have to be assessed and compared for each alternative. All practical methods of construction for each of the major junctions will need to be considered, and congestion assessed both at the junction and within the wider highway network. Approval of the local authority will required for whichever construction method is adopted.

Conflicting road and tram movements will be controlled by signals at junctions and where tram alignments cross major carriageways. Existing traffic signals will need to be upgraded or new signals installed to accommodate the tram. Minor junctions and crossings will be priority controlled. It is anticipated that where traffic signal control is proposed at major junctions they will have to be linked to the existing Urban Traffic Control (UTC). Work may be required to the existing control system to accommodate the additional signal controlled junctions.

The period required to complete construction at a junction will depend on the junction size, type, complexity and the traffic flow(s) to be dealt with. Periods have been included in the construction programme(s) for each of the major junctions based on individual assessments in this respect.

Power Supply and Overhead Line Equipment (OLE) Installation

Power (750 volts dc) will be directed to the Light Rail Vehicles via a ducted supply and overhead line equipment (OLE). All practical measures will be incorporated within the track construction, power supply and return cable, to protect underground services from stray currents and to protect sensitive telecommunications signal cables from interference arising from the tramway power supply system. Construction would include suitable insulating and shielding materials in the track form design and/or stray current collection systems in the track-bed.

Installation of OLE will follow completion of the track construction in two stages:

1. Erection of the supports.

2. Suspension of the contact wire from the OLE supports and energisation.

The contact wire will be supported from poles or shared lighting/OLE columns situated along the outside edges, or centrally from poles positioned between the lines of tracks. Alternatively and where permissible, the contact wires will be suspended from building fixings particularly in the more built-up areas where space is limited. The supports for the overhead conductors will be poles at approximately 30 to 50m centres on straight track. The spacing of the supports will be determined by the design speed of the tram, tram curvature and the gradient of the track. Additional supports may be required at highway junctions and closer spacing will be required on bends.

The foundations required for the OLE support poles may coincide with services, especially where supports lie outside the tram tracks. Generally, support poles should be positioned so as to avoid services, but this may not be possible in some areas. Where this cannot be avoided, the services will have to be diverted. In extreme cases where space is limited, individual foundations may have to be designed so that the services remain unaffected.

Figure C.12: Typical Overhead Line Equipment (OLE) Wolverhampton Midland Metro

Measures will be necessary to deter the public from getting within touching distance of the overhead wires.

Although the supports for the contact wire can be erected during the construction of the track if necessary, this is not recommended because of the possibility of damage. Normally the support poles will be erected following completion of track/highway/accommodation works, but prior to the surface finishes to the footpaths. Similarly, the contact wire for each section should not be suspended in position until all civil construction activities have been completed on that section.

Stops

A total of 22 Stops are proposed for the proposed route. The majority of Stops are likely to be of similar design and construction, most probably of brick and concrete. Platform construction will begin following completion of the trackwork in each location, with final installation of platform infrastructure and equipment being carried out at the end of the Contract to avoid the risk of damage. It is anticipated that each stop will take between 2 and 3 months to construct depending on location and design. Stops requiring special access arrangements such as Haymarket Station will require a longer construction period and will be assessed individually.

Figure C.13: Typical Stop Wolverhampton Midland Metro

Testing and Commissioning

Before any vehicle can be entered into public revenue earning service, HM Safety Executive-Railway Inspectorate will require full testing, operator training and commissioning. A six-month period has been allowed in the programme for this to be carried out.

C.11.4 Construction Methodology and Programming

Construction Timetable and Key Dates

Current projections for the construction programme is three years (subject to optimism bias) The actual programme will be subject to the procurement methods used and completion to the target date of 2009.

Table C.8 Timetable for Construction

Event	Target Date
Parliamentary Submission	Christmas 2003
Parliamentary Inquiry	October 2004
Royal Ascent	To end 2005
Contract Award	2006
First Service	2009

Construction in Sections

In order to meet the target completion date of 2010, it will be necessary for the route to be constructed in a number of sections simultaneously. Having examined the route it is considered that it divides naturally into the following sections for construction purposes:

Table C.9 Construction Sections

Reference	Approximate Chainage (m)		Approximate Length (m)	Comments
	From	To		
Section 1	0	700	700	Haymarket Station. Viaduct and tie in with Haymarket Station Development.
Section 2	700	3000	2300	Section of off-street track running on existing railway embankment between Haymarket Station and Telford Road. Construction sequence and programming likely to be controlled by restricted access to embankment, restricted working space and structural works
Section 3	3000	6500	3500	Section of off-street (some on existing railway embankment) and street running track between Telford Road and Sea Wall. Not restricted by significant structural works and access problems.
Section 4	6500	8200	1700	Section of track affected by proposed structural works to the Sea Wall and within area of scientific interest.
Section 5	8200	11500	3300	Section of on-street and off-street tack between Sea Wall and World Heritage Site.
Section 6	11500	15600	4100	Section of on-street track within the World Heritage Site.

The direction of construction within each section will depend on a number of factors, including safety, environmental considerations, economics, access and practicality. The location of the construction compound sites along the route will have a major influence on the decisions made as to where construction will start and finish within each of the sections in this respect. At the present juncture the availability of areas of land for use as construction compound sites is still under consideration and no definite information is available.

Methods of Construction

The construction methods outlined above are based on the following assumptions:

1. Complete road closures for the main roads will only be sanctioned in the following circumstances:
    (a) For short periods only to facilitate the construction of track across junctions
    (b) Where a closure is planned as part of a proposed highway improvement.
    (c) In exceptional circumstances where there is no other practical alternative.

2. The methods of construction adopted for each section of the route should be designed to minimise congestion and disruption both to vehicular and pedestrian traffic and local residents.

3. Construction of the main works elements will not commence until Statutory Undertakers' plant has been diverted from the route of the alignment.

It should be borne in mind, however, that the Contractor appointed for the Scheme will bring his own knowledge and expertise to the construction of the works. As a consequence, the methods actually adopted for construction will not necessarily be the same as those described in the following paragraphs. In addition, details of the diversions required by the Statutory Undertakers are not available at this juncture. For the purposes of this Report therefore it has been necessary to assume that all Statutory Undertakers' diversions will be completed prior to the start of the main construction programme. It is likely however bearing in mind the current programme, that some if not most of the diversion works will have to be carried out in conjunction with the main works.

Rates of Construction

The rates achievable for construction of the works within each of the Work Sections described above will depend on the following factors:

1. Availability of plant, labour and materials as already discussed above.
2. Restrictions on access and space available for construction.
3. Restrictions on working times.

On sections such as those within Work Sections 3 and 5 where access is not a major problem and the restrictions on working times are not likeley to be prohibitive, the rate of construction will depend primarily on the availability of resources. On other Work Sections such as 1, 2, 4 and 6 restrictions an access and working space, phasing of structural works, environmental factors and limitations on working times will be factors in determining the speed with which the works can be constructed.

To achieve optimum rates of progress on construction of the track, the Concessionaire will need to open as many areas for construction as the constraints and resources allow. If constraints are placed on the number of areas that can be opened for construction at any one time by the promoter or other bodies, then progress will be affected.

Experience gained on NET Line 1 in Nottingham showed that a planned rate of construction of 3.23m/day on a typical 110m section of single on-street within the city centre could reduce to 1.4m/day because of difficulties with the need to maintain access, space for construction, dealing with uncharted services, procurement of materials and availability of resources. Based on NET Line 1 the rates of construction that are likely to be achieved for track construction at any location is likely to vary as follows:

1. Single on-street track – 1.4m/day to 3.23m/day

2. Double on-street track – 1.1m/day to 1.7m/day

Overall on Net Line 1 approximately 4.2km of double on-street track was completed in a planned construction period of 14 months. It should be noted however that:

1. Services diversions were carried out by the promoter in advance.

2. Resources had to be increased to achieve the programme because of delays that occurred.

3. There was little restriction on the Concessionaire/Contractor as to how many sections of track could be opened up for construction at any one time.

4. Temporary semi-welded steel track had to be provided on bends and turnouts in order to begin the testing and commissioning phase in accordance with the programme, because of difficulty in procuring the special cast sections required to comply with the specification. These temporary sections of track were replaced as the final track sections became available.

C.11.5 Construction Compounds and Work Sites

Principal Site Compounds and Facilities

Site compounds of varying capacities will be required for the construction of each section of the route. Prior to the start of construction the Concessionaire/Contractor will, subject to local authority planning approval, need to enter into agreements for land and/or facilities to be used for principal site compounds. Ideally these compounds should be positioned for easy access to the main areas of work and to minimise the number of traffic movements for delivery of goods and materials, but this will depend on availability.

Bearing in mind the extent of the works to be carried out, the following principal site facilities/ compounds will be required:

1. The Concessionaire will require administrative offices for his team and supervisory staff. These could possibly be located centrally in office buildings.
2. A number of principal construction compounds will be required to accommodate workshops, batching facilities and for the storage of the larger items of plant and materials.
3. Further compounds adjacent to the areas of work and the sites of the major structures will be required, to facilitate access, economic use of resources and storage of materials.
4. Appropriate facilities for staff and visitor car parking will be required.

Opportunities for Principal Site Compounds.

Discussions with the City Authorities on the use of appropriate facilities and general open spaces as principal site compounds will need to be instigated. Those suitable areas of land currently available should be identified and scheduled and the schedule updated as further information is received. It should be noted however that the availability of suitable sites will almost certainly change as the scheme progresses and it will almost certainly be necessary for the Concessionaire/Contractor to locate other suitable sites.

Depot Site

The Depot Site is normally used as a principal site compound on schemes of this nature. The use of the Depot Site for this purpose depends on its position relative to the route, the overall area of land available, the size and layout of the proposed Depot facilities and the programme for construction of the Depot infrastructure. On the Edinburgh Tram Line One scheme the proposed Depot Site is ideally placed but the area of land available for use as a site compound may be an issue especially with regard to the programming if the works.

In addition, a concrete batching plant presently occupies part of the proposed Depot Site. Maintaining this facility in place for as long as possible to facilitate the construction of concrete track and structural works along the route may be advantageous or even necessary depending on the alternatives available.

Work Sites

The nature of the excavation and track laying works will be on a linear progression basis subject to service diversions and access arrangements. In normal circumstances on a scheme of this size, local site compounds would be established to aid communication and provide messing facilities and secure storage areas for plant and materials. The nature of a city-wide site, however, is that there is unlikely to be any spare land available in some areas, especially within the city centre core itself. In these circumstances, work sites will consequently have to be located within the areas where work is being carried out, and will have to be adapted on a continuous basis to suit the progress of the works. Local site offices, mess huts etc are likely to have to be provided at the Concessionaire/Contractors principle compounds in these areas since there is unlikely to be sufficient space available within the street.

Access to Work Sites and Site Compounds

The Concessionaire/Contractor will have to agree pre-defined routes, which can be used by construction traffic between the site compounds and the work sites, together with routes to be used by construction traffic accessing the work areas directly from outside the City. It may also be necessary to limit the times during the day when these routes can be used.

Similarly, access to the site compounds and offices is also likely be subject to control by the Highway Authority. This subject will be discussed more fully once the locations of the site compounds and offices have been determined.

Appendix D: List of Consultees

Full Name	Address/ Job Title	Organisation	Stakeholder Category
Mr John Anderson and Ms Tricia Alderson		Edinburgh Lothians Badger Group	Environmental
Mr John Gannon Ms Janet Brown		CEC Environmental Health Officer	Environmental
Mr Guy Winter Ms Fiona Leslie		Scottish Executive Development Department	Environmental
Dr Stuart Smith		Local Bat and Otter Conservation Groups	Environmental
	SPOKES	SPOKES Cyclist Organisation	Environmental
Mrs C M Sibbald		New Town Conservation Committee	Environmental
		Forth Estuary Forum	Environmental
Mr Kevin Dunion		Friends of the Earth Scotland	Environmental
Mr Bob Saville		Lothian Wildlife Information Centre	Environmental
Dr W Duncan		Royal Society of Edinburgh	Environmental
		RSPB Scotland	Environmental
Mr John Gerrard		Scottish Civic Trust	Environmental
Mr Bruce Logan		Scottish Rights of Way and Access Society	Environmental
Mr Alan Anderson		Scottish Wildlife Trust	Environmental
Mr Tony Grant	Sustrans	Sustrans	Environmental
Mr Phillip Riddle	Visit Scotland	Visit Scotland	Environmental
Mrs Lilianne Lauder	The City of Edinburgh Council	CEC - Environmental Departments	Environmental
Ian Gibson		Green Party	Environment
Mr Peter Hawkins		Cyclists Touring Club Scotland (CTC Scotland)	Environmental
Ms Carolyn Clark, Mr Lachlan Lamont	Scottish Natural Heritage	Scottish Natural Heritage	Environmental, Heritage
Mr Charles Prosser		Royal Fine Art Commission for Scotland (RFACS)	Environmental, Heritage
Mr James Simpson		Edinburgh Architectural Association	Environmental, Heritage
Dr Sean O'Reilly		Architectural Heritage Society of Scotland	Environmental, Heritage
Mr Martin Hulse		Cockburn Association	Environmental, Heritage
Mr John Mayhew		National Trust for Scotland	Environmental, Heritage
MR G A Cook	HSE Hazardous Installations Directorate	Health and Safety Executive	Environmental, Statutory
Mr Alan Church	Scottish Environmental Protection Agency	Scottish Environmental Protection Agency (SEPA)	Environmental, Statutory
Mr Guy Winter	Scottish Executive Environmental Group	Scottish Ministers	Environmental, Statutory
Mr Gordon Laing		Scottish Water	Environmental,

Full Name	Address/ Job Title	Organisation	Stakeholder Category
			statutory
Mr Graham Reed	Longmore House	Historic Scotland	Environmental, Statutory
Mr Alan Couper		Waterfront Edinburgh	Environmental, Business
Mr Terry Smith		Forth Ports	Environmental, Business
Mrs Lisa Hannon	Scottish Enterprise	Scottish Enterprise Edinburgh and Lothian	Environmental, Business
		Princes St / George St Association	Environmental, Business
Mr Peter Stilwell		Edinburgh Chamber of Commerce and Enterprise	Environmental, Business
Mr Paul Dorby Mr Amaroop Utam		Second Site	Environmental, Business
John Lawson		City Archaeologist	Heritage
Mr John Mengham		Edinburgh World Heritage Trust	Heritage
Aileen Grant		CEC Planning	Statutory
Mr John Browne	Scottish Executive Development Dept	Planning	Statutory
Mr Ian Mathie Ms Aileen Grant		CEC Traffic Interface Group	Statutory, Council Transport
Mr Colm Smyth		CEC Traffic Signals Team	Statutory, Council Transport
Mr David Thornton		HMRI Railway Inspectorate	Statutory
Mr David Finnie		BT	Public Utility
Mr Frank McGrath		Cable & Wireless	Public Utility
Mr Ken Sharp		ScottishPower	Public Utility
Mr Gordon Laing		Scottish Water	Public Utility
Mr John Millan		Thus	Public Utility
Mr Robert Brown		Transco	Public Utility
Mr Denys Arnold		Telewest	Public Utility
Mr Geoff Cook		Network Rail	Transport
Mr Bill Campbell	Operations Director	Lothian Buses	Transport
Mr Alistair Gunn		Light Rail Scotland (Member of LRTA)	Transport
	Bus Operator	Burnos	Transport
Ms G Campbell	Administrator	Comcab Edinburgh. Taxi Operators	Transport, Business
Mr William Smith	Chairman	City Cabs (Edinburgh) Ltd	Transport
	Bus Operator	First Group	Transport
Mr Bob Armstrong	Director	Freight Transport Association	Transport
Mr Phil Flanders	Regional Director	Road Haulage Association	Transport
Mr David West		SRA	Transport
		Scotrail	Transport
Mr Gerry Egan		Ambulance Service	Emergency

Full Name	Address/ Job Title	Organisation	Stakeholder Category
			Service
Mr Steven Hawkins		Lothian & Borders Fire Service	Emergency Service
Mr To Cook Mr Murray Dykes		Lothian & Borders Police	Emergency Service
		ITI Technical advisors coordination meeting	Business
		3rd Party Meeting – Business & Tourism	Business
		Haymarket Pub	Business
Mr Graham Russell	BAE Systems	BAE	Business
Mr Steven Thomson	Premises Manager	State Street	Business
Mrs D Kinloch Anderson	Kinloch Anderson Manufacturers	Kinloch Anderson	Business
Bill Furness	Chief Executive	Edinburgh Chamber of Commerce	Business
Bob Downie	President	Leith Chamber of Commerce	Business
		Federation of Small Business	Business
		Scottish Enterprise (National – SEN)	Business
		Scottish Enterprise Edinburgh & Lothian (SEEL)	Business
		Scottish Homes	Business
		Telford College	Business
		United Wire	Business
		3rd Party Meeting – Disability	Disability, Transport
Ms Valerie Robertson	Princes House	Disability Scotland	Disability
		Royal National Institute for the Blind	Disability
		Royal Institute for the Deaf	Disability
Cllr Allan Jackson	Council Offices	Council	Council
Cllr Steve Cardownie	Council Offices	Council	Council
		Local Council Meeting – West End	Council
		Local Council Meeting - Trinity	Council
Cllr Allan Jackson	Council Offices	Council	Council
Cllr Wm Fitzpatrick		Council	Council
Cllr Lesley Hinds		Council	Council
Cllr Iain Whyte	Council Offices	Council	Council
Cllr Wardlaw		Council	Council
Cllr Steve Cardownie		Council	Council
Cllr James Gilchrist		Council	Council
Cllr Tom Ponton		Council	Council
Cllr D Guest		Council	Council
Cllr Trevor Davies		Council	Council
Cllr Dougie Kerr		Council	Council
Cllr Rob Munn		Council	Council
Cllr Philip Attridge		Council	Council

Full Name	Address/ Job Title	Organisation	Stakeholder Category
Cllr Kingsley Thomas		Council	Council
Cllr Sheila Kennedy		Council	Council
Cllr Bill Cunningham		Council	Council
		Planning Topic Group Meeting	Council
		CEC – City Development	Council
		3rd Party Meeting – Community Councils	Community, Council
		Drylaw/Telford	Community, Council
		Gorgie/Dalry	Community, Council
		Leith Bonnington	Community, Council
		Leith/Harbour	Community, Council
		Leith/Links	Community, Council
		Lorne	Community, Council
		Murrayfield	Community, Council
		New Town/Broughton & Pilrig	Community, Council
		Newhaven	Community, Council
		Pilton Partnership and NEAR	Community, Council
		Trinity	Community, Council
		West End	Community, Council
		Formal Frontagers (collaborator)	Community
Cllr Elizabeth Maginnis	Council Offices	Trinity Public Meeting	Community
		Craigleith Public Meeting	Community
		MSP's Reception	Community
Michael Clarke		Public Consultation, Trinity	Community
		Public Meeting	Community
Cllr Elizabeth Maginnis		Council	Community
Alan Penman	Project Manager	Western General Lothian University Hospitals NHS Trust	Hospital/ Business
Mr Gavin Murray	Project Manager	Faber Maunsell – Line Two	Technical

Appendix E: Public Utilities

E.1 Introduction

As with most street running tram systems, an issue during development is the accommodation of Public Utility (PU) apparatus located along the proposed route. It is necessary therefore, to make provision to provide public utility companies with access to maintain their apparatus without affecting the safe operation of the tram. Most frequently this involves the diversion or rationalisation of the utility from the swept path of the proposed tram. The swept path is defined as the physical area of ground that is delineated by the extremities of the moving tram vehicle. In addition offsets from the swept path may be defined to allow for adjacent excavations to be opened up safely. This wider area is defined as the exclusion zone.

The diversionary works strategy developed for the Edinburgh Tram Line One project is to undertake the minimum of diversions whilst allowing for Utilities to access and maintain their plant and apparatus without interruption of the operational services, as far as reasonably practicable.

A PU Workshop was held on the 26th February 2003, with representatives from Mott MacDonald, Babtie, Transport Initiatives Edinburgh (TIE) and the utility companies which have apparatus present along the proposed route. Representatives from BT, Cable and Wireless, Scottish Power, Scottish Water, Thus, Transco and City of Edinburgh Council attended the workshop. Telewest chose not to attend the Workshop.

The utility companies were issued with a set of composite apparatus plans on 27th March 2003. Cost and programme information was then formally requested from the utility companies detailing their proposals along the route to accommodate the tram. A summary of their responses is detailed in section 3.

Costs were provided by the utility companies on the basis that all plant within the defined apparatus 'exclusion zone' would be diverted where possible. For underground plant and apparatus the exclusion zone is defined as 450mm outside of the swept path to a depth of 1200mm below existing ground level. Underground services crossing the alignment transversely will need to be lowered to 1200mm, although transverse services already installed at a depth between 1000-1200mm will be considered on a case-by-case basis.

E.2 Composite Utility Plans

The PU companies (including CEC) were provided with a 48 drawing set of composite utility plans showing a swept path alignment prepared from Mott MacDonald's Technical Development plans issue P1. The alignment upon which the diversionary cost estimates have been prepared is therefore different in certain areas to the current 'Design Freeze' alignment shown on Mott MacDonald Drawings 203011/EDIN/0501 to 0555 inclusive. After review, in the case of certain specific utility companies, the 'Design Freeze' alignment could add significantly to the diversionary works required. Further details are included in the section dealing with each specific utility below.

It is important to note that the diversionary cost estimates prepared by the PU companies do not take account of any potential diversions required for the siting of tram stops along the tram route.

E.3 Public Utility Companies

BT provided a diversionary cost estimate of £6,285,523 (Exc. VAT). However, no information regarding the breakdown of individual diversions or major items of apparatus was provided. BT also declined to provide any information on lead in times.

Following review of the BT apparatus location plans, no items of BT plant which would pose significant diversionary works issues were identified along the route of the tram line.

E.3.1 Cable & Wireless

The diversionary works cost estimate prepared by Cable and Wireless totalled £592,800 (exc. VAT). No significant diversionary works issues were identified along the route of the tram. Cable and Wireless provided a full breakdown of costs along with plans detailing the diversionary works to be undertaken.

The majority of the proposed Cable and Wireless diversionary works occurs on two sections of the route, namely the section of the route between Haymarket Terrace and Lothian Road, and the section around the St Andrews Square loop to Picardy Place. Cable and Wireless estimate that approximately 6 to 9 months lead in time is required for the diversionary works identified.

As the Cable and Wireless network serves only selected users along the route there is greater scope for diverting Cable and Wireless apparatus on to alternative roads, when compared to relocating utilities which have a much greater frequency of service connections such as water, gas and electricity.

E.3.2 Scottish Power

ScottishPower provided a diversionary costs estimate of £2,937,272 (exc. VAT). In the case of ScottishPower, the change in alignment to the current 'design freeze' alignment has significant impact on the cost of ScottishPower diversionary works. The design freeze alignment shows the tram route requiring the demolition of the Ocean Drive Primary Substation. A cost estimate for the demolition and relocation of the substation was obtained from ScottishPower, and it is anticipated that the relocation would add approximately £1.5m to the diversionary works cost estimate. Adding this to the initial diversionary works cost estimate increases the total cost estimate to £4,437,277 (exc. VAT).

Of the initial diversions identified by ScottishPower, the diversion of 2 x 275 kV transmission cables on Leith Walk (cables run from the junction with Arthur Street to the junction with Dalmeny Street) account for just over £1.6m of the diversionary cost estimate. These are substantial items of plant and lead in times of around 18 months would be expected for any construction works to be carried out. Excavations for joints in transmission cables may require to be 2 to 3 metres wide and 6 to 8 metres long. It is likely that there would be a significant impact on traffic at this site during the period of the diversionary works being undertaken.

In total, 63 diversionary works schemes were identified by ScottishPower. Of these two schemes were estimated at costing over £100,000. These are the diversion of two 275kV Transmission Cables on Leith Walk and a £195,000 diversion of cables in the St Andrews Square area. Of the remaining schemes, 5 were estimated at costing between £50,000 and £100,000, and the remainder were estimated at costing less than £50,000.

E.3.3 Scottish Water

Scottish Water provided a detailed diversionary cost estimate for the project. Information on the diameter and depth of apparatus was verified using Scottish Water's GIS system. The diameter and depth information was also obtained from the GIS system and was augmented by reference to ongoing manhole and sewer surveys where applicable.

Scottish Water identified 248 diversionary schemes from the 48 combined public utility apparatus drawings issued to them. It is likely that the total number of Scottish Water affected assets is less than 248 due to the fact that assets can span several sheets. This will not however, affect the total cost estimate, as the estimated cost for each diversion has been calculated by the length of diversion required on each sheet.

Scottish Water have included protection works for their apparatus at several of the over and underbridges on the disused Roseburn Railway Solum section of the route. Unless there are major bridge works occurring at these sites it is unlikely that any utility diversion work will be required. However, this cannot be confirmed until proposed works (if any) for each bridge has been finalised. Removing these costs from Scottish Water's diversionary works cost estimate would result in a reduction of diversionary works cost of approximately £100,000.

Scottish Water identified each scheme using a 'work' label to identify the activity that would be required for the asset, namely: 'Divert', 'Protect', and 'Do Nothing'. Schemes given a work label of 'Do Nothing' are thought to be non-essential at this stage but may require to be included in the project at a later date. The total diversionary cost estimate prepared by Scottish Water is £11,864,840 (Exc. VAT). A breakdown of costs is identified in Table E.1.

Table E.1 Scottish Water PU Costs

Work Items	No. of Schemes	Total Length	Total Cost
Water main protection	90	783	£406,740
Water main diversion	49	6,578	£4,151,450
Sewer protection	12	95	£68,850
Sewer diversion	27	3,597	£6,028,750
'Non-essential' Water main protection	0	0	£0
'Non-essential' Water main diversion	0	0	£0
'Non-essential' Sewer protection	70	779	£1,209,050
'Non-essential' Sewer diversion	0	0	£0
Total	**248**	**11,832**	**£11,864,840**

Of the 248 schemes identified by Scottish Water, 3 were identified as costing more than £0.5m. The 3 largest schemes are:

- The diversion of a 1600 x 990 mm combined sewer on West Maitland Street;
- The diversion of a 1300 x 680 mm combined sewer on Constitution Street; and
- The diversion of a 1250 mm diameter combined sewer on McKelvie Parade.

The Scottish Water report also included approximate timescales for carrying out the diversion works. The three largest schemes identified above are all estimated to require 5-6 weeks construction duration each.

It is the impact of the tram on Scottish Water's sewerage system which poses the greatest challenge for diversionary works. The sewerage system is gravity fed and therefore options for diversion are more limited. It is expected that priority may have to be given to sewerage apparatus when allocating space alongside the tram line for relocated utility apparatus, in order to avoid costly and lengthy diversions.

E.3.4 Telewest

Telewest did not provide a diversionary cost estimate for the project. As the vast majority of Telewest plant is located within the footways in central Edinburgh, as opposed to within the carriageways, it is not thought that a large quantity of diversionary works would be required. It is considered that a reasonable diversionary works cost estimate for Telewest plant would be comparable to that prepared by Thus and would be in the order of £500,000 for the complete route.

E.3.5 Thus

Thus provided a detailed diversionary works cost estimate of £425,000. This figure contained a provisional amount of £60,000 for proposed ducting to allow future expansion of their network. The change in alignment from the original swept path plan issued to the PU companies, to the current 'design freeze' plan means that an additional thus duct will require to be diverted in the Haymarket Yards area. However, the 'design freeze alignment requires one less Thus duct diversion on Haymarket Terrace, so any potential increase in cost is likely to be a zero balance. Thus did not provide any information on lead times for construction work.

As the Thus network serves only selected users along the route there is greater scope for diverting Thus apparatus on to alternative roads, when compared to relocating utilities which have a much greater frequency of service connections such as water, gas and electricity.

E.3.6 Transco

Transco provided a diversionary works cost estimate of £1,900,000 (exc. VAT). However, it is noted that the estimate prepared by Transco does not include costings for individual service connections which may have to be renewed when uncovered. Transco's DRS system does not record these connections, hence figures on the possible numbers of properties involved are unclear. Each individual service costs £400 to renew. The renewal of a connection to a 12 flat tenement block could therefore cost in the region of £5,000. Given that a significant proportion of the tram route runs through areas of tenement housing, it is considered likely that the cost for diversionary works on Transco apparatus could increase significantly once the extent of service connections is uncovered at the construction stage.

Transco's cost estimates are based on a suitable location being available for the replacement gas main. Should this not be the case in certain areas of the route, due to congestion, lengthier and more costly diversions will have to be carried out.

Transco highlighted a 48" diameter Steel Medium Pressure Mains which will require to be diverted as part of the tram works. This diversion is considered not to be part of standard diversion works which contractors would undertake and would have to be covered by a separate contract. Transco's estimate for the diversionary cost of such a main is approximately £120,000. The estimated lead in time for the

moving of such a main would be approximately 6 months from planning to the commencement of work on site.

It is also noted that Transco are undertaking a mains replacement programme in Edinburgh over the coming years. This may mean that some of the mains earmarked for diversion are removed from the swept path reducing the need for diversionary works, but conversely it could mean that new mains are laid within the swept path adding further to diversionary costs. It is therefore important that communication is maintained with Transco to avoid any future conflict in this regard. Whilst Transco are fully aware of the current tram proposals, they are not required by statute to take full cognisance of the proposals until the tram proposals become a committed scheme.

Transco declined to provide lead in times for the proposed works.

E.3.7 Programme

Based on other schemes current at this time it is estimated that three months are programmed for the preparation of C3 diversionary cost estimates and a further 6 to 8 months are scheduled into the project programme for the preparation of the detailed C4 estimates, in accordance with the New Roads and Street Works Act, 1991. These are likely to be minimum durations.

Diversionary works could be undertaken as an advanced works package or alternatively programmed to be undertaken in parallel with the tram track construction period. The latter approach is perhaps the most flexible as this would result in a phased approach to the diversionary works to match the laying of different sections of track. It would also have the advantage of disrupting traffic flows only once during the tram construction period, as opposed to disrupting traffic for the period of advanced works and then again for the construction period. Also items of plant which have longer lead times can be incorporated into the project programme early, reducing the overall project duration.

E.4 Summary

Table E.2 gives a summary of the diversionary works cost estimates by utility company. Costs associated with the diversion of City of Edinburgh Council lighting and communication cables are excluded. A separate allowance for these works has been made by the cost consultant in preparing the overall project costs. Costs are shown excluding VAT and excluding any potential discount.

Under the New Roads and Street Works Act 1991 a discount (contribution from a relevant utility company) is available to the transport authority on the cost of the diversionary works. The extent of the available discount and how this is to be managed should be agreed during subsequent stages of project development. Current indications are that an 82% / 18% cost sharing arrangement would apply to this project, although legal confirmation of this should be sought.

Transco's costs have been increased to reflect the service connections which will be required in some form. At this stage the number of service connections can only be estimated, but a reasonable number should clearly be allowed for. Based upon on the swept path alignment of drawings 201011/EDIN/PU/0601 – 0648, an allowance has been made for service connections to approximately 70 properties. £30,000 has therefore been added to Transco's diversionary works cost estimate to account for this

Mott MacDonald

Table E.2 Summary of PU Costs

Utility Company	Diversionary works cost estimate (Exc. VAT)
Scottish Water	£11,864,840
British Telecom	£6,285,523
Scottish Power[66]	£4,437,272
Transco	£1,930,000
Cable and Wireless	£592,800
Telewest[67]	£500,000
Thus	£425,800
TOTAL	£26,036,235

The diversionary costs for Scottish Water account for approximately 50% of the overall budget. This is not unexpected, as Scottish Water have a much greater volume of apparatus within the tram's swept path in comparison with the other utilities.

Figure E.1 (overleaf) gives a breakdown of relative diversionary works cost by drawing number. This drawing has been prepared to show the anticipated spread of diversionary works along the tram route on a relative cost basis, based on the cost breakdowns provided by the utility companies. Where the cost estimate was not provided on an individual drawing sheet basis a simple pro-rata calculation was made to simply spread the cost across the affected areas.

The sections of the route from Haymarket to the west end of Princess Street and the area from the St Andrews Square up to the north end of Constitution Street appear to be the most costly sections of the route in terms of utility diversionary works.

[66] Estimate includes £1.5M for the relocation of Ocean Drive Primary Substation.

[67] The Diversionary works cost shown for Telewest is an estimate only.

Figure E.1 Relative Cost Indication of Diversionary Works