A number of habitats are found along the proposed route including extensive areas of low value amenity and improved grassland, tall ruderal, introduced shrub, arable land and field boundaries have been identified along the tram route. Habitats of note include:

- Woodland – Various classifications of woodland have been identified along the tram route. These include broadleaf woodland of plantation origin, mixed woodland of plantation origin along with scattered and dense scrub. No Ancient Woodland or long established woodland of plantation origin has been identified along or immediately adjacent to the tram route.
- Watercourses – Two main watercourses are present along the route of the tram. These being the Gogar Burn and the Water of Leith. The Gogar Burn has been modified and extensively culverted with little of the semi natural alignment left. Both areas are regarded as being important wildlife corridors.

When assessed in isolation many of the habitats along and adjacent to the proposed tram route are of low ecological value. However, when assessed along the length of the route the value of many habitats increases due to linear linkages and the ecological continuum of habitats. This occurs adjacent to the existing main Edinburgh/Glasgow railway line. Where this occurs the value of the habitat increases to medium.

8.2.7.3 Summary of Impacts and Mitigation Measures

Worksheet B2 in Appendix C provides a summary of the results of the assessment.

Disturbance, killing and injury are the greatest potential impacts to wildlife along the Edinburgh Tram Line Two corridor. These may occur through clearance of vegetation, demolition and the use of plant, destruction of foraging and or sheltering habitat, trapping and/or poisoning of animals by materials left on site and disturbance and disruption to successful breeding. The predicted impacts are summarised below:

Table 8.5. Impacts on Biodiversity

Impacts on Designated Sites		
The disused railway UWS	Loss of habitat	Minor negative impact
Water of Leith UWS	Disturbance	Minor negative impact
Gogar Burn SINC	Break in integrity and habitat loss	Minor negative impact
Entire route	Loss of habitat along various sections of the route. Ranging from loss of amenity grassland and isolated low value introduced shrub to loss of broadleaf plantation woodland	Range from Neutral to Moderate impact
The disused railway line (Roseburn)	Loss of habitat of low value	Minor negative impact
Main Edinburgh /Glasgow Railway line Roseburn to Bankhead drive)	Loss of habitat adjacent to Baird Drive	Minor/Moderate negative impact
Gogar Burn	Disturbance and temporary loss of vegetation	Minor negative impact
Water of Leith	Disturbance and very limited temporary loss of vegetation	Minor negative impact
Badgers	Disturbance during construction and operation	Moderate to Major negative impact
Otters	Disturbance during construction.	Minor negative impact
Bats	Disturbance, loss of foraging areas during construction.	Minor negative impact

The contractor would be required to work under a strict code of practice. This would incorporate wildlife and habitat protection best practice including: requirements to erect hoardings to restrict the working area, standards of dust control to protect adjacent habitats, and suitable precautions to prevent entry of pollutants into any bodies of water. Protected species surveys would also be required prior to work commencing.

Replacement planting along the route corridor would be undertaken within the LODs. While detailed proposals would be worked up prior to construction of the Edinburgh Tram Line Two, the ES includes plans of indicative mitigation proposals. These plans identify areas along the route of the tram where replacement planting would take place. Replacement planting would include woodland, scrub, amenity planting and areas for habitat creation. The replacement planting proposals have been prepared in tandem with the landscape mitigation strategy. The strategy aims to ensure that ecological impacts are minimised and opportunities are identified to provide ecological benefits. With respect to protected specifies, such as badgers, discussions have been held with Scottish Natural Heritage (SNH) to identify appropriate measures to protect these animals.

8.2.8. Landscape

8.2.8.1 Approach

In accordance with good practice and the requirements of STAG the assessment of landscape effects has been undertaken following the Design Manual for Roads and Bridges Volume 11 Section 11.3.5 with reference to the following documents:

- Landscape & Visual Assessment Supplementary Guidance (LVASG)(Scottish Executive; 2002);
- Guidelines for Landscape and Visual Impact Assessment (GLVIA)(Institute of Environmental Management and Assessment: IEMA; 2002);
- Cost Effective Landscapes: Learning from Nature (CEL:LfN) (The Scottish Office; 1998);
- Planning Advice Note (PAN) 58; Environmental Impact Assessment (Scottish Executive 1999); and
- The Lothians Landscape Character Assessment dated 1998 (Scottish Natural Heritage Review Number 91.

Detailed landscape assessment methods are set out in Chapter 8 of the ES. The approach involved a review of published documentation (including development plans, current and historical Ordnance Survey mapping, aerial photographs and data on conservation interests within the area) combined with site surveys in order to describe and evaluate the existing components, character and quality of the landscape of the study area. All relevant designated sites were included within the assessment.

The study area was broken down into a series of distinct landscape character areas and the effects on each area assessed. In order to assess the significance of impacts, the sensitivity of the landscapes to change and the likely magnitude of change have been considered. Impacts of moderate and above have been considered significant, as this is the level at which the changes to the landscape would be clearly perceived. The assessment year has been taken as year 15 after scheme completion.

The assessment has been based on an exemplar engineering design which for the purposes of this assessment, forms the basis upon which both the assessment and the indicative landscape mitigation is founded. Further details with regard to the assumptions which have been made during the landscape assessment process about the various scheme components are set out in Chapter 8 of the ES.

8.2.8.2 Key Features

Edinburgh Tram Line Two runs through very diverse landscape character types from St Andrew Square in the heart of the New Town, along Princes Street and the West End to Haymarket on the edge of the New Town and the World Heritage Site, out past Murrayfield and through mixed residential, industrial and recreational landscapes to peripheral commercial and retail developments along the western built edge of Edinburgh bounded by the City Bypass to more urban fringe greenbelt landscapes typified by rolling arable farmland and traditional estate planting.

Central Edinburgh contains one of the largest areas of Georgian architecture in Europe and almost the entire city centre has been designated as a World Heritage Site due to its unique architectural heritage and distinctive townscape. Conservation areas cover about one third of the city.

Between Roseburn and Newbridge there are no landscape designations within the immediate tram corridor, although the section of route from Gogar roundabout to the Airport would run to the north of an Area of Great Landscape Value (AGLV) at Gogar. There is a Designed Landscape (Millburn Tower) to the south west of the corridor route and a designed landscape (Newliston House) to the north of Newbridge terminus, both of which would be entirely unaffected by the tram proposals as there would be little intervisibility between the landscapes and the proposed tram route. The section of tram corridor from Gogar roundabout to the east of Newbridge falls within Green Belt designated land of which the local landscape character, under local plan policy is to be protected, maintained and enhanced. The tram corridor would also run adjacent to various areas of open space identified and protected under local plan policy.

Areas of particular sensitivity include the New Town landscapes, of St Andrew Square, Princes Street and Shandwick Place, localised residential areas and urban green space and the more open, rural landscape structure associated with Greenbelt areas west of Gogar roundabout.

The Character Areas fall into four categories, which in broad terms, radiate outwards from the city centre;

A: Historic City Core;
B: Urban and Suburban Residential with Urban Green Space;
C: Landscape dominated by large- scale business and office- related developments
D: Urban Fringe Character Greenbelt dominated by infrastructure

These in turn have been sub-divided into a number of smaller recognisable character areas which are described in more detail in Chapter 8 of the ES. These character areas are identified on Figure 8.11. Worksheet L1 is included in Appendix C.

8.2.8.3 Summary of Impacts and Mitigation Measures

The main sources of landscape impact would be the overhead infrastructure (OHLE) – wires and supports, new and altered structures – such as bridges, the tram depot and substation buildings and the tram stops with their associated shelters, seating etc. The tram signalling equipment and additional traffic signalling and signage would generally have small effects but they would add clutter to the streetscape and may in sensitive locations raise the overall landscape impact above a significance threshold. The tram vehicles themselves would have an impact particularly in areas not currently trafficked, such as the disused railway corridors and the more open landscape to the west of Gogar roundabout.

The tram would be a new element in the city, clearly visible to all. The degree of impact is entirely dependent on the design of the system thereby underlining the principle of ensuring that the various new and altered elements are appropriately designed and integrated into the fabric of the city. A Design Manual has been produced which sets out the principles of urban design and detailing. General mitigation commitments arising from the Design Manual have been identified in Chapter 8 of the ES.

Additional landscape mitigation principles have been identified to further integrate the proposed scheme into the landscape and townscape, thereby mitigating more localised impacts and where appropriate enhancing the local landscape structure using the following components and techniques:

- Planting;
- Mounding;
- Earth shaping;
- Restoration of hedge patterns and other rural and urban boundaries; and
- Creation of habitats for ecological interest.

A: Historic City Core
The introduction of the tram into the World Heritage Site and this historic core would have moderate to major negative landscape impacts. The OHLE and stops would have a significant negative landscape impact through this section of particularly sensitive and very high quality landscapes, particularly on the various designed vistas including from South St David Street to the Scott Monument, and the iconic tourist views from Princes Street such as the Castle and Old Town skyline. The use of poles in Princes Street would be particularly sensitive as there are no existing permanent vertical elements in the street. The OHLE and the Shandwick Place stop would impact negatively on the character of Shandwick Place and adjoining crescents in the West End area which form an architecturally coherent extension of the New Town.

The introduction of the tram into Haymarket would have a moderate to major negative landscape impact. This busy junction and thoroughfare is particularly weak in townscape terms with poor enclosure to the junction which would be exacerbated by the demolition of the Caledonian Ale House. However the tram route and stop would visually widen the road at Haymarket Terrace so that Roseberry House would appear to be the natural building line where at present it appears incongruously set back.

B: Urban and Suburban Residential with Urban Green Space
Moderate negative landscape impacts in this character area would be restricted to the low density villa suburbs and amenity open space around the footbridge crossing at Carrick Knowe and the disused railway corridor at Roseburn. The direct impact of the tram line overbridge and OHLE as it crosses the railway at Carrick Knowe and Russell Road at Roseburn would negatively impact these character areas. The loss of the mature tree screen to the railway between Balgreen Road and the Water of Leith crossing would have a moderate negative impact on the more immediate local landscape character of this low density villa suburb area.

Overall the introduction of the tram into this wider character area, including the committed mitigation would have minor negative to neutral landscape impacts, primarily arising from the OHLE and the localised removal of mature tree planting. Localised minor positive landscape impacts would arise particularly for the housing areas bounding Broomhouse and Stenhouse Drives due to the proposed mitigation planting along the tram corridor and the mixed woodland screen planting between the railway and tram corridors.

C: Landscape dominated by large scale business and office related developments
This character area comprises large business related developments including the modern office development at Edinburgh Park set in spacious, attractive landscape grounds contrasting with the more traditional large office developments often located closer to the city centre. These landscape character areas are generally less sensitive to change and are relatively ordinary landscapes with the exception of Edinburgh Park and the adjacent business areas. They are therefore more able to accommodate developments with generally only minor or negligible landscape impacts.

Consequently only minor negative or neutral landscape impacts would result in this character area with occasional minor positive impacts as a result of the mitigation planting. Negative landscape impacts for example would be associated with the tram line running through the landscape corridor in Edinburgh Park and the introduction of the overbridge at Hermiston Gait.

D: Urban fringe character Greenbelt dominated by infrastructure
This character area is relatively rural but with a strong urban fringe character and comprises large scale- and infrastructure- related developments and corridors, to the west of the City Bypass. The Airport and the Royal Highland Showground and Ingliston market areas dominate the landscape to the west of the City Bypass which largely defines the western urban limit of Edinburgh with major infrastructure corridors crossing this whole area. This character area comprises areas which are generally highly sensitive and very attractive to good quality landscapes, characterised by the rural matrix of predominantly arable farmland subtle topographic and woodland features with the traditional estate planting together with agricultural shelterbelts creating a strong and positive influence on the appearance of the landscape.

The introduction of the tram would have direct landscape impacts on the historic setting of Gogar Church resulting in moderate negative impacts. Generally however, minor negative landscape impacts would result with the mitigation planting proposals enabling the intrusive linearity of the tram proposals to fit into the existing landscape framework and where possible enhance the existing landscape structure. Minor beneficial landscape impacts would result in the landscape character at the Airport and sections of infrastructure corridors where the mitigation planting would enhance the existing landscape framework.

8.2.9. Visual Amenity

8.2.9.1 Approach

In accordance with good practice and the requirements of STAG the assessment of visual amenity has also been undertaken based the Design Manual for Roads and Bridges Volume 11 Section 11.3.5 with reference to the following documents:

- Landscape & Visual Assessment Supplementary Guidance (LVASG)(Scottish Executive; 2002);
- Guidelines for Landscape and Visual Impact Assessment (GLVIA)(Institute of Environmental Management and Assessment: IEMA; 2002);
- Cost Effective Landscapes: Learning from Nature (CEL:LfN) (The Scottish Office; 1998);
- Planning Advice Note (PAN) 58; Environmental Impact Assessment (Scottish Executive 1999).

Detailed landscape assessment methods are set out in Chapter 8 of the ES.

Landscape and visual impacts are closely related issues with considerable overlap between the two assessments. Visual amenity is defined as the pleasantness of the view or outlook of an identified receptor or group of receptors. The visual impact assessment determines the degree of anticipated change to visual amenity, considering buildings, areas of public open space, roads and footpaths that would occur as a result of the proposed scheme. The buildings, open spaces, roads and footpaths that would yield views of the tram development are collectively referred to as 'receptors'.

Desk studies combined with detailed site surveys were undertaken. Key components of the assessment of visual amenity included:

- The identification of the zone of visual influence or visual envelope (the extent to which the proposed development could potentially affect people's views of the landscape within the wider area surrounding the development).
- Field assessment and analysis of affected receptors. Receptors or groups of receptors were visited and surveyed using a standardised checklist to enable visual evaluation of sensitivity and magnitude of change leading to assessment of potential impacts.
- An analysis was undertaken of change in receptors' views, and the potential composite change in identity engendered by the development proposals.
- An evaluation was undertaken of the effects of the proposed change in views from receptors.

Impacts of moderate and above have been considered significant, as this is the level at which the changes would be clearly perceived. The assessment year has been taken as year 15 after scheme completion.

Like the Landscape assessment, the visual assessment has been based on an exemplar engineering design which for the purposes of this assessment, forms the basis upon which both the assessment and the indicative landscape mitigation is founded. Further details with regard to the assumptions which have been made during the visual assessment process about the various scheme components are set out in Chapter 8 of the ES.

8.2.9.2 Key Features

The extent to which the proposed scheme would be seen and is intervisible with the surrounding landscape varies considerably along the length of the tram route. In common with many urban corridors located in densely developed urban and suburban areas, the visual envelope is defined by the buildings fronting onto or adjacent to the proposed tram line and in the instances of shared running, existing road. There are, however, areas of space, which open views and extend the influence of the tram line. There are also views available through gaps in the built fabric which frame development and of the overhead wires

and poles inherent in the tram development which extend the influence of the tram proposals beyond the clearly recognisable framework of houses and planting.

Figure 8.12 illustrates the visual envelope for the operation of the tram system. The visual envelope clearly demonstrates that the visual awareness of the tram corridor is much more contained in the eastern city centre sections of the study area compared with the westerly, more sub urban and urban fringe areas, where the visual awareness of the tram corridor is more extensive.

The visual envelope for much of the section from St Andrew Square to Haymarket is relatively narrow. Along much of this section of route the tram and its infrastructure would be seen from a comparatively restricted area; from buildings facing directly onto the tram line and from streets that cross the line. The buildings that form the streets generally block views from further afield. The exception to this is where the tram runs along Princes Street where the visual envelope widens to the south. Receptors along this section of the tram corridor would include visitors, employees, shoppers and residents of the various shops, offices, commercial buildings and properties which lie adjacent to and /or have views of the route corridor.

From Haymarket west the visual envelope is contained in sections by localised planting and buildings but generally forms a relatively wide corridor contained by flats and the railway corridor to the south and open to the north extending across Carrick Knowe golf course towards Corstorphine Hill. The envelope from Carrick Knowe west remains wide although largely defined by the railway corridor to the north and by buildings to the south. Principal receptors along this section of corridor include, properties which lie adjacent to and/or have views overlooking the route corridor; employees working in offices and of the various industrial and commercial premises located adjacent to and/or with views of the route and users of the various footpaths and open spaces which either cross, run adjacent to or have views of the tram route.

From Gogar Roundabout west the visual envelope is more open and extensive. The envelope although often contained to the south by landform and woodland planting is open encompassing large areas to the north with localised built developments, occasional landform and pockets of planting restricting views. Receptors along this section include residents of the various scattered properties and pockets of concentrated development such as at Ratho Station and Newbridge, users of the Airport and visitors to the showground, travellers using the various infrastructure corridors including the A8 and various footpaths and cycle ways which have views of the tram route and employees of the various industrial units at Newbridge and Ratho.

8.2.9.3 Summary of Impacts and Mitigation Measures

Visual impacts would be created by the tram infrastructure; the OHLE, poles, signals, stops and shelter, by the tram vehicles themselves, by the buildings associated with the tram such as the depot and substations and by construction of new structures and alterations to existing. Due to its vertical dimension the OHLE and poles would have the most significant impact on the landscape, which for the most part cannot be screened or hidden. The mitigation for these, to which **tie** has committed through the design manual, which sets out the principles of design and detailing, is to design them well so that they fit comfortably into the scene as far as possible. Points in the Manual which are specifically intended to reduce the visual impact of the tram system as a whole are described in Chapter 8 of the ES. Visual impacts would also be mitigated by the landscape mitigation commitments, which are described earlier in this Chapter under the Landscape Character section. Specific measures to mitigate visual impacts at individual receptors / receptor groups are provided in the ES.

The likely impacts of the proposed scheme on each receptor or group of receptors (buildings, open spaces, roads, rail and footpaths) are presented in detail in Appendix 8.4 of the ES and are summarised in Worksheet VA1 in Appendix C. The reference numbers identified in the worksheets relate to the receptor and receptor groups identified in the visual assessment for the ES.

In certain locations within the study area the existing outlook for receptors is on occasion focussed on neglected corridors of land. Whilst the introduction of the tram system would form a negative intrusion into existing views, the landscape mitigation planting would enhance what was a neglected landscape and help to minimise the visual intrusion of the tram. In such locations the assessment results would be an order of benefits and disbenefits which would be neutral in effect.

In terms of buildings the majority of receptor groups which directly front the tram corridor or with immediate views towards it would experience minor negative or neutral visual impacts as a result of the intrusion of the tram system into their views. However, moderate negative visual impacts would be limited to the following receptor groups by virtue of their immediate orientation towards the tram alignment and visual proximity to new structures, OHLE and poles:

- End properties on Balbirnie Place;
- Flats on Russell Road;
- Properties on southern side of Baird Drive;
- The Fairways flats at Carrick Knowe footbridge;
- Offices and part of waterside landscape corridor at Edinburgh Park;
- Castle Gogar Lodge House;

- Property at junction of A8 and Ingliston Road (this would incur major negative impacts as the tram alignment would immediately pass the property and run through the receptor's garden).

The following building receptors and receptor groups would experience minor to moderate negative impacts which for the purposes of this assessment have been determined as significant and negative:

- Majority of buildings which front the alignment between St Andrew Square to Haymarket;
- Some of the office/commercial premises in the Haymarket Yard area which immediately front the alignment;
- Gogar Church; and
- Ingliston Park Lodge;

Visual impact on Open Space would not be significant and negative other than from the Scott Monument and adjacent gardens, Prince Mall plaza, at Huly Hill and a section of the waterside landscape corridor at Edinburgh Park.

Visual impacts would only be moderate negative for localised sections of the following footpaths and roads where the tram proposals would either fundamentally change the visual amenity experienced along the paths or adversely impinge on the iconic vistas and long views currently experienced from various streets in the New Town, including:

- North/south axis of St Andrew Square;
- Princes Street; and
- Sections of footpaths along the disused railway corridors at Roseburn, Balgreen and to the South of Ratho Station.

The only positive visual impact in the tram corridor would be at Edinburgh Airport with minor beneficial impacts experienced as a result of the assumed high quality amenity planting and hard landscape to the tram stop and terminus in line with the Airport Landscape Strategy.

The overall assessment for Visual Impact is that impacts would be moderate negative and significant for localised sections of the tram corridor, but elsewhere would not be significant.

8.2.10. Agriculture and Soils

8.2.10.1 Approach

This component of the STAG appraisal covers the loss or severance of agricultural land and the potential for soil contamination, including the identification of existing contaminated land areas.

The approach to assessment for agriculture involved identifying and contacting land owners and/or farming tenants with the intention of determining, from an individual farming perspective, the expected impacts resulting from the Edinburgh Tram Line Two alignment across fields currently used for agricultural purposes. The agricultural impacts are summarised on Worksheets AG1 and AG2 provided in Appendix C.

Potentially contaminated sites on or close to the route were identified through a review of historical Ordnance Survey maps together with data collected from CEC and SEPA. The impact assessment for potentially contaminated land uses a risk-based approach following the source-pathway-receptor methodology promoted by SEPA.

8.2.10.2 Key Features

The alignment of Edinburgh Tram Line Two will travel across ten fields, which are currently used for arable cultivation or under "set aside". Ownership and tenancy details as well as access and the agricultural use of the land has been summarised in Section 6 of the ES. All fields are classified as Class 2 agricultural land i.e. high quality. Typically, tenant farmers hold short-term leases. Further information is provided in Worksheet AG1 in Appendix C. Potentially contaminated sites are identified on Figures 8.1 - 8.10 and described in Chapter 7 of the ES. The main types of contaminated land that would be disturbed by the construction of Edinburgh Tram Line Two are listed below:

- Former or existing railway land, particularly at Haymarket, Roseburn, Murrayfield, Baird Drive and west of Balgreen Road, plus Gogar Roundabout and Ratho Station.
- Former factory adjacent to Gogarburn Roundabout (Depot Site).
- Site of former smithy at Gogar.
- Former unlicensed landfill adjacent to the Gogar Burn.
- Made ground on eastern bank of the Gogar Burn.

8.2.10.3 Summary of Impacts and Mitigation Measures

Temporary:

Agricultural Land

Worksheet AG2: Temporary Impacts, summarises the potential impacts on specific agricultural fields. Temporary agricultural impacts are related to the construction compounds being situated on fields currently being used for agricultural purposes. Proposed mitigation measures include:

- Care during construction. This would require possible stripping and storage of top soils to prevent soil structure damage during construction and repair and replacement of agricultural drains.
- Reinstatement of agricultural fields to enable continued farming practices.
- Maintained access to agricultural fields during construction.

In all cases, a Neutral Impact for the significance assessment has been assigned. This is based on the assumption that mitigation measures relating to care during construction, maintenance of access and reinstatement would be carried out correctly and that construction works would be limited to the Edinburgh Tram Line Two corridor and construction compounds.

Soils

In relation to the general management of soils throughout Edinburgh Tram Line Two route alignment, mitigation would include ensuring that soils are adequately protected and/or temporarily removed during construction works, then restored/replaced after construction works have been completed. Neutral impact.

Contaminated Land

During construction any materials encountered that may be contaminated would be tested for potential chemical contaminants associated with known past uses of the site. In addition, all standard health and safely measures would be followed to ensure the minimum contact between site workers and members of the pubic and potential contaminants. Measures would be put in place to ensure that run-off from sites is prevented and that dust and aerosol generation is minimised. Areas of significant contaminated that may impact on construction materials would be removed or isolated to avoid contact with any sensitive materials. The residual impact has been assessed as Minor.

Permanent:

Agricultural Land

Worksheet AG2: Permanent Impacts, specifies the location of agricultural fields and the specific potential impacts on the future agricultural use of the field as a result of the Edinburgh Tram Line Two alignment.

For all agricultural, the common permanent residual impact is the loss of agricultural farming ground required for the operation of the tram line, within LODs. Edinburgh Tram Line Two would also result in areas of land being unsuitable for further agricultural use because the remaining field area (between the field boundary and the Edinburgh Tram Line Two alignment) is considered too small for viable farming use. This assessment was based on discussions with the individual farmers.

Proposed mitigation measures for agricultural land areas include:

- Level crossings with warning lights will be built across access roads and fields to enable safe crossing of the tram line to enable continued agricultural use
- Compensation has been assumed for the area of agricultural land which is no longer viable for farming use.

In all cases the impact significance assessment has assigned a Minor Negative Impact for individual farming plots, because the area of land take is small in terms of the scale of the farming operations. However, because of the combined effect of land take of Class 2 agricultural land, a Moderate negative Impact has been assigned overall.

Contaminated Land

Mitigation in terms of contaminated land would prevent and/or contain spills so that land within the scheme, particularly at depots, is not contaminated by operational activities. Design of infrastructure would take into account potentially contaminated land so that structures would be protected from aggressive ground conditions and/or gas protection measures put in place to prevent ingress/migration of landfill gas if present. Monitoring and or venting of gas may be required.

It is likely, however, that the level of contamination present in each of these areas will not be significant because the areas involved are not extensive and the uses themselves are not likely to have generated large quantities of contaminated material. The impact has been assessed as Minor negative.

8.2.11. Cultural Heritage

8.2.11.1 Approach

The assessment of the impacts of the proposed scheme on cultural heritage in and adjacent to the scheme has considered:

- Scheduled Ancient Monuments;
- Other sites and areas of archaeological significance;
- Listed Buildings and other features of architectural or historic interest;
- Conservation Areas and other important historic townscape features;
- Gardens and Designed Landscapes;
- Edinburgh World Heritage Site.

The variable character of the townscape / landscape along the proposed tram route influenced the width of the baseline study corridor.

- Along the proposed shared section of Edinburgh Tram Line One and Edinburgh Tram Line Two, within the urban environment between St Andrew Square and Roseburn, baseline information was collated by the Edinburgh Tram Line One Environmental Assessment team within a corridor defined by the Limits of Deviation of the scheme. Information was also collated on Listed Buildings with a frontage on the route or in its immediate vicinity (for example Princes Street Gardens). This data has been verified as accurate by the Edinburgh Tram Line Two team and included in this assessment.

- Between Roseburn and Newbridge baseline information was collated for features present within 200m of proposed development locations, although to the west of Gogar Roundabout baseline information was collated on sites with statutory and non-statutory designations present within 500m of proposed scheme features.

Baseline information was collated from a range of archival and documentary sources, including the Statutory List of Buildings of Special Architectural or Historic Interest, the National Monuments Record of Scotland, Local Plans, An Inventory of Gardens and Designed Landscapes in Scotland, historic maps and aerial photographs. Information was also obtained through consultations with Historic Scotland and the City of Edinburgh Council Archaeology Service. Reconnaissance field survey was undertaken along the accessible parts of the proposed tram route to locate and record the current condition of known heritage features and any further features not detected from the desk studies, and to assess the potential impacts of the proposed development upon heritage resources.

8.2.11.2 Key Features

In total, 272 archaeological and heritage sites have been identified within the assessment corridor. The heritage features can be categorised as follows:

- Scheduled Ancient Monuments = 3
- Other sites of archaeological interest = 36
- Listed Buildings = 173
- Other sites of architectural interest = 54
- Conservation Area = 3
- Inventory Status Gardens and Designed Landscapes = 3
- World Heritage Site = 1

Of these 2 Scheduled Ancient Monuments (Gogar Mains fort; Lochend Standing Stone) and 25 other sites of archaeological interest, 11 Listed Buildings, 1 Conservation Area, 2 Gardens and Designed Landscapes (Millburn Tower; Newliston), and 51 features of architectural interest, all located within the wide corridor between Roseburn and Newbridge, would undergo no impacts as a result of the proposed scheme. These unaffected sites are not considered further in this assessment and are excluded from the worksheets (Appendix C) supporting this summary assessment, although they are included in the baseline information presented in Chapter 11 of the Edinburgh Tram Line Two Environmental Statement.

The route corridor can be divided into three sections on the basis of broad differences in townscape / landscape character, which have a considerable influence on the character, extent and importance of the cultural heritage present within each section. These are:

- St Andrew Square – Haymarket: a townscape of international historic and architectural importance;
- Haymarket – Gogar Roundabout: a townscape of predominantly 20th century housing and industrial developments on the west side of Edinburgh;
- Gogar Roundabout – Newbridge: semi-rural landscape considerably fragmented by major transport corridors, Edinburgh Airport, housing and industrial development at Newbridge.

Between St Andrew Square and Haymarket the assessment corridor runs entirely within the Edinburgh World Heritage Site, New Town Gardens Designed Landscape, and Conservation Areas (New Town / West End). There are also 140 Listed Buildings spread densely along the whole of this route section (44

Category A, 76 Category B, 18 Category C(s) and 2 non-statutory C). 29 Listed Buildings are present along the corridor between St Andrew Square and Princes Street, around St Andrew Square; 64 Listed Buildings are present along Princes Street and in East and West Princes Street Gardens; and 47 Listed Buildings are present at the West End, between Princes Street and Haymarket. These designations reflect the recognition of the New Town as a distinctive part of the Edinburgh's status as an internationally important cultural and architectural asset and townscape. St Andrew Square and Princes Street form key formal elements of the grid pattern design of the New Town, both now containing buildings of various dates. The West End forms part of an architecturally coherent extension of the New Town in the period up to 1880. No sites of purely archaeological interest have been identified between St Andrew Square and Haymarket, although Edinburgh Castle is protected as a Scheduled Ancient Monument.

A number of views and viewpoints are particularly important in Edinburgh because of the designed vistas in the New Town. Examples are the views down Princes Street towards Calton Hill, down St David Street to the Scott Monument, down Castle Street towards the Castle, and along George Street to St Andrew Square. There are also highly important views from Princes Street across Princes Street Gardens to Edinburgh Castle and the Old Town skyline, and views from the Castle across the New Town. Where possible, these views have been taken into account in the indicative design.

Between Haymarket and Gogar Roundabout only a scatter of cultural heritage features would be in any way potentially affected by the proposed scheme. These comprise four Listed Buildings (1 Category A, 3 Category B), in particular the Category B Jenners Depository on Balgreen Road; and three sites or areas of limited archaeological interest including the remains of a 19th century field boundary and the former site of Gogar Loch. The potential of this route section to contain currently unidentified archaeological remains is mostly low or negligible.

Between Gogar Roundabout and Newbridge potentially affected cultural heritage resources include 1 Scheduled Ancient Monument and 8 other sites of archaeological interest, and 18 Listed Buildings (3 Category A, 6 Category B, 9 Category C(s)). The Scheduled Ancient Monument comprises the prehistoric barrow and standing stones at Huly Hill. The more important non-scheduled archaeological sites are features recently discovered adjacent to Huly Hill; the site of a medieval and later village at Gogar; and a WWII pillbox located on the edge of Edinburgh Airport. The potential of this route section to contain currently unidentified archaeological remains is moderate or high in areas of agricultural land. Most of the Listed Buildings potentially affected are associated with a series of former country residences set within landscaped grounds to either side of the Glasgow Road (now the A8 trunk road). These include buildings associated with Castle Gogar, Gogarburn House, Gogar Park, Norton Estate and Ingliston House. Those listed structures closest to the proposed tram route are Castle Gogar Lodge, Gogar Parish Church, Ingliston House Lodge, Middle Norton cottages and Norton House Hotel, North Lodge.

8.2.11.3 Summary of Impacts and Mitigation Measures

The preferred mitigation strategy is to preserve in situ and in an appropriate setting all cultural heritage resources. The preferred alignment has been designed to avoid all direct effects wherever possible and to minimise potential indirect effects.

Between St Andrew Square and Haymarket potential direct effects may occur on a range of Listed Buildings and other features of architectural interest. At Haymarket the Caledonian Alehouse (Category C(s)) would be demolished and the Heart of Midlothian War Memorial (Category C(s)) may require to be relocated. Both would form minor adverse effects. 16 Listed Buildings lie within the Limits of Deviation, and might be directly affected by the proposed scheme. These structures mostly comprise historic street furniture associated with 10 Category A and 3 Category B Listed Buildings, mainly around St Andrew Square but also at St John's Church and at the West End. The magnitude of any such impacts are uncertain, although direct effects on Category A listed features are likely to major and adverse, and those on Category B listed features minor and adverse. Any physical effects on the Monument to John, 4th Earl of Hopetoun (Category A) and a police call box at West Princes Street Gardens (Category B) would both likely be major and adverse. Three unlisted railings may be affected, leading to minor adverse effects.

A mitigation strategy has been proposed for all potential direct effects in this route section. Detailed standing building survey and salvage is proposed in relation to the Caledonian Alehouse, and also for the Heart of Midlothian War Memorial if it cannot be preserved. Detailed standing building survey is proposed should a direct effect on the police box at West Princes Street Gardens be unavoidable. For all other sites a detailed photographic record is proposed in the event of physical impacts being anticipated, although depending upon the precise nature of the development works further mitigation responses might be necessary.

Between St Andrew Square and Haymarket visual effects would occur on the setting of the World Heritage Site, New Town Gardens Designed Landscape, New Town and West End Conservation Areas, and the 140 Listed Buildings present along the assessment corridor within those Conservation Areas. The effects would arise mainly through the introduction of the overhead line equipment and tram stops into the streetscapes, and this change would be particularly significant where there are no existing permanent vertical elements in the street. Their presence would affect some key views, such as Edinburgh Castle and the Old Town skyline seen from Princes Street and the Category A Scott Monument seen from South St David Street. The worksheets (Appendix C) do not assess the indirect effects of the proposals on

individual Listed Buildings. However, cumulatively the indirect effect of the scheme upon the cultural heritage of the assessment corridor within the New Town would be major and adverse.

The mitigation for these impacts is to design the tram system well, so that it fits comfortably into the townscape as far as possible. A Design Manual is being progressed which sets out the principles of design and detailing to be followed in the final design, including within the whole of the World Heritage Site. Points in the Manual that are specifically intended to reduce the visual impact of the tram include:

- Careful design of the overhead line equipment to simplify the layout and minimise the size of the wiring;
- Use of visually appropriate methods of overhead line equipment support, including designing a bespoke support column, designed to be attractive in its own right;
- Integration of the overhead line equipment supports with other vertical elements in the street (lighting and signing poles) as far as possible, and coordination of the spacing of new and existing poles, replacing existing lighting columns where appropriate;
- Simple alignment of the tram track to avoid as far as reasonably possible the need for complex overhead line equipment, including straight alignments along the city centre streets to respect the formality of urban design of the New Town. The Princes Street stop would be located so that it does not affect the view from Castle Street, and stops in St Andrew Square would not impact on views of the square from George Street.

Between Haymarket and Newbridge potential effects would be much more localised, reflecting the more fragmentary nature of cultural heritage resources. A moderate adverse effect would occur to the character and setting of Huly Hill Scheduled Ancient Monument. Up to 11 other sites or areas of archaeological significance may, taking into account mitigation proposed below, undergo moderate adverse (1 no), minor adverse (3 no), neutral (2 no) or uncertain (5 no) effects. Those sites of particular importance to be potentially affected are the site of Nether Gogar village, a site of schedulable quality and national importance; regionally important remains discovered close to Huly Hill at Edinburgh Road, Newbridge; and a WWII pillbox at Edinburgh Airport. Of the remainder, three sites lie off-line but within the Limits of Deviation, and it is not known what survives of two others. Buried and currently unidentified remains of archaeological significance might be disturbed by the construction of the tram, particularly in the areas of agricultural land between Gogar Roundabout and Newbridge. Key mitigation measures proposed in relation to these potential effects include:

- A watching brief to be conducted during ground breaking works at selected locations between Murrayfield and Edinburgh Park, including Carrick Knowe golf course;
- A photographic record to be made of the remains of Ratho Station Low Level Station; and photographic survey and building recording of the Edinburgh Airport pillbox if necessary;
- A programme of archaeological recording, through prior excavation or watching briefs as appropriate, of all known archaeological remains that would be directly affected. Such sites include the affected parts of Huly Hill and environs, and the site at Edinburgh Road, Newbridge;
- Archaeological evaluation of areas of agricultural land along the proposed development corridor between Gogar Roundabout and Newbridge, with further mitigation responses (excavation, watching briefs) conducted as appropriate to the results of the evaluation;
- Preservation in situ of the buried remains of Nether Gogar village. The tram route would be built on made ground above the existing ground level; a prior archaeological field evaluation would assess the character and condition of the remains, to allow an appropriate engineering solution to be adopted that avoids compression or distortion of the archaeological remains to be buried beneath the tram line;
- All archaeological mitigation works to be detailed in a Written Scheme of Investigation approved in advance by City of Edinburgh Council and/or Historic Scotland as appropriate. Provision would be made for post-excavation analyses, publication of the results and archiving of the project materials and records.

Between Haymarket and Newbridge indirect visual effects would occur on 3 Category A, 6 Category B and 9 Category C(s) Listed Buildings. A direct effect would occur on the Jenners Depository (Category B listed) to accommodate a tram stop, although with sensitive realignment northwards of that part of its southern boundary railing to be impacted the effect would be neutral. Norton House Hotel North Lodge lies within the Limits of Deviation of the proposed scheme; direct effects could occur, although their magnitude and significance cannot presently be assessed. Where Listed Buildings lie close to the proposed route, the overhead line equipment where possible would be spaced to minimise visual intrusion into their settings. The introduction of sensitive screening in some cases may assist in mitigating the increased traffic noise and visibility experienced by adjacent Listed Buildings. Taking into account this mitigation, the indirect effects on Listed Buildings would be neutral apart from a likely moderate adverse effect at Gogar Church, and likely minor adverse effects upon Castle Gogar Lodge, Castle Gogar, Ingliston House Lodge and Middle Norton cottages.

The cumulative effects of the proposed scheme on cultural heritage would be:

- St Andrew Square – Haymarket: major adverse
- Haymarket – Gogar Roundabout: minor adverse
- Gogar Roundabout – Newbridge: moderate adverse.

8.3. Safety

The following sections discuss the impacts of the proposal on the two safety sub-objectives; Accidents and Security.

8.3.1. Accidents

Traffic accidents are a major transport concern and impose high costs on society; therefore any new proposal must be reviewed in relation to its anticipated impact on the frequency and severity of accidents. Whilst the study of traffic accidents is not an exact science some general considerations hold true including the fact that greater segregation between vehicles will reduce the risk of accidents occurring. This is particularly true where the vehicle follows a controlled path such as that followed by a tram on its tracks.

8.3.1.1 Change in Annual Personal Injury Accidents

The assessment of the changes in the number of road accidents and associated casualties has been made quantitatively, considering the changes in total vehicle distance travelled on the highway network. Standard methodologies are based on accident rates and casualty rates (per vehicle-kilometres) per road type. The rates set out in the NESA manual (DMRB Volume 15) for the year 2000, but changing over time to reflect technological improvements in safety, have been adopted.

The recommended approach uses input data taken from the highway transport model. It takes the total number of road traffic vehicle-km both for the Do-Minimum and Do-Something scenarios for years 2011 and 2026, broken down to a range of standard road types.

The Detailed Assignment Model extends over much of Southern Scotland, but only Edinburgh and its environs are modelled in detail. The impact on highway use extends beyond Edinburgh and is reflected in the model results. The model predicts reduced highway mileage outside Edinburgh which leads to accident savings benefits. However, the ability of the model to quantify changes outside Edinburgh and Newbridge is not as good as for Edinburgh itself. It was therefore decided to take only half accident benefits for the non-Edinburgh/Newbridge Area. This was also done to be more consistent with the Transport Economic Efficiency where External-External benefits were excluded from the analysis.

The scheme reduces the number of peak hour car vehicle trips but the economic regenerative effect of the scheme increases off peak highway trips. During the peak, the modal transfer to tram outweighs the effect of increased economic activity. However this is not the case in the off peak, when congestion levels are lower This decrease and increase almost cancel each other out in the initial years, but by 2026 there are extra highway trips. So in the later years there is an increase in vehicle kilometres and vehicle accidents.

In 2011 the changes in highway flows in 2011 are small, with an increase on urban roads leading to a slight increase in damage only accidents, while decreases on some other roads leads to a slight decrease in accidents overall. In 2026 there is a significant increase in highway flows on urban links, which leads to an annual increase in accidents of 113 in 2026. This includes fatal, severe, slight and damage only accidents.

Current Government advice suggests that accidents on rail-based systems are negligible and so need not be considered (except when shared running by rail and other modes is felt to be likely to increase accident rates).

8.3.1.2 Change in Balance of Severity

Standard accident rates are available by severity level: fatal, severe, slight and damage. Thus, it is possible to estimate the change in the balance of levels of severity, particularly if traffic distribution changes according to road types (e.g. deviation from one road type to another). The number of accident savings per severity level was estimated as show in Table 8.6 below.

Table 8.6 - Number of Accidents Saved per Severity Level

	2011	2026
Damage	-0.2	-107.2
Slight	0.2	-4.8
Serious	0.1	-0.7
Fatal	0.0	0.0
Total	**0.1**	**-112.7**

This shows that accidents are not expected to change in 2011 but increase by 2026 because the improved transport links have increased highway trips as well as PT trips. If damage only accidents are excluded, there is a reduction of 0.6 accidents per annum in 2011 and an increase of 3.1 accidents in 2026. There is no predicted change in fatal accidents and only 1 additional serious injury accident every 3 years in 2026 conditions

8.3.1.3 Total Discounted Savings

Using standard valuations for casualties, accidents and damage to property by severity level (Monetary Values from NESA Manual, DMRB15, Section 6 -1998 prices and values) and the accident saving estimations summarised above, the undiscounted monetary valuation of annual accident savings are estimated as shown in Table 8.7, below.

Table 8.7 - Undiscounted Valuation of Accident Savings

	Valuation of Annual Changes in Accidents	
Type	**2011**	**2026**
Accident Costs		
Damage	£2,586	-£214,900
Slight	£976	-£12,693
Serious	£463	-£3,130
Fatal	£208	-£74
Sub –total	£4,233	-£230,798
Casualty Costs		
Slight	£4,854	-£112,219
Serious	£10,827	-£95,110
Fatal	£19,579	-£11,466
Sub-total	£35,260	-£218,795
Total	**£39,492**	**-£449,593**

The total savings as a result of reduced traffic on the road network has been calculated at £39,492 per year for 2011. Even Damage accidents, of which there are an overall increase in 2011 leads to a saving, because the increase in urban damage only accidents is more than off-set by a reduction in more expensive urban rural and Motorway accidents.

With more accidents in 2026, the scheme leads to a negative saving of -£499,593 per annum.

Feeding this valuation through the accident calculations framework which discounts the annual valuations to a present value, the NPV of these savings represent -£2.9 million (NPV), over the project lifetime. Casualty costs represent approximately half of the total costs (the remainder are accounted for by accident costs).

The overall objective of improving road safety is not met in the later years of the scheme life. The reason for this is that the benefits of the scheme in relation to the economic life of the city lead to increased travel, much of it by car. As a result there is a net increase in car use and accidents. However, if the economic development effect was removed, for example through planning controls, there would be a reduction in road traffic and road traffic accidents. It is therefore the second order effect on the economy, rather than the scheme itself, which is leading to this outcome.

8.3.2. Security

The popular perception about travelling by public transport is that specific groups in society are at greater risk than others, for example, women are at greater risk of sexual attack and the elderly more likely to be targeted by muggers. This perception results in lower proportions of these user groups travelling by public transport, as they feel at greater risk and more susceptible to attack. Remote and isolated public transport stops require to incorporate good design to mitigate feelings of insecurity.

Collaboration with private business and/or community groups can help to provide a 'human presence' within or around public transport facilities. Unstaffed stops should be constructed to take account of passenger safety and security, with lighting, CCTV and open areas, where waiting passengers are visible from neighbouring roads or streets.

The preferred central route corridor is generally off-street and will allow in most instances an open and bright aspect, although there will be limited background activity levels along the segregated parts of the route. As Edinburgh Tram Line Two is advanced a careful review will be undertaken of the street environment in the vicinity of potential stops/interchanges. Lighting and street furniture will be designed to provide maximum safety and security. This may involve 'more than bright lights' but will have the objective of providing street environments that are pleasing, attractive and calming in every sense. Stops and cycle parking facilities should be located where there is, as far as possible, plenty of human activity to avoid feelings of isolation; and, for cyclists, to minimise the risk of cycle theft.

Provision of an attractive waiting facility is part of a package approach towards making stops welcoming to the individual. Location is crucial, and whilst safety in traffic terms is also important, locating stops in places where there is human activity deserves equal emphasis. This is especially so where stops are unstaffed, as in off-peak periods.

Staffing tram stops is not economically viable and the use of closed circuit television cameras is now widespread. However, there can be no single technical solution to the problems of ensuring complete passenger safety. CCTV is perceived by many as 'reactive' (that is, it may help convict an attacker but is not a great deal of help to the victim). An interchange with prominently located signs, citing the presence of discreetly positioned 'see in the dark' cameras, may however have a stronger deterrent effect. Panic

buttons and PA links/help lines are possibly more reassuring for a passenger waiting alone at a remote suburban tram stop on a dark morning or night.

It is important to undertake extensive consultation, through a combination of market research and discussion with consumer bodies, about questions of safety and security. As discussed in Chapter Six, there has been wide ranging consultation associated with Edinburgh Tram Line Two – the information gathered during the consultations to date alongside further feedback from public and statutory bodies will allow the genuine concerns of users to be understood, especially those who may be vulnerable.

In summary, the personal security concerns of many individuals when using public transport can be dealt with in the provision of mitigating facilities designed into the tram development. For example, Edinburgh Tram Line Two will have stops fitted with high quality lighting and closed circuit television. In addition it is possible to provide emergency help phones if necessary. Similarly, on board the modern tram it is possible to design a safe and secure environment. Thus it is fair to assume that Edinburgh Tram Line Two will provide a degree of improved security for potential patrons and system employees, meeting the improved security objective.

8.4. Economy

8.4.1. Transport Economic Efficiency

The Transport Economic Efficiency (TEE) appraisal addresses the economic welfare impacts of the proposals. This includes a review of what users are willing to pay in order to use the tram line; the financial impact on private sector transport providers; and impacts arising from land use or other impacts of the tram line.

The TEE analysis has utilised DfT's Transport Users Benefit Appraisal (TUBA) software. TUBA is compliant with STAG and with the Guidance on the Methodology for Multi-Modal Studies (GOMMS), though output must be restructured for input to STAG. The input data is summarised in Table 8.8.

Table 8.8 - TUBA Inputs

TUBA Input	Units	Comments
Highway journey times	Minutes	
Highway distances	Kilometres	
Car trips (non-working time)	Vehicles	CSTM3 Edinburgh vehicle occupancy figures used to convert to person trips
Car trips (working time)	Vehicles	
LGV trips (non-working time)	Vehicles	
LGV trips (working time)	Vehicles	
OGV1 trips (working time)	Vehicles	
OGV2 trips (working time)	Vehicles	
City Centre parking charges	£2001 prices	0.94 factor to 1998
Public Transport Generalised time (excluding fares)	Generalised minutes	Calibrated assignment parameters used
PublicTransport Fares	£2001 prices	0.924 to factor to 1998 prices (fares index of 121.8 (1998) and 131.8 (2001) for Scotland (source Transport Statistics of GB 2002)
Public Transport Demand	Persons	

As per DfT advice, default TUBA economic parameters are used, except where local data is available. Edinburgh household data showed that 2.6% of public transport (PT) trips are in-work trips and 9.1% of car trips are in-work, as opposed to default values of 0.2% and 15.1% respectively. As in-work trips have a higher value of time, this implies that travel time changes will have a greater economic impact on Edinburgh PT trips and a lesser impact on Edinburgh car trips than is the case in most of the rest of the UK.

Car occupation figures were derived from Edinburgh CSTM3a, as shown in Table 8.9.

Table 8.9 - Car Occupancy

Period		Occupancy	Purpose
AM	Non-work time	1.184	Home based work
	Work time	1.277	Non-home based employers business
Off peak	Non-work time	1.612	Home based other
	Work time	1.530	Non-home based employers business
PM	Non-work time	1.371	Home based work
	Work time	1.655	Non-home based employers business

Annualisation factors were derived from Edinburgh household data and are shown in Table 8.10.

Table 8.10 - Annualisation Factors

Period	Public Transport	Car
AM Peak	557	585
Inter peak	2425	2288
PM Peak	563	656

8.4.1.1 Parking Revenue

Estimates of the impact on city centre parking have been taken from the TRAM model. Parking charges have not changed, so the impact on users is nil, what changes is the number of cars parking in the city centre. This decreases in the peaks but increases in the off peak periods. The TRAM model provides an estimate of on-street parking, which is predominantly public-sector supply, and off-street parking which is predominantly private sector supply. VAT is deducted from this revenue.

8.4.1.2 Public Transport Revenues

PT revenue is calculated by the public transport Detailed Assignment Model (PT DAM) model on the assumptions that full adult single fare is paid on buses and tram and that half the return fare is paid for Airlink bus and heavy rail. There are no return bus fares in Edinburgh City, but there are a variety of passes available. The number of period passes sold and Day Travel tickets sold by period was provided by Lothian Region Transport and an estimate was made of the fare reduction due to pass usage. There will also be some fare evasion. The impact is summarised in Table 8.11

Table 8.11 - PT Revenue Adjustment

	AM	OP	PM
Loss due to use of passes	8.0%	13.0%	13.0%
Loss due to fare evasion	5.0%	5.0%	5.0%
Cumulative loss	12.6%	17.3%	17.3%

Revenue for the PT modes was extracted from PT DAM, which calculates fare based on boardings and ride distances compared to a distance-based fare scales.

The 20 year revenue profile is derived by interpolating the 2011 and 2026 DAM results, these being the first and last modelled years in the LUTI model. The years 2009 and 2010 were extrapolated from these results, taking account of ramp-up where it is assumed that take up of the new service is only partial for the first three years (75%, 85% and 95% respectively). Patronage and revenue is assumed to be constant after 2026, as it would be unreliable to extrapolate 2011 to 2026 trends indefinitely.

8.4.1.3 Scheme Costs and Price Base

The scheme costs within the TEE are as follows (2003 Q2 prices):

- Construction cost of £336.315 million, which includes:
  - £30.263 million for land;
  - £ 8.603 million for design; and
  - 31% optimism bias as per Green Book recommendations.
- Construction costs are spread over the years 2006 to 2009 based on the cost profile provided with the estimate. The design costs are spread over 2004 to 2006.
- Included in the land cost is £4.8 million of land owned by the Scottish Executive, the City of Edinburgh and New Edinburgh Limited.
- Annual Operating cost of £5.71 million.
- Lifecycle costs of £51.672 million allocated over the 30 years operation period as required for replacement and overhaul of items reaching the end of their lifecycles. This has been included in the operating costs rather than the investment costs.

It is not intended that bus or rail services be withdrawn in response to Edinburgh Tram Line Two, therefore there is no saving in bus or rail operations.

Costs were discounted to 1998 market prices using an RPI value for 2003 Q2 of 181.3 in comparison to 162.8 for 1998. An RPF factor of 0.98 was used for the construction costs (excluding land, preparation and design) to correct for long term trend prices. Operating costs are assumed to inflate at 0.5% over the RPI due to the estimated impact of salary increases. The costs are summarised in Table 8.12.

Table 8.12 - Costs

Cost Element	Current Price (2003 Q2)	1998 PV Market Prices
Construction	£336.315 million	£218.222 million
Operating Costs	£ 5.710 million p.a.	£ 73.185 million over 30 years
Lifecycle Costs	£ 51.672 million	£ 18.945 million

8.4.1.4 User Benefits

Table 8.13 Presents the TEE analysis.

Table 8.13 - TEE Table and Safety (£'000s Present Value)

	STAG	TOTAL	Cars	Freight	PT
Safety					
Accident savings	PV1	**-2906**	-2906		
User benefits – consumers					
Travel Time		**205502**	50203		155299
User charges		**18002**	-4		18006
VOC		**-15946**	-15946		0
net consumer benefits		**207558**	**34253**		**173305**
User benefits – business					
Travel Time		**37015**	18455	6263	12297
User charges		**581**	0	0	581
VOC		**1737**	473	1264	0
net business benefits		**39333**	**18928**	**7527**	**12878**
User benefits – TOTAL					
Travel Time	PV2	**242517**	68658	6263	167596
User charges	PV3	**18583**	-4	0	18587
VOC	PV4	**-14209**	-15473	1264	0
net user benefits		**246891**	**53181**	**7527**	**186183**
Private Sector Provider Impacts					
Investment costs	PV5	**-218222**			-218222
Operating costs	PV6	**-92130**			-92130
Tram revenue		89539			89539
Bus/rail revenue		30612			30612
Forth Bridge revenue		-485	-485		
City centre parking		3088	3088		
Net revenue	PV7	**122753**	**2603**		**120151**
Grant/subsidy	PV8	**218222**			
net private sector impacts		**30623**	**2603**		**120151**
Present Value of Benefits	**PVB**	**274608**			

Issues to note include:

- In line with STAG practice a negative number is a cost and a positive number is a benefit;
- Total PT benefits of £186.2million;
- Total highway benefits of £26.4 million;
- While increases in PT revenue covers the tram operating cost, the combined lifecycle and operating cost is greater than tram revenue by 3%;
- Overall PT revenue increases by £121.2 million, due to a shift to PT and a generation of new trips due to increased accessibility; and
- A small increase in city centre off street parking giving increased revenues of £3.1 million.

8.4.1.5 Spatial Benefits

The Detailed Assignment Models employed in the TEE analysis have 345 zones, including external zones. The PT assignment has an additional 7 external zones for external rail connections. Tables 8.14 and 8.15 aggregate the travel time savings to 10 Edinburgh sectors and 3 sectors external to Edinburgh. Figures 8.13 and 8.14 illustrate the sectors used for this analysis.

Table 8.14 - PT Time Benefits By Sector (£'000s Present Value)

	Origin	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
1	City Centre	-188	1434	1092	138	-174	538	601	3614	3331	18242	568	2080	3897	**35173**
2	Haymarket	32	-9	-298	40	-6	33	154	141	742	5690	620	601	1037	**8777**
3	Leith Walk/ Leith	-422	-194	132	123	-75	25	183	1136	58	3556	116	-50	930	**5518**
4	Granton	-92	-16	91	-27	197	19	37	-28	45	748	15	38	47	**1074**
5	N. Edinburgh	-642	-25	119	159	-7	-2	-1	-21	163	3151	144	90	248	**3376**
6	Leith Docks	30	38	30	21	7	0	64	308	159	1118	2	68	122	**1967**
7	Railway corridor	-383	-45	40	40	32	29	97	-208	80	2413	138	-29	115	**2319**
8	S. Edinburgh	-2333	488	531	5	-108	287	33	76	813	3902	236	720	1137	**5787**
9	E. Edinburgh	839	552	2550	205	360	784	133	1117	525	6115	91	337	471	**14079**
10	W. Edinburgh inc. Newbridge	14726	7826	2847	358	2363	393	3523	3993	4258	26278	1005	4780	1863	**74213**
11	Ext. North	1259	95	444	18	-10	47	59	94	287	712				**3005**
12	Ext. West	1817	386	372	-4	231	15	-182	-11	184	4252				**7060**
13	Ext. South/ East	1661	404	215	-23	55	45	35	552	329	1970				**5243**
	TOTAL	**16304**	**10934**	**8165**	**1053**	**2865**	**2213**	**4736**	**10763**	**10974**	**78147**	**2935**	**8635**	**9867**	**167591**

Note: External to external benefits have been excluded – see text for explanation

Not surprisingly, the largest PT benefits are movements to and from West Edinburgh, with the greatest benefits being movements between West Edinburgh and the city centre. There is a broad spread of PT benefits across the rest of the modelled area, some due to the tram being used as part of a longer journey. However, the broadest effect is the impact of reduced highway traffic, particularly in the peaks. While this is due to a switch from car to PT, it increases highway speeds in general benefiting many other movements. Overall, £102.6 million (61%) of the benefits accrue to trips to, from and within West Edinburgh.

The main areas to suffer from the impact of tram is the City Centre and, to a lesser extent, Haymarket. This is where the tram takes capacity from the highway network and potentially reduces bus speeds. Ideally, PT measures would be taken to mitigate the adverse impact on bus speeds, though this may have to be at the expense of other highway traffic.

The modelling of the External areas is not as detailed as the rest of the network. The model forecasts Public Transport benefits in the external areas due to increased bus speeds from increased use of Public Transport to Edinburgh. It was felt that the level of detail within this part of the model is less and may not be as robust as elsewhere within the model. An overall economic conservative economic assessment has resulted from the decision to omit these benefits (see zero cells in Tables 8.14 and 8.15) from this area.

Table 8.15 - Highway Time Benefits By Sector (£'000s Present Value)

	Origin	1	2	3	4	5	6	7	8	9	10	11	12	13	TOTAL
1	City Centre	-1682	-1858	-157	-63	-190	66	-306	-215	-189	-269	-328	-316	11	**-5496**
2	Haymarket	-2721	-1190	-564	-142	-223	18	-353	-879	-723	-736	-4	-454	-178	**-8149**
3	Leith Walk/ Leith	200	-332	681	-42	178	525	285	1261	1792	774	217	266	249	**6054**
4	Granton	-266	-118	111	60	52	221	33	-3	450	-131	105	49	180	**743**
5	North Edinburgh	-382	-299	100	20	5	121	3	-57	460	-99	158	201	58	**289**
6	Leith Docks	-101	-111	91	-82	-64	30	-9	629	1107	151	226	558	843	**3268**
7	Railway corridor South	-904	-468	7	-24	-40	13	-62	-135	244	-367	174	171	22	**-1369**
8	Edinburgh East	-280	-1456	1003	-118	-92	1477	-463	-4	-399	1790	427	730	312	**2927**
9	Edinburgh West	1838	549	4714	2724	2129	4783	1352	1901	854	1892	588	841	1124	**25289**
10	Edinburgh inc. Newbridge	-2273	-1414	-27	-203	-19	1097	-47	836	347	4859	3893	5468	2618	**15135**
11	Ext. North	-381	-25	251	131	222	264	146	643	372	4976				**6599**
12	Ext. West	-453	49	508	413	611	479	1019	1329	985	9327				**14267**
13	Ext. South/ East	694	28	1904	1491	1313	3749	625	1046	731	3779				**15360**
	TOTAL	**-6711**	**-6645**	**8622**	**4165**	**3882**	**12843**	**2223**	**6352**	**6031**	**25946**	**5456**	**7514**	**5239**	**74917**

Note: External to external benefits have been excluded – see text for explanation

The overall impact on highway is positive, with the benefits spread across the modelled area due to a general reduction in traffic. Disbenefits arise on trips to and from the City Centre and Haymarket, particularly trips from West Edinburgh to the city centre, due to the reallocation of road space to the tram.

As noted above, the modelling of the External areas is not as detailed as the rest of the network. The model forecasts highway benefits in the external areas due to reduced congestion as a result of a switch to PT for trips to Edinburgh. It was considered advisable to exclude these benefits from the economic assessment as their reliability could be questioned.

Overall the tables demonstrate that accessibility is improved for both highway and public transport users.

8.4.2. Costs to the Public Sector

Edinburgh Tram Line Two is treated as a private scheme with all scheme costs being paid by the private sector. However, it is assumed that the government provides grants and subsidies to the value of the scheme. This includes gifting the land required by the scheme currently owned by the public sector. The cost of this gifted land has been given the full market value.

Revenues and benefits are shown with positive values, costs and disbenefits are shown with negative values. A comparison was done between the modelled prediction of current public sector parking revenues and they were found to be similar but slightly high, therefore a correction factor of 0.82 is applied to adjust the public sector revenue.

VAT is assumed on parking, though in the case of public sector parking, this is a redistribution of public sector revenues to public sector indirect tax revenues.

Table 8.16 shows the Costs to the Public Sector, while Table 8.17 summarises the Net Present Value and the Benefit Cost Ratio to the Public Sector.

Table 8.16 - Costs to the Public Sector (£'000s Present Value)

	STAG	TOTAL	Highway		PT
Cost to government					
Public sector investment costs	PV9	**0**			
Public sector operating & maintenance costs	PV10	**0**			
Grant/subsidy		-214949			-214949
Gifted public land		-3273			-3273
Net grant/subsidy	PV11	**-218222**			-218222
Revenues	PV12	**19920**	19920		
Taxation impacts	PV13	**-633**	11921		-12554
Total PVC to Government	**PVC**	**-198935**			

Table 8.17 - NPV and Benefit Cost Ratio to the Public Sector (£'000s Present Value

	STAG	Derivation	Value
Present Value of Transport Benefits	PVB	sum(PV1:PV8)	274608
PV of Cost to Government	PVC	sum(PV9:PV13)	-198935
Net Present Value	NPV	PVB+PVC	75673
Benefit Cost Ratio to the Public Sector	BCR	PVB/(-PVC)	1.38

8.4.3. Economic Activity and Location Impacts

8.4.3.1 Overview of Approach

The STAG AST2 Appraisal requires an assessment of the economic activity and location impacts (EALI) of the proposed tram line scheme. This assessment is undertaken at the local or regional level and at the wider Scottish level. The appraisal seeks to quantify the impacts in terms of employment gains and losses as well as income/GDP.

The analysis is also intended to identify how impacts will be distributed across geographical locations and at differing spatial levels. It is worth remembering, however, that the impact outlined in this section of the report should not be treated as additional to those identified in the earlier transport economic efficiency (TEE) section. The EALI section merely highlights the estimated impacts in an alternative format to that expressed by the TEE approach.

Our approach reflects the STAG guidance in devising a means of understanding: "the potential behavioural responses of different 'sectors' of economic activity...The approach suggested involves dividing or segmenting the economy into 'sectors' and considering each of these in turn. Once a usable segmentation has been selected, this approach involves investigating how the economic actors relevant to each sector might be affected by, and respond to, the changes in costs or accessibility brought about by the transport proposals under analysis." To this end we have made use of the DELTA modelling capability available to **tie** through the David Simmonds Consultancy (DSC) and MVA to generate an understanding of the economic and spatial impacts of the proposed tram line.

Following the DELTA model run we have analysed the results in terms of outputs and provided the necessary conclusions in terms of impacts by zones within the wider modelled area and within proximity of the tram line corridor. These impacts have been set within the relevant development context and policy framework; the impacts to the relevant economic sectors have been ascribed; and the likely related regeneration effects have been identified. The model provides a range of outputs indicating the likely effects of the tram line on population and households, employment, floor space development, rental values and changes in value added.

Although this approach does not specifically involve any survey-based work, comments have been made outlining the anticipated land use effects of this significant investment in the tram line.

A full economic development report has been prepared, offering further detailed and supplementary information to this part of the STAG report.

8.4.3.2 Tram Corridor Impacts

The STAG AST2 EALI analysis requires detailed consideration of impacts, including an expression of the levels of economic activity by type and location of business or land use activity. The findings of the analysis of the tram line model are provided in detail within the aforementioned economic development report, but are also shown in summary below.

The greatest impact will be experienced in relation to employment, with up to 410 additional jobs being created within the City of Edinburgh during the period 2009-2025. Since these impacts would result from the introduction of the tram, they would occur mainly in the areas directly served – the West Edinburgh corridor and the city centre. In relation to employment sectors there will be limited notional gains in construction, public administration and other services. The greatest employment increases will occur amongst the financial and business sectors. This will provide opportunities for employment in providing support services as well as the more highly skilled occupations.

In respect of property related impacts the tram line is projected by 2025 to directly contribute towards the creation of minimal additional residential, retail and industrial development, but slightly higher levels of office accommodation.. Similarly, it is estimated that there is unlikely to be any resultant impact upon property rental values in the retail, office and industrial sectors, from the introduction of the tram line in West Edinburgh. It does, however, envisage a small rental value fall in the residential market across Lothian.

As many of the businesses and other land uses within the tram line corridor do not as a whole depend upon high levels of passing trade, by virtue of the nature of employment, there is likely to be limited direct impact from the tram line, especially in respect of access to customers and suppliers. Indeed Edinburgh

Tram Line Two alignment has fewer areas of traditional retail and commercial orientated areas, than, say, along the route of Edinburgh Tram Line One (ie Leith Walk).

It is expected that the tram line will provide some benefit to businesses and residents alike through improved accessibility to employment and also through the widening of the available labour market.

8.4.3.3 Developments Likely to Benefit from Edinburgh Tram Line Two

Although many of the proposed and committed developments within the tram line study area are already planned to proceed irrespective of whether or not the tram itself is introduced, there may be some development areas where the full development potential or realisation, as well as the timing and scale of development, could be influenced by the operation of the tram line.

These developments and areas may comprise:

- Newbridge – further potential for industrial and distribution development – the accessibility analysis set out below shows significant improvements in ease of access to Newbridge;
- Edinburgh Airport – Airport related development and expansion linked to increased growth at the Airport. This may include airline-related and support services, and terminal facilities;
- Gogarburn – long term re-development of site for Royal Bank of Scotland HQ;
- Edinburgh Park – continuing development of Park's southern extension site which could create up to 20,000 further jobs (for example, financial and business services) in a 10- to 15-year period.
- South Gyle and Sighthill – site development and redevelopment for range of potential uses including commercial, industrial and office accommodation.
- Gyle Shopping Centre and Hermiston Gait – additional potential scope in the longer term for further leisure and retailing development.
- Murrayfield Stadium – redevelopment proposals for surrounding land to west and north of the stadium including the existing Murrayfield Ice Rink.
- Tynecastle Park – possible relocation of Heart of Midlothian FC to Murrayfield (matches) and Riccarton football academy (training) release Tynecastle Park and surrounding land for redevelopment, whilst encouraging greater use of Murrayfield Stadium.
- Westfield Road – existing bonded warehousing and range of other under-utilised and lower value uses could provide future development potential for higher value land uses.
- Haymarket – the proposed redevelopment of Donaldson's College for Deaf Children providing a prime residential development opportunity.

8.4.3.4 Property Related Impacts at Scotland Level

The STAG appraisal guidance indicates that potential impacts of transportation projects should also be examined at the Scotland level. The analysis of the model outputs indicates that the tram line will contribute towards the creation of additional floorspace across all four land use categories – residential (200 sq m), retail (240 sq m), office (1,100 sq m) and industrial (100 sq m).

Furthermore, the EALI assessment estimates that the implementation of Edinburgh Tram Line Two will have no resultant impact upon property rental values in the retail, office, residential and industrial sectors.

However we consider in qualitative terms that the development of Edinburgh Tram Line Two will act as a fundamental 'building block' in the continuing competitiveness of Edinburgh as an investment location, particularly within the West of Edinburgh, which acts as the premier business location in the East of Scotland for the attraction of high value mobile investment, with proximity to Edinburgh Airport and the benefits of the multi-modal transport network connections and accessibility in the area. In addition if this continued competitiveness is to be maintained the area's 'gateway' role to the City from both the motorway network and from airline/airport connections by highly accessible rapid public transport, must be improved, by this form of investment.

8.4.3.5 Property Related Impacts at Regeneration Area Level

The tram line will clearly provide a key strategic transportation link connecting West Edinburgh to both the City Centre and Edinburgh Airport. It will also provide greater accessibility and choice of transport for many of the more deprived and social excluded regeneration areas, particularly those in the South West of the City. This would include some of the more established residential neighbourhoods such as Broomhouse, Sighthill and Stenhouse.

It is very difficult to provide an estimate of the precise level of any such impact upon these local regeneration areas, but it will clearly depend upon the extent to which the residents of these communities are able to access the provided tram line services to subsequently gain access to new employment opportunities throughout West Edinburgh and indeed elsewhere in the City.

The anticipated growth and increasing levels of demand and pressure for new forms of development across the City will result in a potential growth in the construction industry which may also subsequently provide greater employment opportunities for local residents.

8.4.3.6 Regeneration Areas

The Scottish Indices of Multiple Deprivation (SIMD) measure levels of deprivation through means of five key indicators of deprivation: access, education, employment, health and income. In the areas immediately alongside and adjoining Edinburgh Tram Line Two, five wards fall within the 21 worst wards in the City of Edinburgh (out of 58 wards):

- Stenhouse - ranked as 14th most deprived in Edinburgh;
- Dalry - ranked as 15th most deprived;
- Sighthill - ranked as 17th most deprived;
- Moat - ranked as 18th most deprived; and
- Tollcross - ranked as 21st most deprived.

In assessing the extent of the level of deprivation within the tram line corridor we have also taken into consideration the ward's overall deprivation ranking across Scotland. The SIMD indicates that the Stenhouse ward is the 399th most deprived ward in the country out of 1222 wards, the lowest of all the respective wards falling within the Edinburgh Tram Line Two corridor.

- Stenhouse - ranked as 399th most deprived in Scotland;
- Dalry - ranked the 432nd most deprived;
- Sighthill - ranked as 502nd most deprived;
- Moat - ranked as 517th most deprived; and
- Tollcross - ranked as 660th most deprived.

Again it is anticipated that the regeneration area wards will seek to benefit from the transport improvements resulting from the tram line, primarily by virtue of increased accessibility and greater job and labour market opportunities being created in West Edinburgh, as well as other opportunities situated within the City Centre and elsewhere in the City. Table 8.18, below, shows both the current working age population levels at the time of the 2001 Census and the number of unemployed residents within each ward.

Table 8.18: Regeneration Areas: Population and Unemployment

Ward	Working Age Population (16-74 yrs)	Unemployed Residents	Unemployment Rate (%)
Stenhouse	5,724	168	2.9 %
Dalry	7,100	244	3.4 %
Sighthill	6,702	221	3.3 %
Moat	5,893	166	2.8 %
Tollcross	6,228	237	3.8%

Source: 2001 Census

As can be seen from Table 8.18, unemployment is higher than the 2.9% City of Edinburgh average in Dalry, Sighthill and Tollcross; equal to the City average in Stenhouse and just below in Moat. In each instance, employment was less than that across Scotland where average unemployment stood at 4%. Although more recent unemployment figures are available at the City level in April 2003, similar corresponding data is not available at the ward level.

It is more than likely that overall economic activity rates within these neighbourhoods are below the average corresponding levels for the City of Edinburgh. This would therefore suggest that there may be additional available labour workforce in the area which could benefit from, and be accessed to satisfy, a number of employment opportunities which may arise in the West of Edinburgh.

8.4.3.7 Employment Opportunities in West Edinburgh

The Edinburgh and Lothian region continues to benefit from the buoyant effects of the City region's growing economy and property market, and employment levels are also likely to benefit as a result.

The future development sites identified in the above Sections could provide a significant range of job opportunities for the local population in West Edinburgh. However, historically in the wider Edinburgh conurbation there have been few opportunities for high quality, highly accessible sites appropriate for high value business investment and development. The former focus of such development in the City Centre has more recently been constrained by lack of development land and conservation factors, and the result has been the pressure for development to the west of the city, and particular pressure for development towards Edinburgh Airport. The focus for much high value internationally mobile business investment has to date been Edinburgh Park, which is regarded as the premier business park location in Scotland, and the attractive facilities, prestigious occupier profile, proximity of and access to multi-modal transport links, and high quality environment have continued to attract such development interest. This has also been built upon by the location and development of the Royal Bank of Scotland Group's World HQ at Gogarburn, which adds to the critical mass of such high quality, high skill, and high value activities.

The benchmark criteria that provide the basis for a successful business location can be illustrated with reference to equivalent locations throughout the UK. Those attributes, most highly valued by high quality and mobile business investors and occupiers comprise:

- Excellent Accessibility, Location and Visibility - The significance of accessibility, location and visibility cannot be emphasised enough. Close to strategic routes and/or major public transport infrastructure, including airport, main line railway station, and/or major bus station. It is also important for any business to be situated in a prime location with highly visibility particularly from the major transportation routes, including strategic routes and motorways.

- Proximity to an Airport – Many occupiers favour a business location in close proximity to a major airport, particularly for those firms trading on a global level. The level of international scheduled flights and 'interlining' routes therefore is also a key requirement.

- Proximity to Major Urban Conurbations – Business locations should preferably be close to one or more major urban conurbation. This relates not only to availability of supporting facilities but also to access to markets. The relative proximity of a location to a major conurbation also has implications for the availability of labour.

- Provision of Infrastructure - It is essential to have good on-site infrastructure in terms of telecommunications, and other utilities. There is also a continuing and growing importance attached to the level of on-site car parking provision, particularly for those businesses where 'mobility' during working hours is an integral part of employment.

- High Quality Environment - The wider environment should include sites with good quality profile and presence; complementary uses and attractive visual appearance; and should support good quality housing, good schools and attractive facilities.

- Sufficient Scale of Development Land - Small sites are unlikely to have the critical mass sufficient to create a prestigious environment. Smaller sites could, however, be suitable where they form an integral part of a larger high quality environment that lends prestige to the smaller scheme.

- Good Quality and Availability of Labour – it is important to have a substantial resident population and labour catchment within a 30 minute travel time. Sites would, typically, be located close to major cities and/or motorway junctions that are highly accessible to such major settlements.

- Prestigious Occupier Profile – Occupiers or users should in principle be high quality offices, research and development facilities, and light industry, which in effect are all businesses falling within Class 4 of the Use Classes Order (Scotland) 1997. Available sites should ideally be developed for multiple-occupation, rather than simply for single-users.

- Supporting Services and Amenities – It is becoming increasingly important for high quality business locations to have a range of supporting services and amenities in close proximity, such as shops, restaurants, and leisure facilities.

- Proximity to other Related Businesses – for some high value businesses it is a very important aspect of business location that they be located within close proximity to related industries, sectors, and other businesses.

- Proximity to Higher Education Institutions (HEIs) – those companies actively involved in knowledge intensive industries will likely seek a business location with ready accessibility to Higher Education facilities.

Thus it is clear from this analysis of the key attributes for a high quality business location, that these are answered particularly in the West of Edinburgh, with the top factors being associated with accessibility to transport networks and services, and an airport with international and 'interlining links'. It is therefore no surprise that this area has and is likely to continue to be the focus of attraction of such investment in the city in the future.

Such employment opportunities are likely to emerge in the continuing agreed expansion and pressure for further expansion of established employment locations including Edinburgh Park, South Gyle, Edinburgh Airport and the Gyle Shopping Centre. For example, there is currently projected to be up to 12,000 additional jobs at Edinburgh Park over a period of 10-15 years, associated with the Park's expansion.

Other pressures will be for employment growth directly and indirectly related to the continuing development of Edinburgh Airport, its burgeoning international and domestic route networks, and passenger numbers. Such airport related employment growth is generally found within close proximity of the subject airport and Edinburgh would seem unlikely to be an exception. Thus for the economic benefits of such high value investment and employment to be accommodated within wider west Edinburgh area, the pressures derived from this future growth must be addressed in terms of public transport networks and services and the management of the constraint of increasing congestion.

To maintain this economic buoyancy and address the pressures which will inevitably arise will require a high volume high quality public transport system, best served by a LRT network. Without this type of network the pressures deriving from the existing employment and residential allocations to the West of Edinburgh will be difficult to accommodate, and the increasing traffic congestion will act as a discouragement to the very high value mobile investment essential for future prosperity of both Edinburgh and the wider Scotland economy.

Although we cannot predict the precise type and nature of employment opportunities which may arise in the future, we can expect that at least a reasonable proportion of employment will be suited to existing West Edinburgh residents. In particular, the continuing growth in the services and construction sectors could provide appropriate opportunities for higher employment, especially amongst the female working population and those that may be seeking part-time employment.

It should be noted that despite such employment opportunities it is likely that only a proportion of these jobs will be truly additional, with others resulting from business and job relocations. There should thus be some caution or allowance made to account for any such displacement effects.

It is, therefore, anticipated that in tandem with wider changes in society, the introduction of Edinburgh Tram Line Two will provide positive impacts and employment opportunities across the social group spectrum.

8.5. Integration

8.5.1. INTRODUCTION

Published in July 1998, the Transport White Paper is the framework within which the Government aims to develop a transport system which recognises that:

"A sustainable environment requires, above all, an effective and integrated transport policy at UK, Scottish and local level that will provide genuine choice to meet people's transport needs."

The Government's transport policies seek to achieve improved integration:

- "Within and between different modes of transport, to promote genuine choice, so that each mode contributes its full potential and people can move easily between different modes;
- "With environmental aims and policies, so that transport choices do not conflict with the achievement of environmental objectives;
- "With land use planning at national, regional and local level, so that the two work together to reduce the need to travel and support more sustainable regional travel choices;
- "With Government policies on education, health, economic growth and the objective of a fairer, more inclusive society."

Environment integration is considered in Section 8.3 and integration with social inclusion is dealt with in Section 8.8. Issues relating to transport, land-use and policy integration will be reviewed in this Section.

8.5.2. Transport Integration

An integrated transport system must operate as a true network across all modes in order that passengers can move easily from one service to another in a comfortable environment. Integrated transport can, thus, reduce the need to travel, tackle congestion and pollution and support a strong economy, a sustainable environment and a healthy and inclusive society.

Important elements which should be considered when planning integrated transport facilities include through-ticketing / joint-ticketing arrangements; enhanced connections and co-ordination of services; clear, accessible and wider availability of information; improved waiting facilities; appropriate location and accessibility for the elderly and mobility impaired.

The attractiveness of the public transport system as a whole in Edinburgh can be enhanced with the implementation of Edinburgh Tram Line Two by:

- The existence and quality of infrastructure facilities at stations, such as seating and waiting areas with weather protection (shelter) – slight beneficial;
- Maximising bus and rail interchange with tram at key locations, with greater opportunities for interchange, greater convenience and shorter distance between boarding points, and level floor boarding for all trams. In addition, there may be opportunities for the provision of cycle racks at some stops – moderate beneficial;
- Maximising public transport interchange with car at Park and Ride location; and
- Real-time passenger information at all stations – moderate beneficial.

For an integrated public transport system to be fully exploited by the public, it must provide a truly "seamless" journey in which passengers can have sufficient confidence to use it as an alternative to the private car. Interchange facilities therefore form a key component of transport integration. The preferred

route corridor offers interchange with bus, rail, air and Park and Ride. This will potentially have a significant impact on patronage and opportunities for feeder services to widen the catchment for the tram. The direct, segregated alignment will provide good access to interchange facilities in the City Centre in addition to connections at key locations in the corridor.

As described more fully in paragraph 9.2.6, **tie** has recognised the potential for a lack of transport service integration, or bus competition, to impact adversely on the benefits, which should result from the introduction of the trams. **tie** has therefore instigated the Development, Partnering and Operating Franchise (DPOF) process leading to the appointment of a tram operator early in 2004 to confirm assumptions made by **tie**'s technical, legal and financial advisors related to the operation of the network. The operator's brief will require their active cooperation with bus operators in the region to reach operating agreements to facilitate service integration.

The preferred route corridor provides interchange opportunities at Edinburgh Airport and Haymarket Rail Station. This corridor would allow a principally dedicated tram route, and would likely provide the fastest journey time between the Airport and Haymarket. This corridor would also interchange with the new Edinburgh Park Rail Station and there is potential for interchange with buses at the Gyle Shopping Centre. In addition, there are good opportunities for interchange with the A8 bus halt between Gogar Roundabout and Gogar hamlet.

The tram route will provide direct access to Edinburgh Airport with a stop immediately adjacent to the terminal entrance. The tram will, therefore, act as a feeder mode from the Airport to Edinburgh Park and the City Centre. A high quality and fully accessible interchange will be provided at Edinburgh Airport. The role of this interchange would be further enhanced when the proposed Edinburgh Airport Rail Link opens.

The tram route will enable the integration of journeys via car and public transport through the use of Park and Ride at Eastfield Road, Ingliston. The stop which serves both the main line and the Newbridge branch has been located to maximise the use of the Park and Ride. This will therefore offer an attractive alternative to the congested route into the City Centre.

It is estimated that all users of Edinburgh Tram Line Two will benefit, to varying degrees, from the various aspects of transport integration improvements identified above, when compared to the existing level of service. The overall impact of Edinburgh Tram Line Two on transport integration is expected to be moderate beneficial, leading to an improvement in the accessibility of the public transport network.

8.5.3. Land-Use Transport Integration

Recent developments in UK and Scottish Government policy have provided a clear framework for the integration of land use and transport planning with a general requirement to promote sustainability and reduce the need to travel to relevant existing or future developments.

The land-use transport integration sub-objective should consider whether:

- Any land required for the proposal is preserved for uses which are incompatible with transport (for example, protected or conservation areas);
- The proposal fits with the general policies of all authorities at all levels concerning transport and land use; and
- The proposal conflicts with any other existing or planned development.

Thus, there is a requirement for the identification of the land use policies or proposals conflicting with statutory planning documents at local, regional and national levels. This has been carried out to some extent during the AST1 process and any serious conflicts would have been identified at an earlier stage.

At the national level, the National Planning Policy Guidelines set out the policies on land use and sustainable transport. Edinburgh Tram Line Two supports a range of land use policy objectives at all levels. National policies supported include:

- National Planning Policy Guidance (NPPG) 17, Transport and Planning, sets out Government policy on the integration of land use and transport planning, under the following relevant principles (which are also referred to by the accompanying Planning Advice Note PAN 57):

- Locate and support development in places well served by public transport and restrict associated car parking, so that access to significant travel-generating developments by non-car modes improves significantly;
- Need to prioritise accessibility within the integrated transport system by sustainable modes of travel;
- Use Green Transport Plans and planning agreements to promote sustainable transport solutions; and
- Manage traffic demand effectively and support the provision of high quality public transport services on the road network.

The Scottish Planning Policy (SPP) 17, Transport and Planning - Maximum Parking Standards, is an addendum to NPPG17 which provides further guidance relating to maximum parking standards, stating specifically the need to:

- Manage motorised traffic to contribute to sustainable development objectives;
- Constrain car parking for new developments;
- Locate development where it is most accessible to more sustainable modes of travel; and
- Provide for travel by public transport, on foot and by cycle.

The regional policies supported include:

- The Regional Planning Guidance (RPG) in relation to economic prosperity, regeneration, ensuring quality of life and choices of opportunities for all;
- The overall development principles of the RPG, together with the specific objectives which it defines in relation to transport and regeneration; and
- The aims of the Regional Transport Strategy (RTS).

Further planning objectives have been described in Chapter Two, including those in the Local transport Strategy (2001 – 2004).

Overall, it can be said that the preferred route corridor integrates well with land-use, as outlined below.

The Finalised Edinburgh and Lothians Structure Plan 2015 makes clear that the delivery of a tram system is crucial for the successful delivery of the plan's development strategy. That strategy includes identification of core areas where major new development will take place. One of these is the Ratho/Newbridge/Kirkliston area where major new business developments and greenfield land release for housing is to take place. These land releases are dependent on the provision of new associated infrastructure, including provision of the West Edinburgh Tram. The Structure Plan has not yet been approved by the Scottish Ministers. However, draft modifications published by the Scottish Ministers in January 2004 suggest that there is unlikely to be any significant changes made to this strategy before approval.

The Finalised Rural West Edinburgh Local Plan is designed to implement the emerging Structure Plan. Major new greenfield housing land sites for a total of 765 houses are identified in the plan at Kirkliston North and Ratho Station to meet the requirements of the Structure Plan. However, the Local Plan makes clear that housing on these sites shall not be occupied before the West Edinburgh Tram to Newbridge is operational or its funding committed (Policy H2). In justification of this the plans states that the West Edinburgh Tram to Newbridge, and eventually beyond, is crucial to delivering a sustainable development solution in the Newbridge/Kirkliston/Ratho area.

The preferred route corridor will integrate well with major employment, leisure and transport hubs, such as Edinburgh Airport, Haymarket Rail Station, the Gyle Shopping Centre, Edinburgh Park and the RBoS, thus contributing to sustainability and reducing the need to travel. In addition, there is also greater scope for development opportunities resulting from the eventual routing of Edinburgh Tram Line Two.

The preferred route option will provide a generally positive impact for the business community, principally through improving accessibility and also potential for increased trade custom. This is particularly relevant for businesses located in Edinburgh Park, South Gyle and Sighthill, as well as those businesses located nearer to the City Centre.

There will be some minor impacts where existing business and residential holdings may require to be compulsory purchased to accommodate the tram line.

The Roseburn – Carrick Knowe section of the preferred route corridor will significantly impact upon residential properties on Roseburn Drive and residents along Baird Drive raised concerns regarding noise and visual impacts from the tram.

It can be summarised that the improvements in public transport brought about by Edinburgh Tram Line Two are expected to meet or support most local, regional and national policy objectives, in particular those related to sustainable travel (with increased use of public transport and reduced dependence on the car), regeneration and improving access, particularly for those dependent on public transport.

The overall assessment of the land-use transport integration impacts can be considered moderate beneficial.

8.5.4. Policy Integration

The White Paper, Travel Choices for Scotland, quotes education, health and wealth creation as key areas of concern when planning transport, recognising that transport decisions have wide impacts upon communities.

The Policy Integration criterion examines whether the proposed scheme contributes to, and is consistent with, other Government policies and legislation beyond transport.

Edinburgh Tram Line Two can contribute to the following wider Government policies:

- Disability – The design of trams and stations, fully DDA (1995) compliant and with level boarding, will provide easy access to wheel chairs and push chairs, thus facilitating access not only for the mobility impaired but also the elderly and those with young children;
- Health – The expected modal shift from car to public transport for journeys by local residents and others travelling to local employment and recreational facilities will provide greater opportunities for increased walking and cycling trips to reach the new tram stops. In addition, the use of trams (as opposed to cars) will reduce the adverse environmental impacts of traffic, particularly harmful local emissions, with an overall positive effect on health;
- Rural affairs – The scheme does not reach rural areas and therefore it can do very little to contribute to improve rural affairs or retaining rural communities;
- Social exclusion – the scheme fits in with policies to promote social inclusion, by enabling the socially deprived (particularly those with no access to a car) access to the public transport network. These benefits are accounted for in the following section.

It can therefore be said that the scheme is consistent with national policies beyond transport.

The local and regional planning policy context is set within national guidance and particularly reflects priorities for sustainability and integration. The West Edinburgh Planning Framework has been prepared by the Scottish Executive and provides policy guidance on planning, development and growth in West Edinburgh. A key element is that adequate transport provision is essential to enable any additional development in the area.

Similarly, the emerging Edinburgh and the Lothians Structure Plan presents the challenge to ensure that a sustainable future can be built in West Edinburgh and the wider area using the proposed tram corridor as a key artery of business and community activity. Key principles of this policy are as follows:

- Combating social exclusion by ensuring access between disadvantaged local communities and subsequent new employment opportunities situated in or adjacent to the proposed tram corridor.
- The need to ensure access to affordable transportation networks for all parts of the local community and particularly those in disadvantaged areas, such as West Edinburgh and West Lothian.
- Support for controlled development and re-use of existing buildings and vacant, derelict and Brownfield sites where regeneration potential will be maximised through integration with the proposed tram line.

The preferred route corridor will provide additional public transport in a previously un-served corridor. It is thus likely to have a positive impact on congestion, converting car users to public transport passengers utilising a highly efficient transport mode. The tram route will also improve accessibility and social inclusion, particularly in relation to the less advantaged communities to the south of the route.

The preferred route corridor integrates well with planning and transport policies by serving the Gyle Shopping Centre and avoiding further impacts on traffic congestion at Gogar Roundabout.
The requirement for a signal controlled junction at the A8 – RBoS access junction may not suit planning policy, and is likely to draw an objection from RBoS and possibly CEC Transport. In addition, the development of Green Belt land will be required at this location.

8.6. Accessibility

The proposed Edinburgh Tram Line Two will increase accessibility by public transport, with key benefits realised by those who do not own a private car and the socially disadvantaged. The higher reliability of tram, relative to bus, will particularly benefit these groups and will, in practice, increase the accessibility of the public transport network.

The key destinations of trips to access employment opportunities, local services and transport interchangeshave been identified as:

- City centre (employment, shopping);
- Haymarket Rail Station (transport interchange);
- Murrayfield Stadium (leisure);
- Sighthill Industrial Estate (employment, services);
- Edinburgh Park (employment);
- The Gyle Shopping Centre (employment, shopping);
- Hermiston Gait Retail Park (employment, shopping);
- Royal Bank of Scotland Headquarters (employment);
- Edinburgh Airport (employment, transport interchange);
- Ingliston Showground (leisure);
- Ratho (employment);

- Newbridge (employment); and
- Proposed Park and Ride sites (transport interchange).

As illustrated in Tables 8.14 and 8.15 above, the impact of tram is broadly positive with time savings for most movements. This is the key measure of accessibility as it is weighted by usage to provide a monetary value. Table 8.14 shows a Present Value of benefits of £167.6 million to public transport users, while Table 8.15 shows that remaining highway users would also benefit, by £74.9 million.

The new tram obviously assists movements from West Edinburgh to the city centre. Other public transport movements are improved due to reduced peak highway traffic relieving congestion and therefore increasing bus speeds.

However, bus journeys to and from the city centre, or which pass through the city centre are adversely affected. Between Haymarket and St Andrew Square, tram takes away highway capacities, reducing highway speeds and, hence, bus speeds. This study has taken a conservative approach and assumed that these changes will impact on bus speeds and hence on PT benefits. However, in practice it is hoped that this can be counteracted by bus priority schemes to mitigate these problems. The scope for such changes must be viewed within the context of other traffic changes. The City of Edinburgh Traffic Management proposals provide an ideal opportunity to integrate tram and bus provision with arrangements for other vehicles. Accordingly, the above benefits may be conservative.

Some of the key public transport movements to benefit from the Edinburgh Tram Line Two scheme are shown in Table 8.19.

Table 8.19 - Example of PT time improvements in the AM peak

Origin	Destination	Time saving (generalised minutes)	Percentage Saving
Roseburn	Edinburgh Park	30	49
Edinburgh Park	Roseburn	30	49
Portobello	South Gyle	27	26
Wardie	South Gyle	26	28
Roseburn	South Gyle	25	44
Picardy Place	South Gyle	25	43
Edinburgh Park	Haymarket	24	45

An important improvement to the public transport network is connections between key transport interchanges. Table 8.20, below, outlines the improvement in connections between transport interchanges in the AM peak.

Table 8.20 - Improvement in connections between transport interchanges in the AM peak

	Change in Generalised Time (minutes/percentage change)			
	Airport	**Gyle Centre**	**Edinburgh Park Stn.**	**Haymarket**
Airport		-5 (–11%)	-27 (-48%)	-1 (-3%)
Gyle Centre	-8 (-18%)		-6 (-15%)	0 (0%)
Edinburgh Park Stn.	-32 (-52%)	-10 (-28%)		-24 (-43%)
Haymarket	-2 (-6%)	-5 (-12%)	-14 (-31%)	

The greatest benefit is between Edinburgh Park Station and the Airport, while most other movements experience significant improvements. The reductions in generalized time range from 15% (Gyle Centre to Edinburgh Park station) to 52% (Edinburgh Park station to Airport). However, the improvement between the Airport/Gyle Centre and Haymarket is minimal as the Airlink express bus already proved a very competitive and attractive service. However this is dependant on maintaining the effective operation of the Greenways as congestion levels rise and this may not be possible, as discussed in Chapter 3.

Connections between residents and employment centres are also important. There is a very broad geographic spread of residential areas and employment centres, thus Table 8.21 (below) concentrates on three residential areas in West Edinburgh which were identified as being particularly deprived.

Table 8.21 - Improvement in connections between areas of Multiple Deprivation and some employment centres in the AM peak

	Change in Generalised Minutes (percentage change)				
	Newbridge	**Edinburgh Park**	**City Centre**	**Leith**	**Granton**
Sighthill	-23 (-23%)	0 (0%)	-3 (-6%)	0 (0%)	-5 (-5%)
Stenhouse	-23 (-21%)	0 (0%)	-3 (-6%)	4 (6%)	-4 (-5%)
Dalry	-17 (-18%)	0 (0%)	-2 (-8%)	5 (9%)	-4 (-5%)
Moat	-16 (-14%)	0 (0%)	-3 (-6%)	4 (6%)	-4 (-5%)
Tollcross	-19 (-19%)	-5 (-10%)	1 (4%)	2 (4%)	-1 (-2%)

Tram would assist significantly in providing access to employment opportunities in Newbridge and employment, shopping and leisure opportunities in the city centre. However, it does little to improve connections to Edinburgh Park, because Sighthill and Stenhouse are more appropriate for walking and short bus rides and the tram is not very appropriate for Moat or Dalry either. There is a benefit to trips from Tollcross however. Part of the reason is that Sighthill and Stenhouse are served by the fully segregated sections of WEBS and would benefit less than the rest of the corridor from improved accessibility after conversion of the busway to tram. . Links to Granton benefit, but those to Leith suffer because they require bus connections which suffer from the reduced capacities in the city centre. This appraisal focusses on the impact of Tram Line 2 in isolation. However, the combined effect of constructing both Line 1 and Line 2 would be to improve access to both Leith and Granton.

It is also worth noting that the scheme leads to some very significant improvements in accessibility at a zone to zone level. We have analysed the 100 movements with the largest improvement in public transport accessibility, all of which enjoy a reduction in generalised time of at least 19.8 minutes as a result of the tram. These include 49 flows to or from Sighthill and 29 flows to or from zones in Edinburgh Park, showing that these areas enjoys some of the greatest benefits from the scheme. Other areas that feature in the top 100 movements include Gyle Shopping Centre, Hermiston Gait, Murrayfield and a range of zones in the City Centre and Haymarket.

Table 8.22 - Improvement in connections between some employment areas and transport interchanges in the AM peak

	Change in generalised minutes (percentage change)			
	Airport	**Gyle Centre**	**Edinburgh Park Station**	**Haymarket**
Newbridge	-32 (-42%)	2 (3%)	-33 (-36%)	-21 (-24%)
Edinburgh Park	-32 (-52%)	-10 (-28%)	0 (0%)	-24 (-43%)
City Centre	-8 (-18%)	-4 (-11%)	-17 (-34%)	0 (0%)

Table 8.22 shows a general improvement in links between employment areas and transport interchanges. Increased traffic on the A8, west of the Airport accessing the Park and Ride site has made a small adverse impact on Newbridge-Gyle Centre links. Some of the benefits are very significant, for example a 52% reduction in generalised journey time between Edinburgh Park and the Airport and 43% between Edinburgh Park and Haymarket.

Overall, the analysis demonstrates a general improvement in accessibility with some very significant benefits for certain movements. There are, however, some disbenefits, mainly as a result of reduced highway capacity in the city centre. In general, access to local services is improved as a result of the scheme and the more deprived areas within the corridor share in the benefits. Overall, the objective of improving accessibility is met.

8.7. Cost to Government

8.7.1. Introduction

Edinburgh Tram Line Two shares a section of common track with Edinburgh Tram Line One, extending from St Andrew Square to Roseburn Junction. The technical work to design the infrastructure and provide cost estimates for this section of the route has been undertaken by the Edinburgh Tram Line One technical team led by Mott MacDonald. The costs associated with this element of the infrastructure have been added to those developed by the Edinburgh Tram Line Two team for the route between Roseburn Junction and Newbridge/Edinburgh Airport.

Full details of the estimate build-up for the section between the western termini and Roseburn Junction can be found in Appendix F to this report.

Where practicable, the assumptions used to derive the costs have been agreed between Edinburgh Tram Line One and Edinburgh Tram Line Two, as driven by **tie** and Grant Thornton (GT). For example, rates used for vehicle costs, contractors' preliminaries and design costs are consistent for both lines. For the majority of other factors, the rates and/or quantities used are expected to vary from line to line, as the individual characteristics of the particular route are taken into consideration

8.7.2. Capital Costs

Cost estimates have been prepared using a combination of benchmarking, previous experience and engineering judgement, with the rates used reflecting experience in a wide variety of LRT and highway projects throughout the UK and Europe. Rates are based upon 2Q 2003 prices.

The assumptions underlying the estimates are provided in the Scheme Cost Report in Appendix F.

The detailed cost estimate has been split into three main constituents:

- St Andrew Square to Roseburn Common Section;
- Roseburn to Airport; and

- Newbridge Shuttle.

Table 8.23 provides a summary of Edinburgh Tram Line Two costs, a more detailed breakdown can be found within Appendix F.

Table 8.23 - Summary of Edinburgh Tram Line Two Costs

Scenario	Route Description	Capital Cost (£M)
Line One already completed	Roseburn to Airport only	225.8
Line One already completed	Roseburn to Airport; Ingliston to Newbridge	279.4
No Line One	St Andrew Square to Airport	282.8
No Line One	St Andrew Square to Airport; Ingliston to Newbridge	336.3

Note: All costs include 31% Optimum Bias

8.7.3. Operating Costs

Operating cost is a major component of the business case. However, this element is often difficult to assess as it varies a lot from network to network. Moreover, engineering consultants have very little access to the accounts of public transport operators. Recognising this, **tie** has instigated the DPOF process through which the appointed Operator will provide information to verify or adjust the assumptions made in this report.

Estimations of the operating costs have been realised based on an iterative process to take into account the different updates and the level of definition of the project. The methodology and the unit rates for the calculation have also been discussed with Edinburgh Tram Line One consultants to ensure consistency in the calculations.

The assumptions used to provide the basis can be found in Appendix F. The Newbridge shuttle service is presented separately, but most of the administrative costs have been allocated to the principle between St Andrew Square and the Airport.

Table 8.24 - Operating Cost Breakdown

Item	Airport Service (£M)	Newbridge Shuttle (£M)	Total (£M)
Staff Cost	3.07	0.64	3.71
a. Drivers	*0.70*	*0.17*	*0.87*
b. Conductors	*0.54*	*0.14*	*0.68*
c. Other Operating Staff	*0.52*	*0.06*	*0.58*
d. Management and Admin Staff	*0.36*	*0*	*0.36*
e. Maintenance and Engineering Staff	*0.95*	*0.27*	*1.22*
Power	0.22	0.04	0.26
Maintenance Materials	0.61	0.14	0.75
Insurance	0.23	0.05	0.28
Policing	0.17	0.03	0.20
Other Overheads	0.21	0.05	0.26
Business Rate 5%	0.16	0.05	0.21
Automatic Ticket Gates	0.03	0	0.03
TOTAL	**4.70**	**1.01**	**5.71**

8.7.4. Lifecycle Costs

Lifecycle costs have been estimated using a similar approach to the capital costs, namely using a combination of benchmarking, previous experience and engineering judgement. In addition, detailed discussions with Edinburgh Tram Line One Consultants have taken place to ensure consistency of approach.

The lifecycle costs for Edinburgh Tram Line Two encompass all costs associated with operating and maintaining the tramway that are outwith the standard operating costs. These include the replacement of civil, electrical and stop installations, tram vehicle refurbishment and other non-routine maintenance activities.

The build-up of lifecycle costs has been based around a standard list of lifecycle items agreed between **tie** and the Consultants for Edinburgh Tram Line One and Edinburgh Tram Line Two. Lifecycle costs have been determined by specifying maintenance intervals for "minor" or "major" refurbishment of each item, and by applying a cost as a percentage of the original value.

Lifecycle costs have been "smoothed" through the 30-year design life of the system, by using a profile agreed between **tie** and the Consultants for Edinburgh Tram Line One and Edinburgh Tram Line Two.

The lifecycle costs for Edinburgh Tram Line Two are summarised in Table 8.25, below:

Table 8.25 – Lifecycle Costs

Section	Cost (£M)
St Andrew Square to Roseburn	6,760
Roseburn to Airport	34,264
Newbridge Shuttle	10,648
St Andrew Square to Airport	41,024
St Andrew Square to Airport plus Newbridge	51,672

8.7.5. Revenue

A thirty-year profile has been calculated assuming that Edinburgh Tram Line Two commences operation at the start of 2009. A period of ramp up is assumed, in which full revenue is only achieved in the fourth year of operation. Table 8.26 shows the ramp up assumed.

Table 8.26 - Assumed Ramp Up

	Year 1	Year 2	Year 3(2011)
Percentage of base revenue	75%	85%	95%

Base revenue between 2011 to 2026, the two model years was interpolated as a straight line, which was also extrapolated back to 2009. Past 2026, revenue is assumed to be constant as per TUBA recommendations. The impact of ramp-up ceases to apply after 2012.

The model uses full adult single fare to compare the relative attractiveness of the different modes, however, not everyone pays full single fare. Therefore, revenue loss due to ticket type and fare evasion should be taken into account in estimating actual revenue.

Adjusted patronage and revenue forecasts are shown in Table 8.27, below.

Table 8.27 – Edinburgh Tram Line Two Patronage and Revenue (2003 prices)

	2011 (excluding ramp-up)	2011 (including ramp-up)	2026
Patronage	**5.38M**	**5.11M**	**6.94M**
Revenue (full adult fare)	**£7.98M**	**£7.58M**	**£9.90M**
Loss due to ticket type	£0.94M	£0.89M	£1.15M
Loss due to fare evasion	£0.35M	£0.33M	£0.44M
Revenue, less revenue loss	**£6.69M**	**£6.36M**	**£8.31M**

The impact of various sensitivity tests, including that of not implementing the Newbridge shuttle service, is discussed in Section 9.6.

8.7.6. Economic Returns

The relevant report forms contain details of the calculated benefit/cost ratios for the tram scheme. Table 8.17 shows that the benefit / cost ratio for the preferred scheme is 1.38. This illustrates that the provision of the Edinburgh Tram Line Two represents excellent value for money.

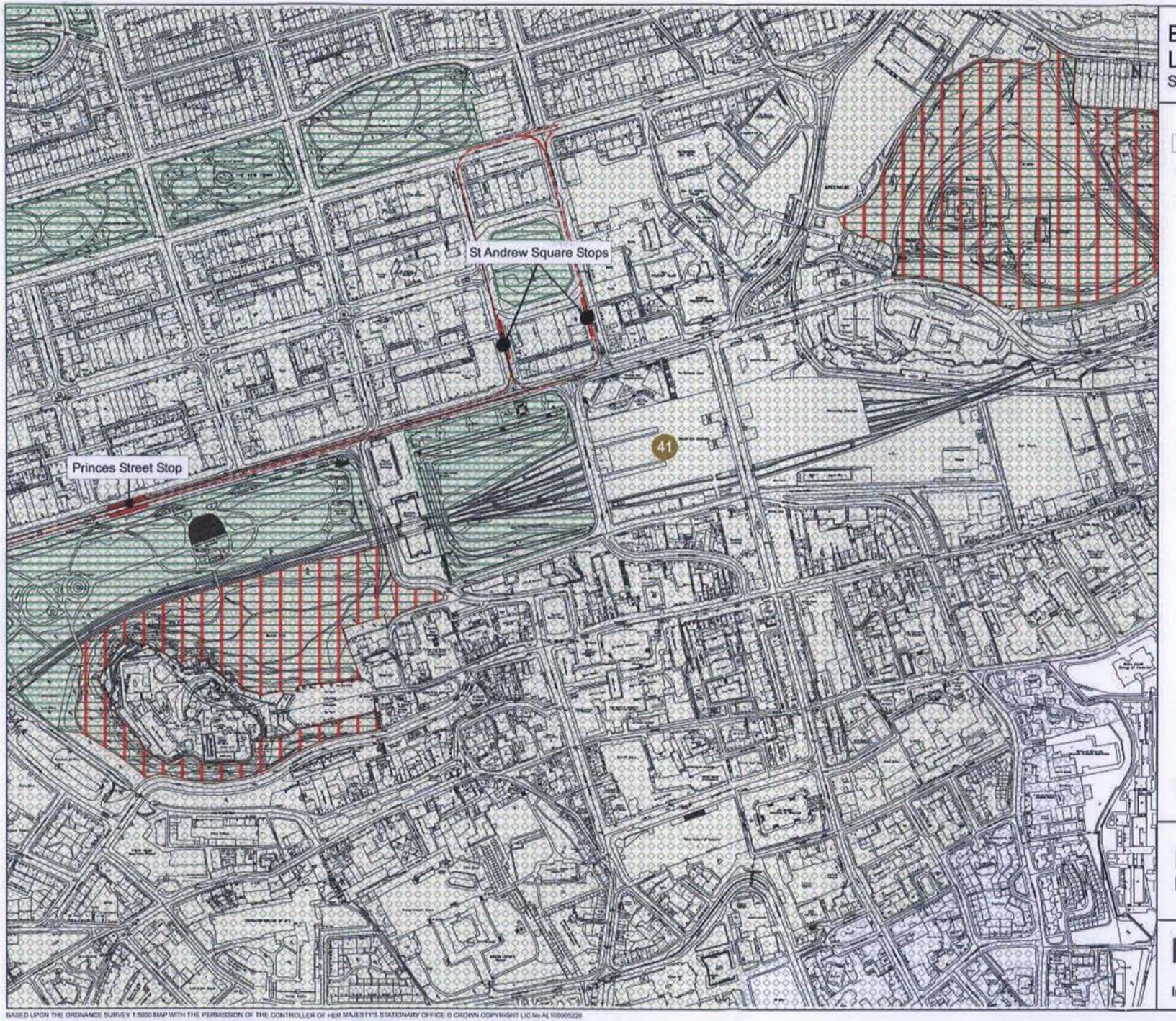
8.8. Contribution To Meeting Planning Objectives

Table 8.28 below summarises the Planning Objectives for the scheme and the extent to which the appraisal has shown that it meets them.

Table 8.28 Contribution to Meeting Planning Objectives

Planning Objective	Contribution of Scheme
Improve access to public transport	Accessibility improves, with a saving in generalised journey time worth £168 million over the scheme life
Improve access to employment opportunities	Journey times from residential areas and transport interchanges generally show a reduction, with limited exceptions
Support economic development	The scheme would unlock additional development potential in the corridor and could assist in attracting major new developments
Increase proportion of journeys made by public transport, walking and cycling	There is a significant transfer from car to tram
Improve local air quality	Local air quality would be improved for 176,000 residents in 2011 and 165,000 in 2026 as compared with 101,000 and 106,000 respectively who would suffer worse air quality
Reduce greenhouse gas emissions	Greenhouse gas emissions in the study area would reduce by 3% in 2011 and 9% in 2026 relative to the do-minimum
Reduce number of private vehicle kilometres	There is a reduction in peak vehicle kilometres and an increase in off peak trips. This is due to a combination of increased economic activity, generating extra highway trips, and modal transfer to tram. The latter is greater in the peak due to higher congestion levels. This leads to a reduction in peak and an increase in off peak traffic volumes. There is a small increase in road traffic accidents. These objectives are met in the peak but not in the off peak or overall. However this is due to the increased economic activity that the scheme induces. If this did not occur, the objectives would be met
Reduce traffic volumes on key routes	
Reduce number of road traffic accidents	
Improve personal security	Tram will provide improved personal security relative to other public transport options.

The table shows that the scheme would make a significant contribution to meeting the majority of the Planning Objectives. However the increased economic activity that would be generated by the scheme leads to an overall increase in travel. As much of this would be made by car, the aims of reducing road traffic and associated road traffic accidents would not be met. The scheme has the potential to support economic development or to reduce car trips, but these objectives are in conflict with each other. In consequence, there is a policy choice to be made. Planning controls could be used to suppress development and achieve the reduction in car trips. Conversely, development could be permitted, resulting in additional car trips. However, it is important to recognise that, in the latter scenario, the level of car travel would be less than if the same level of development had been achieved through other – non-transport related - policy measures. Accordingly the traffic reduction objectives would be met in relative, though not absolute, terms,



EDINBURGH TRAM LINE TWO
STAG Report

tie

10 9 8 7 6 5 4 3 2 1

Plan Refrence

Key :

- Edinburgh Tram Line 2
- Site of Special Scientific Interest (SSSI)
- Areas of Importance for Flood Control
- Conservation Area
- Urban Wildlife Site/Site of Interest for Nature Conservation (SINC)
- World Heritage Site
- Historic Gardens & Designed Landscape
- Depot Site
- Significant Open Space
- Scheduled Ancient Monument
- Green Belt
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- Area of Great Landscape Value
- Potentially Contaminated Land (See ES Appendix 7)
- Licensed Waste Management Sites (See ES Appendix 7)
- Watercourse

0 125m 250m

Scale 1:5000

Figure 8.1
Environmental Summary Plan

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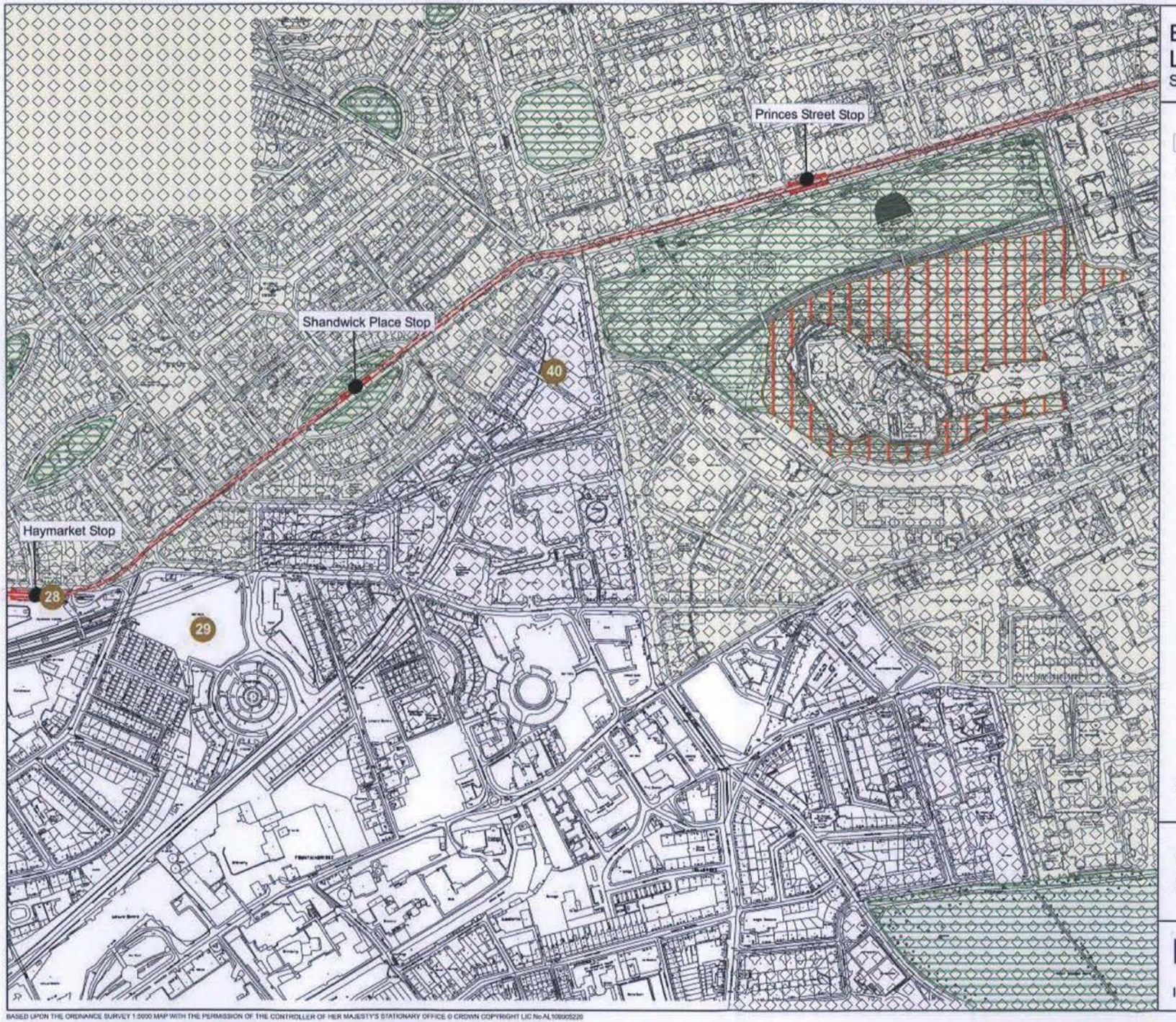

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Figure 8.2
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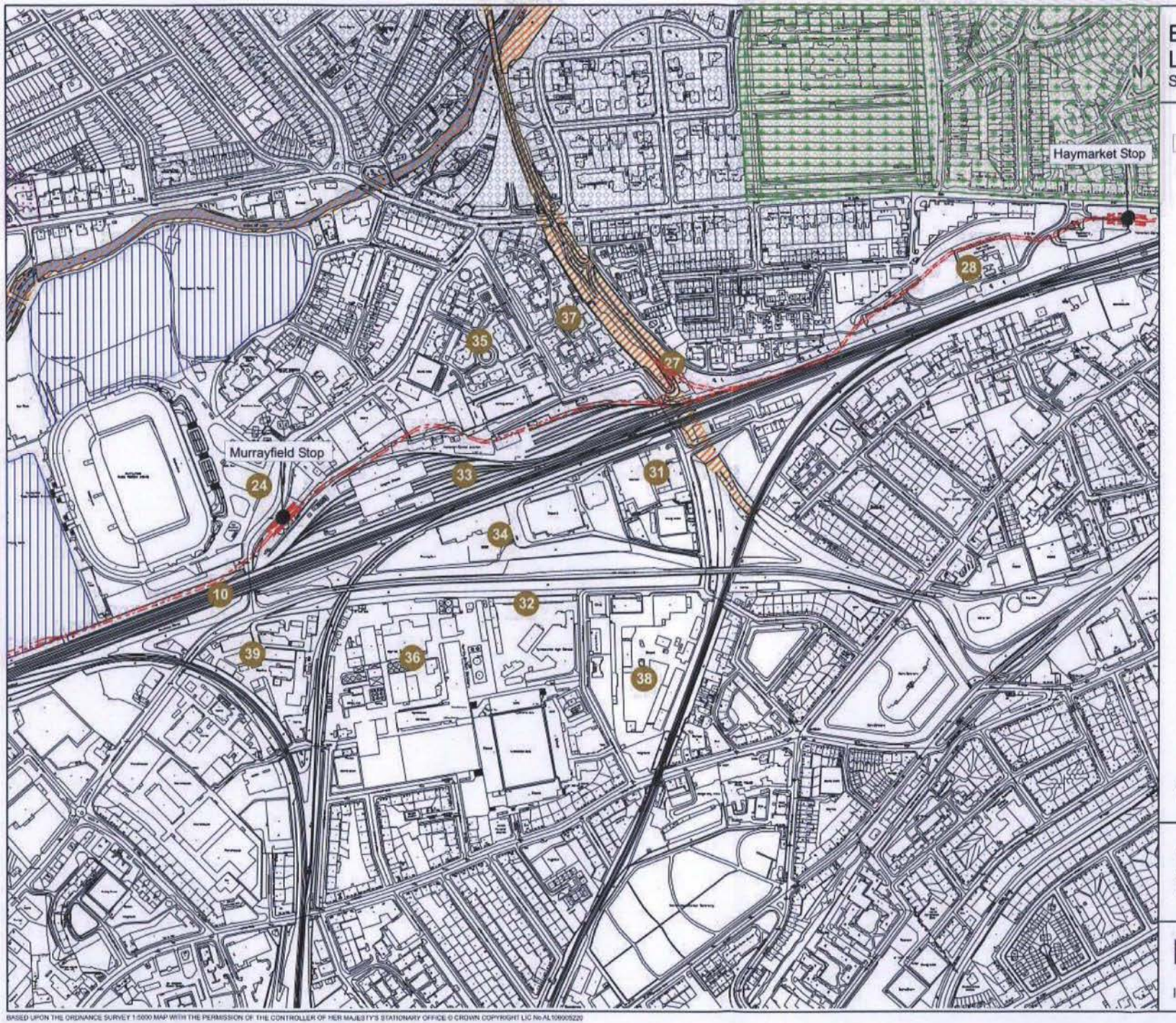

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Figure 8.3
Environmental Summary Plan

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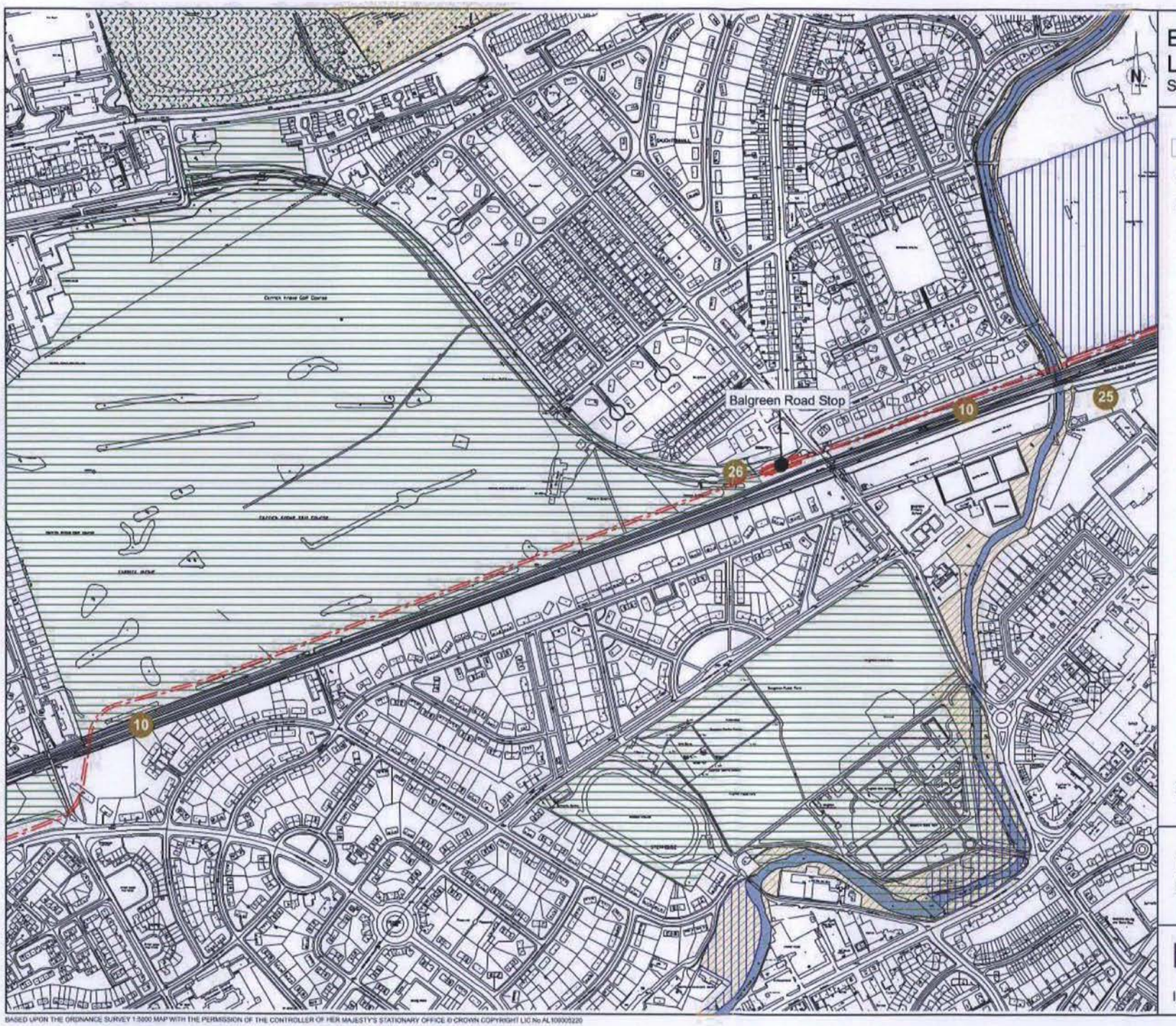

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Scale 1:5000

Figure 8.4
Environmental Summary Plan

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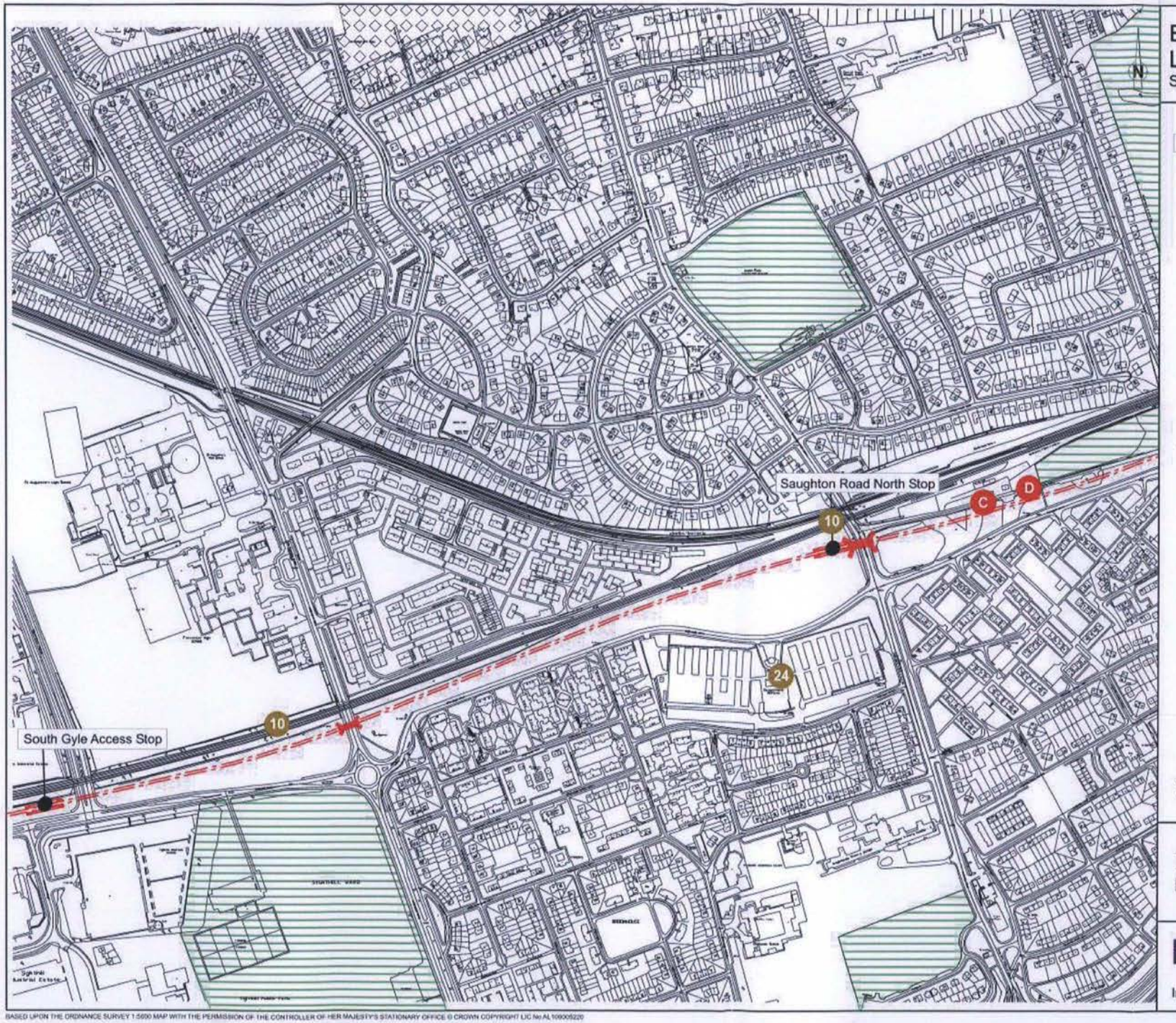

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Figure 8.5
Environmental Summary Plan

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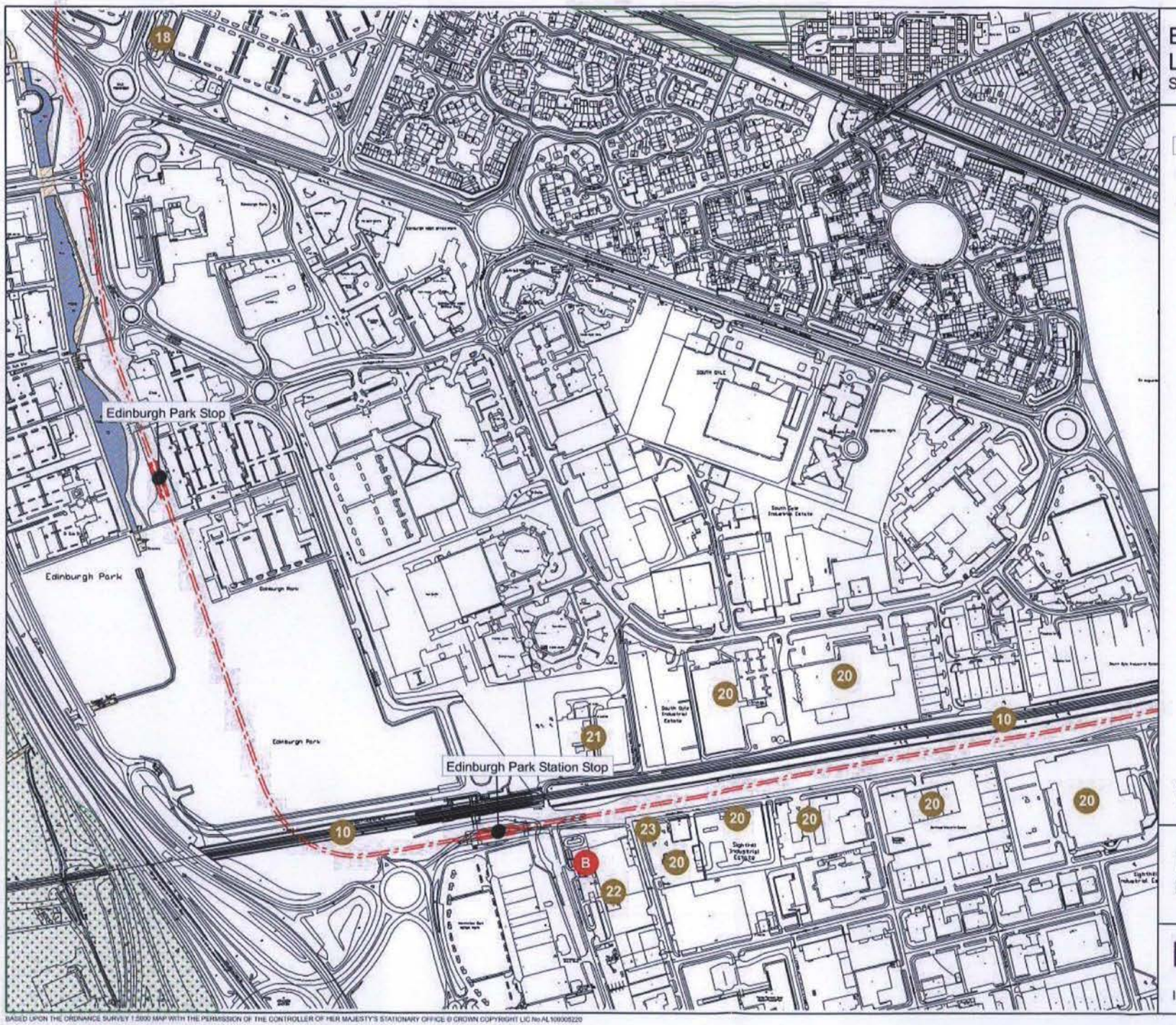

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Figure 8.6
Environmental Summary Plan

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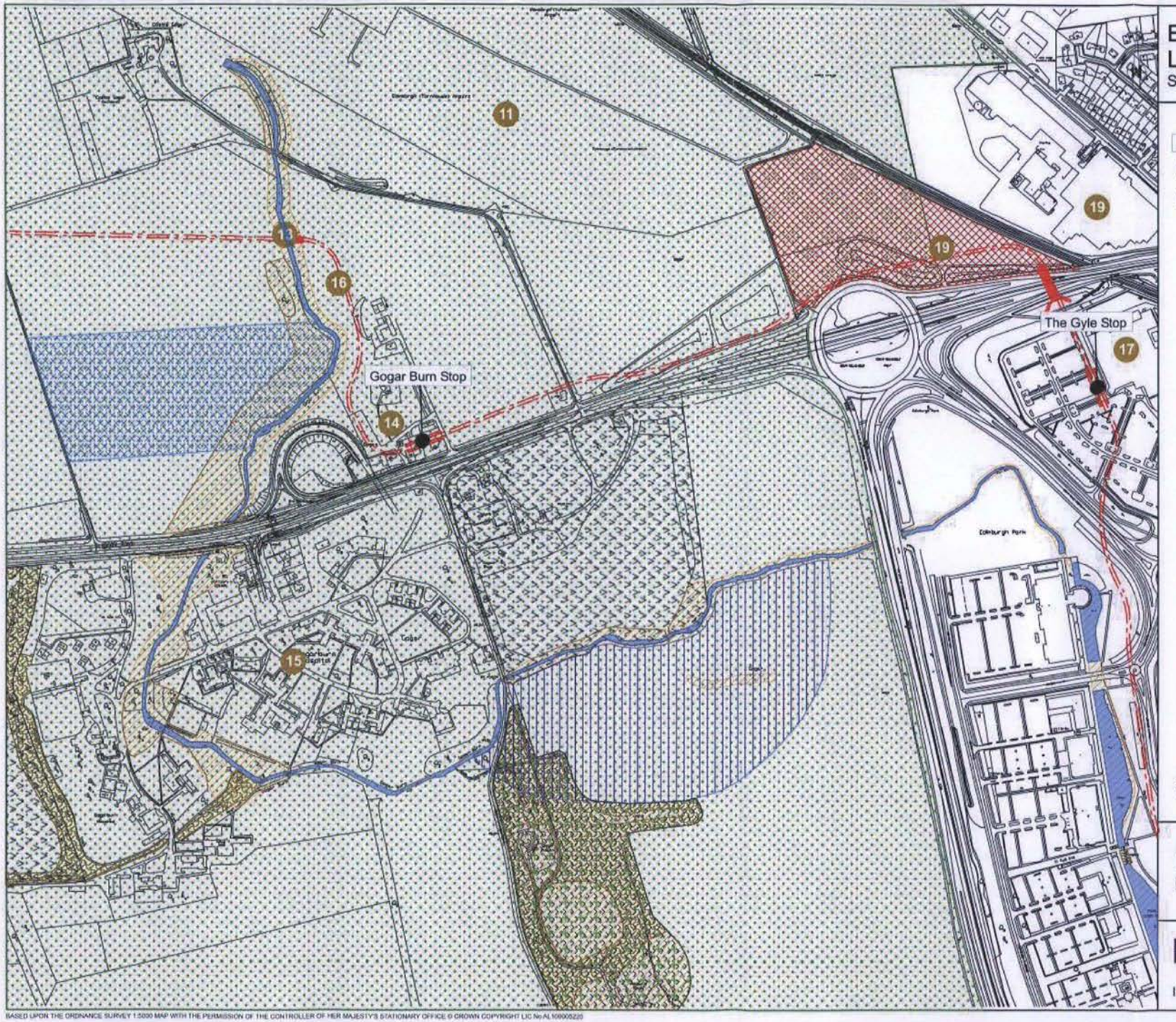

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Figure 8.7
Environmental Summary Plan

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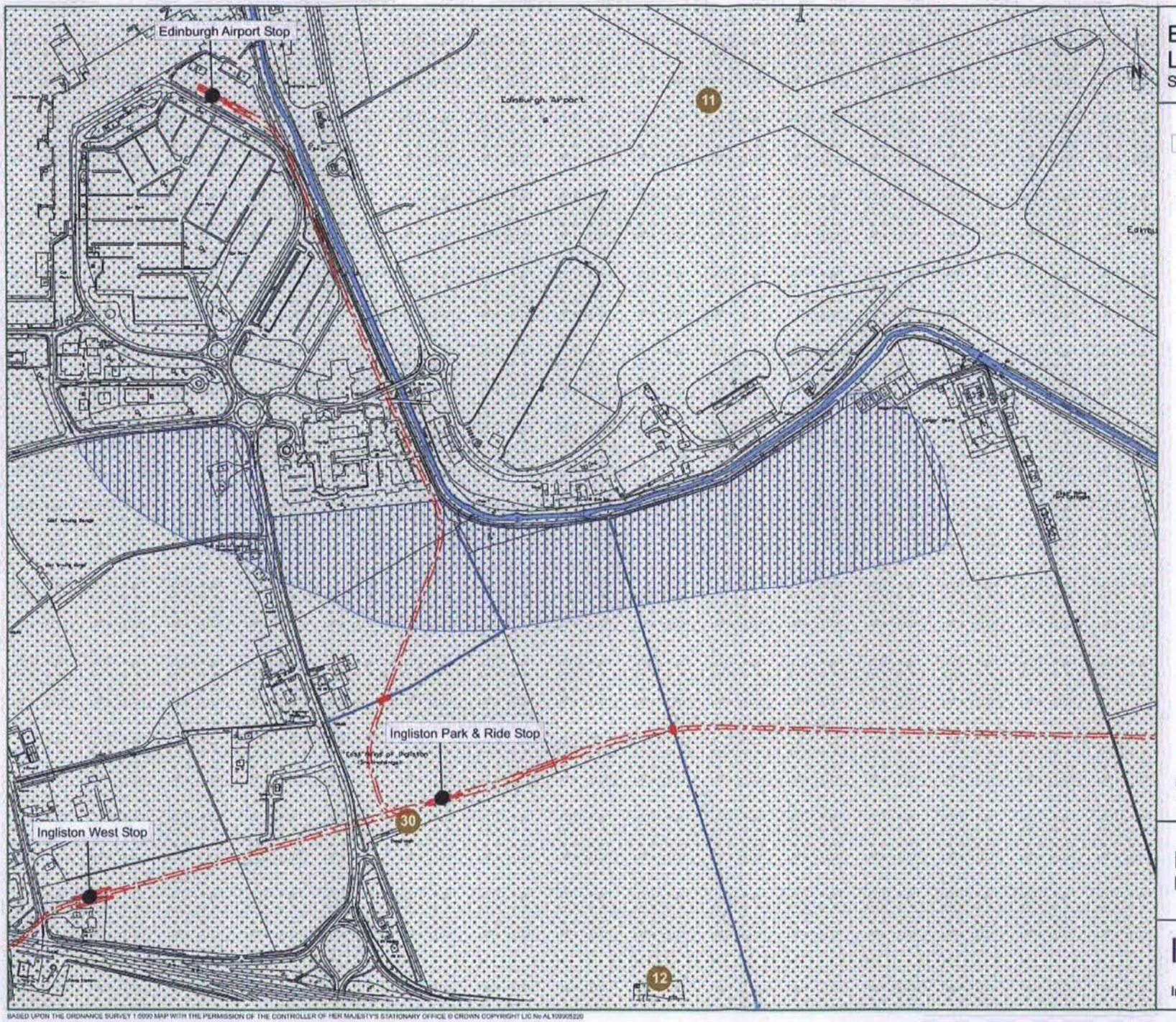

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0 125m 250m

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Figure 8.8
Environmental Summary Plan

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EDINBURGH TRAM LINE TWO
STAG Report

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Scale 1:5000

Figure 8.9
Environmental Summary Plan

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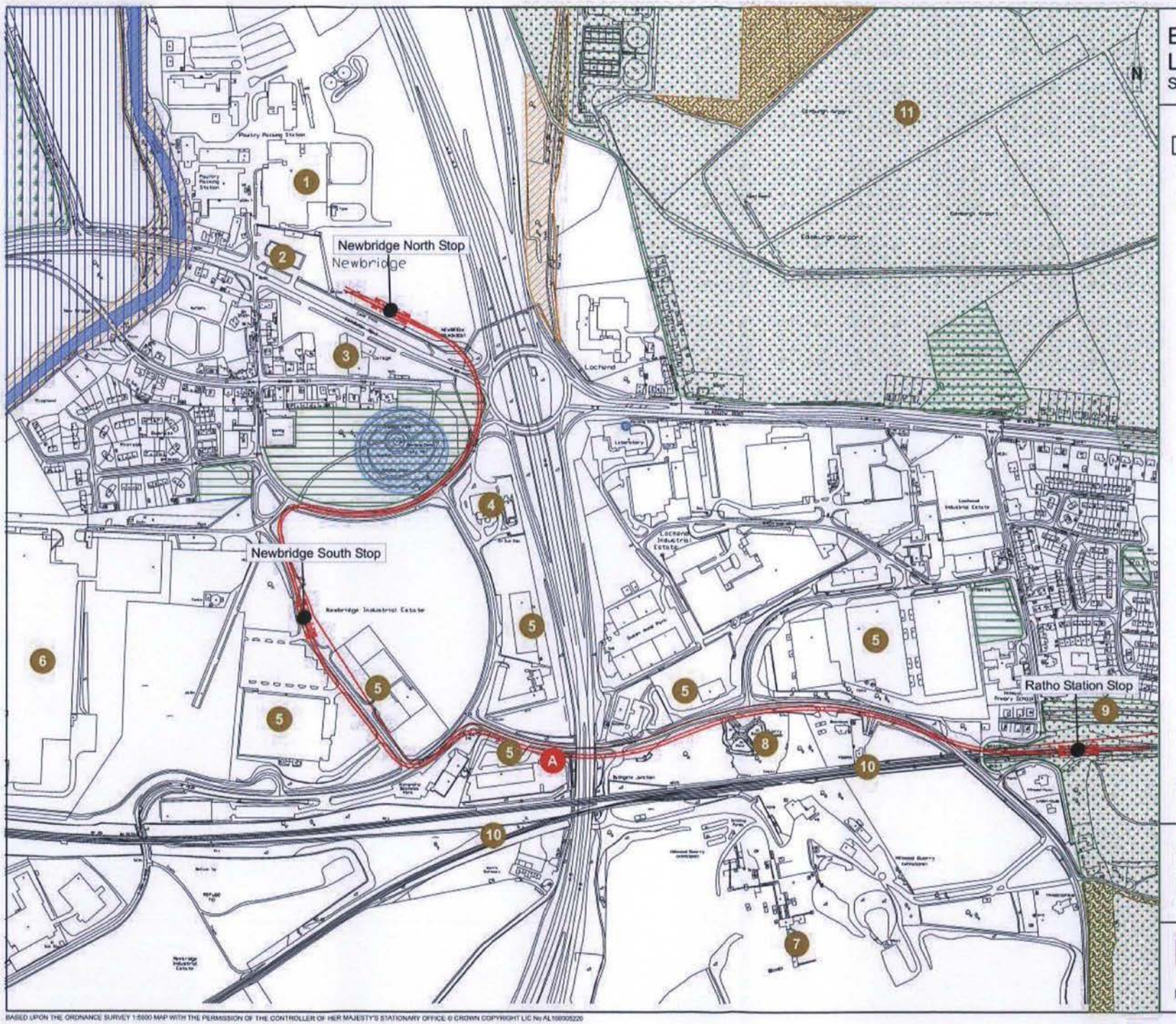

EDINBURGH TRAM LINE TWO

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0 125m 250m

Scale 1:5000

Figure 8.10
Environmental Summary Plan

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EDINBURGH TRAM
LINE TWO
STAG 2

Key :

- Tram Alignment
- Tram Alignment & Stops
- Study Corridor

Character Area A: Historic City Core

- A1 New Town: St. Andrews Sq.
- A2 New Town: Princes St.
- A3 New Town: West End
- A4 Haymarket

Character Area B: Urban and Suburban Residential with Urban Green Space

- B1 High Density Housing
- B2 Low Density Villa Suburbs
- B3 Low Density Town Housing
- B4 Terraced Town Housing
- B5 Terraced Town Suburban Housing
- B6 Tenement Housing
- B7 Mixed Housing/ Industry
- B8 Low Density Cottage Style Housing
- B9 High Rise Buildings
- B10 Village
- B11 Amenity and Open Space
- B12 Linear Green Space

Character Area C: Landscape Dominated by Large Scale Business and Office Development

- C1 High Technology Business Centre
- C2 Derelict Area, Expansion Zone
- C3 Business Centre
- C4 Office Development
- C5 Industrial Retail Park
- C6 Light Industrial Area
- C7 Heavy Industrial Area
- C8 Retail Development
- C9 Leisure Development

Character Area D: Urban Fringe Character Greenbelt Dominated by Infrastructure

- D1 Rolling Lowland Agriculture
- D2 Wooded Estate
- D3 Flat Farmland
- D4 Airport
- D5 Showground
- D6 Link to Airport
- D7 Motorway

Plan Reference

b | a

0 500m 1000m

Scale 1:25000

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Figure 8.11a Landscape Character Areas Rev A: 20/11/03

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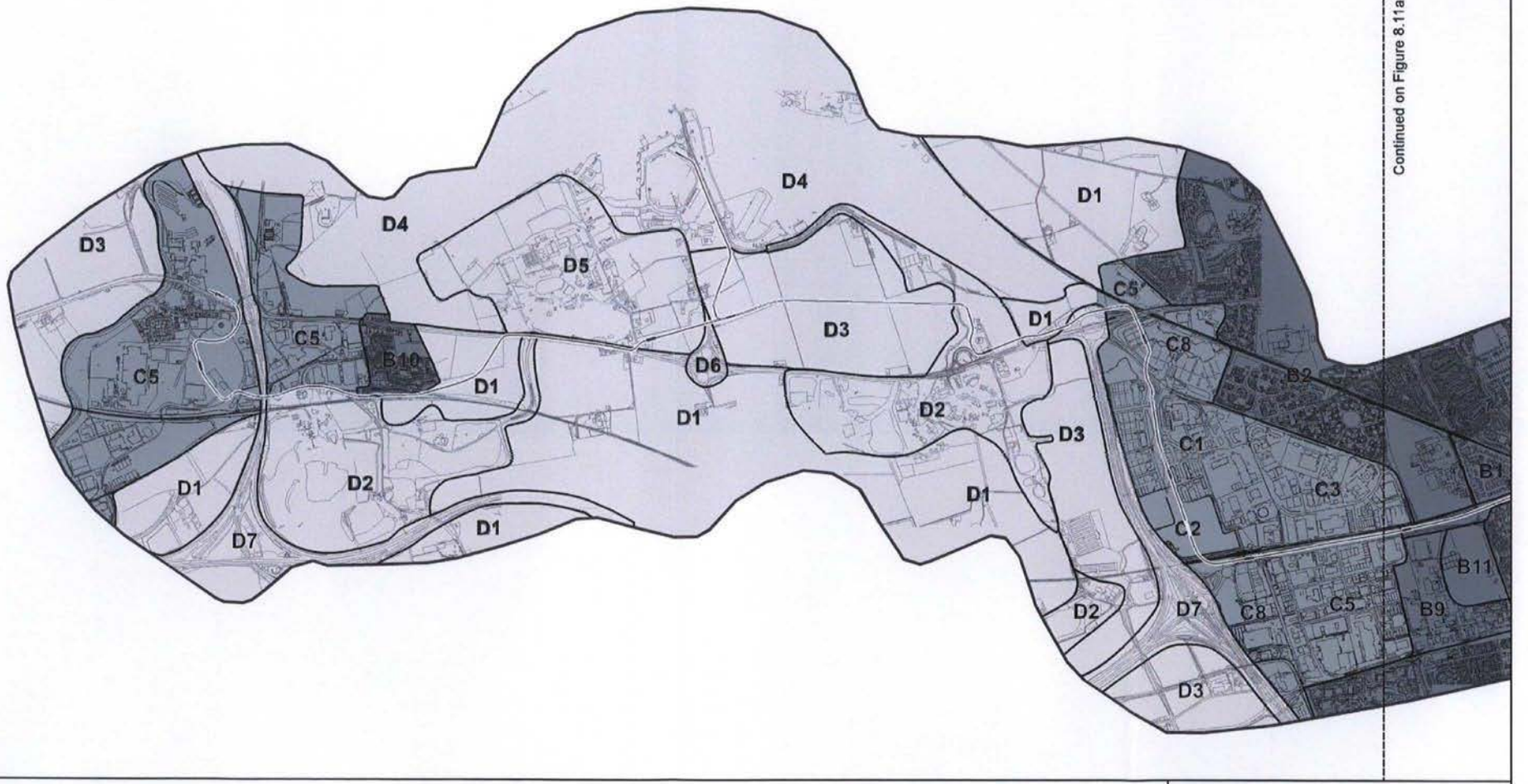
EDINBURGH TRAM
LINE TWO
STAG 2



Key :

- Tram Alignment
- Tram Alignment & Stops
- Study Corridor

Character Area A: Historic City Core

- A1 New Town: St. Andrews Sq.
- A2 New Town: Princes St.
- A3 New Town: West End
- A4 Haymarket

Character Area B: Urban and Suburban Residential with Urban Green Space

- B1 High Density Housing
- B2 Low Density Villa Suburbs
- B3 Low Density Town Housing
- B4 Terraced Town Housing
- B5 Terraced Town Suburban Housing
- B6 Tenement Housing
- B7 Mixed Housing/ Industry
- B8 Low Density Cottage Style Housing
- B9 High Rise Buildings
- B10 Village
- B11 Amenity and Open Space
- B12 Linear Green Space

Character Area C: Landscape Dominated by Large Scale Business and Office Development

- C1 High Technology Business Centre
- C2 Derelict Area, Expansion Zone
- C3 Business Centre
- C4 Office Development
- C5 Industrial Retail Park
- C6 Light Industrial Area
- C7 Heavy Industrial Area
- C8 Retail Development
- C9 Leisure Development

Character Area D: Urban Fringe Character Greenbelt Dominated by Infrastructure

- D1 Rolling Lowland Agriculture
- D2 Wooded Estate
- D3 Flat Farmland
- D4 Airport
- D5 Showground
- D6 Link to Airport
- D7 Motorway

Plan Reference: b a

0 500m 1000m
Scale 1:25000

N

Figure 8.11b Landscape Character Areas Rev A: 20/11/03

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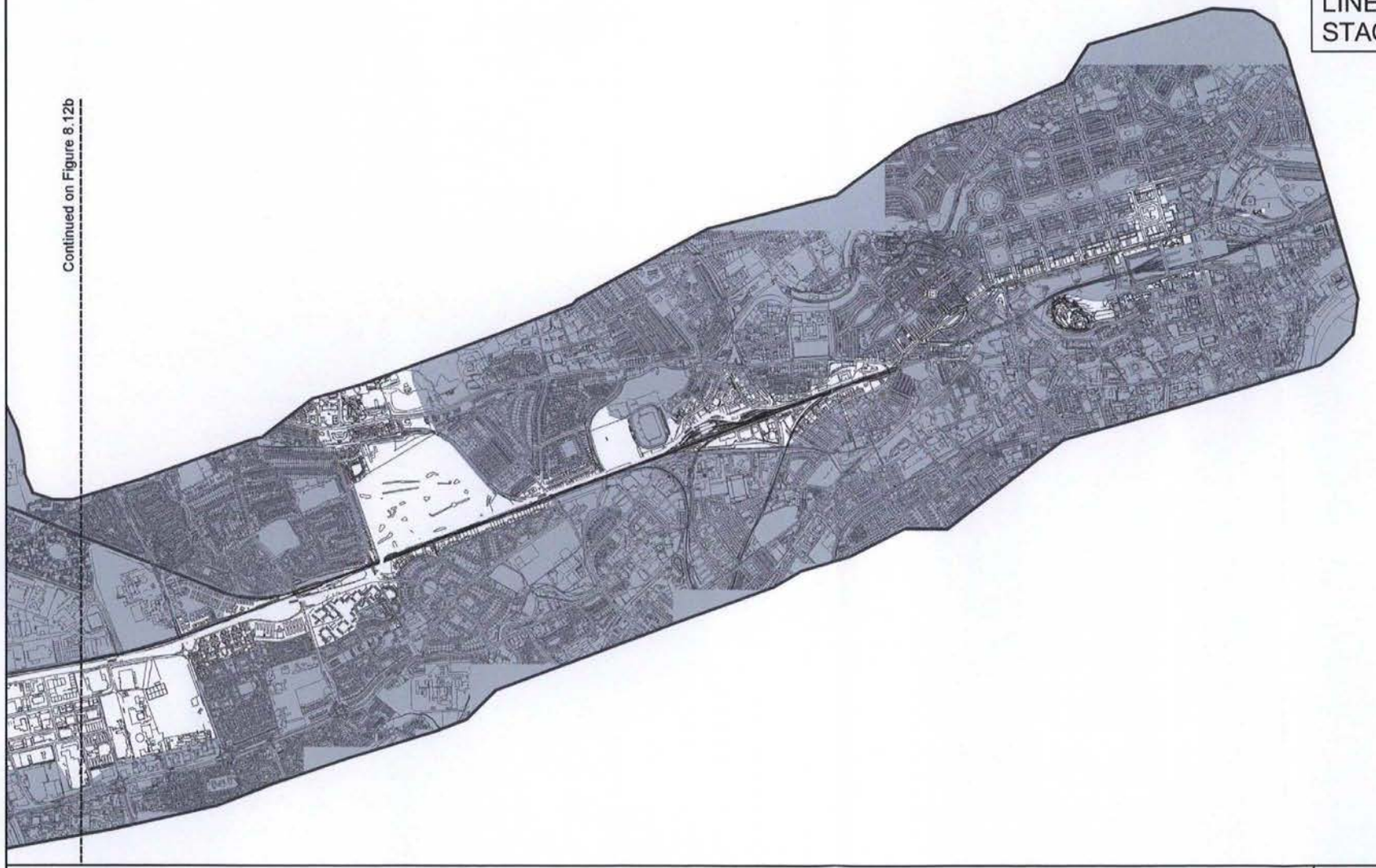
EDINBURGH TRAM
LINE TWO
STAG 2



Key :

- Tram Alignment
- Tram Alignment & Stops
- Study Corridor
- Zone of Visual Influence

Plan Reference

b | a

0 500m 1000m

Scale 1:25000

Figure 8.12a
Zone of Visual Influence
(During Operation) Rev A: 20/11/03

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In association with: ash

EDINBURGH TRAM
LINE TWO
STAG 2

Key :

- Tram Alignment
- Tram Alignment & Stops
- Study Corridor
- Zone of Visual Influence

Plan Reference

b | a

0 500m 1000m

Scale 1:25000

Figure 8.12b
Zone of Visual Influence
(During Operation) Rev A: 20/11/03

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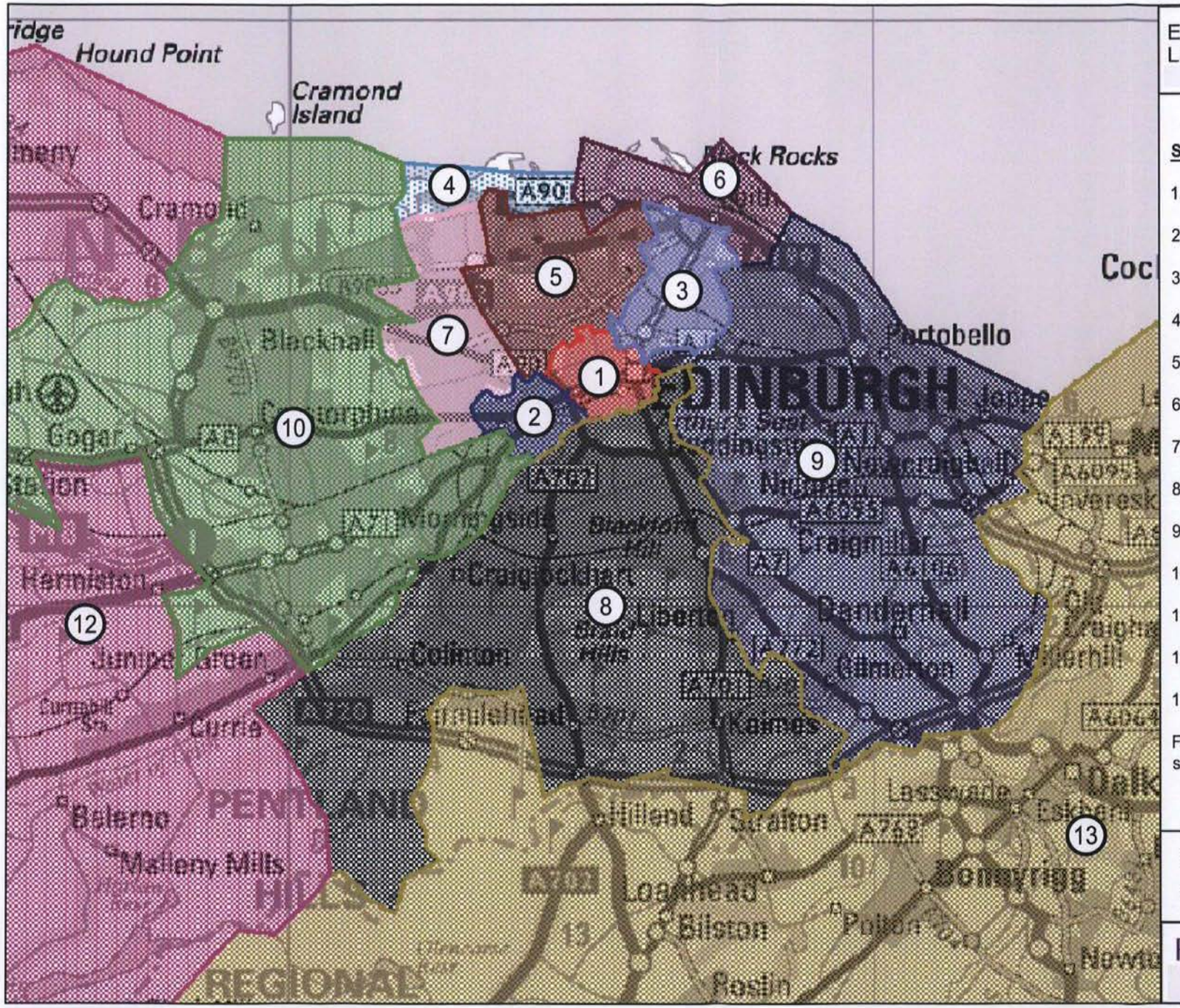
In association with: ash



EDINBURGH TRAM LINE TWO

Sectors

1. City Centre
2. Haymarket
3. Leith Walk & Leith
4. Granton
5. North Edinburgh
6. Leith Docks
7. Railway Corridor
8. South Edinburgh
9. East Edinburgh
10. West Edinburgh & Newbridge
11. External North
12. External West
13. External South & East

For details of sectors 11-13 see Figure 8.14

Figure 8.13
Edinburgh City Sectors

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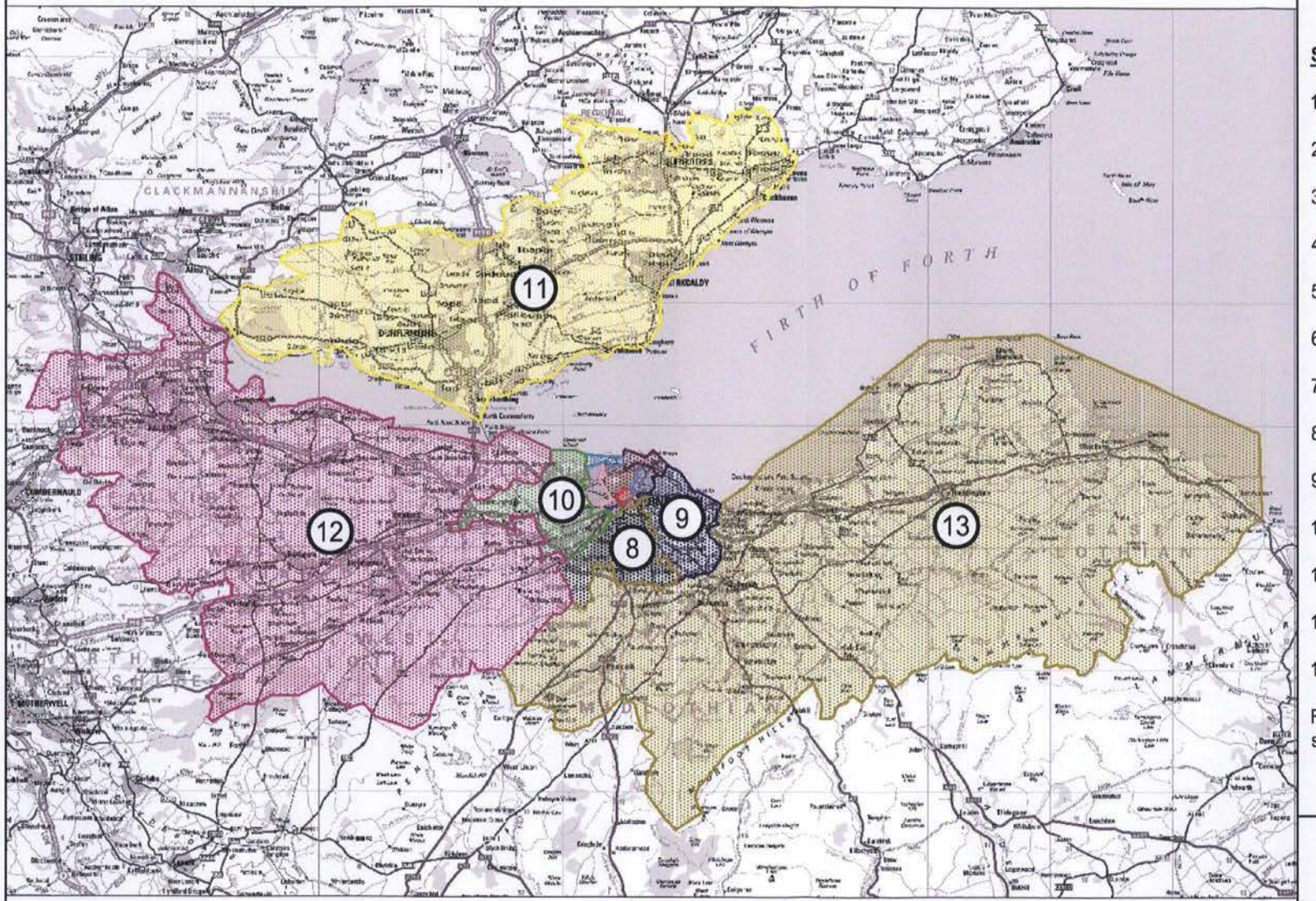
EDINBURGH TRAM
LINE TWO



Sectors

1. City Centre
2. Haymarket
3. Leith Walk & Leith
4. Granton
5. North Edinburgh
6. Leith Docks
7. Railway Corridor
8. South Edinburgh
9. East Edinburgh
10. West Edinburgh & Newbridge
11. External North
12. External West
13. External South & East

For details of sectors 1-7
see Figure 8.13

Figure 8.14
Outer City Sectors

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9 RISK AND UNCERTAINTY



9. Risk and Uncertainty

9.1. Introduction

One of the critical success factors for Edinburgh Tram Line Two is the identification and mitigation of the risks inherent in a project of this nature. HM Treasury's Green Book has identified optimism bias as the systematic tendency for appraisers to be over-optimistic about key project parameters. Evidence from other tram projects in the UK has confirmed this to be a major issue. In order to manage risk in a structured manner, **tie** has appointed a full-time Risk Manager to develop and apply a framework of risk analysis and evaluation to assist in decision-making, and identified the following prime objectives:

- Mitigate all identified risks to a 'medium' significance or less;
- Pass all identified risks to the best parties capable of managing the risk;
- A culture of risk awareness (not risk averse) and management be created;
- Delivery within budget and on time;
- Provide a fully functioning operational service; and
- Obtain support from all key stakeholders.

9.2. Risk Management Process

9.2.1. Early Strategic Risk Appraisal

During 2002, **tie** and CEC gave early consideration to the overall strategic risks associated with the introduction of a tram network in Edinburgh. Previous experience with the proposed City of Edinburgh Rapid Transit (CERT) suggested that a major risk was that associated with the integration of public transport services following introduction of the trams. CEC commissioned a report by Turner & Townsend to review the development of the Edinburgh Tram Line One and the appropriateness of potential procurement routes, funding sources, best practice in scheme delivery and issues and pitfalls on other schemes. Papers were written as a means of briefing both CEC members and officers on the nature of strategic risks related to the proposed tram system and other ITI proposals. Identified risks were recorded as a preliminary risk matrix used as a basis for discussion at a workshop involving CEC officers, the **tie** Board and several key advisors during January 2003. This matrix and discussion upon it assisted **tie** in the formulation of an overall Risk Management Plan.

9.2.2. Line Specific Activities

In parallel with overall risk management, all advisors appointed by **tie** to provide services associated with the tram network and other ITI schemes were required within their appointment briefs to advise **tie** on risks associated with their particular element of work. The advisors for technical, operational and environmental issues have such responsibilities and this report covers both the overall and line-specific issues related to risk management.

Soon after appointment, a line-specific risk register was compiled for each line, with the intention of populating the register with detailed information on the likelihood and potential impact of each identified risk.

9.2.3. Tie Risk Management Plan

Throughout the development of the tram and other ITI proposals, **tie** has initiated and continued to develop a plan for management of risk. The principle components are:

- Appointment of experienced advisors covering legal, financial, technical, operational, environmental, PR and communications, project management and implementation issues;
- Engagement of Partnerships UK for specialist procurement advice;
- Consultation with relevant authorities such as the Office for Fair Trading, Scottish Executive, etc to obtain advice on competition issues and on the funding and development of similar schemes;
- Involvement of an Operator at an early stage in scheme development;
- Periodic briefing and updating of CEC to advise progress and development of risk management process;
- Benchmarking with other schemes;
- Constitution of a multi-disciplinary Risk Management Working Group to facilitate preparation of a consolidated risk register and to monitor the management of risk; and
- Appointment of a full-time Risk Manager to oversee the complete process.

9.2.4. Consultation

In order to reduce strategic risk, **tie** has taken steps to consult with key organisations such as Scottish Executive, City of Edinburgh Council (CEC) and bus operators in the Edinburgh area.

In the case of Scottish Executive:

- In terms of overall knowledge of the progress of scheme development, Scottish Executive has an observer on the board of **tie**. In addition there have been a series of specific consultations:
- The **tie** Risk Manager has held meetings concerned with scheme economics and risk;
- Grant Thornton (**tie**'s financial advisor) has consulted the Financial Partnerships Unit;
- There have been meetings between **tie**, **tie**'s technical ,advisors and Scottish Executive on the structure and coverage of the STAG report; and
- The Private Bills Unit has been consulted by **tie**'s legal advisor, Bircham Dyson Bell and the land referencing teams.

CEC provides a number of **tie** Board members and is thus directly involved in the decision-making process related to tram scheme development. At the technical level, there has also been regular and close involvement, with Council officers engaged in some of the Topic Working Groups established by **tie**, notably the Planning and Environment Working Groups. These have been involved in detail with development of the Design Manual and with the evolution of streetscape designs in critical areas of the city, with the aim of ensuring that the scheme meets CEC's aspirations for the tram. In addition, a senior officer from CEC Transport is a member of **tie**'s Steering Group which convenes monthly to discuss all tram projects.

Recognising the importance to the viability of the tram scheme of a properly integrated public transport network, **tie** has been in discussion with major bus operators in the Edinburgh region. In addition to regular liaison at Chief Executive Officer level through the Operator Liaison Group, there have been specific discussions related to the appointment of a tram operator using the DPOF process. See 8.2.6 below.

9.2.5. Risk Transfer and Procurement

Optimal risk transfer dictates that risk is allocated to the party best able to manage that risk. This in turn requires the terms of any contract to be negotiated in order to achieve the optimal risk spread amongst the participants in the project. A key element in determining how best to manage and mitigate the risk has been the evaluation of the appropriate procurement route and the conclusion of this analysis is to separate the Operator and Infrastructure contracts. The consequence of adopting this approach has been to allocate the appropriate risks to the Operator contract and similarly the appropriate risks to the Infrastructure contract. This separation is believed to offer a more attractive commercial package to bidders for the respective contracts and should, as a consequence, deliver a better value for money solution to **tie** and CEC. **tie** and CEC will retain certain risks and will require to ensure that during the operation of the tram system that risk is appropriately attributed to either the Operator or the Infrastructure provider(s).

9.2.6. Early Operator Involvement / Development Partnering and Operating Franchise

The potential for a lack of integration of public transport services to adversely impact the introduction of a viable tram network was recognised at an early stage of scheme development. The review by Turner and Townsend of comparable transit schemes in the United Kingdom (September 2002) also identified a number of issues and problems associated with their delivery. The report did not fully address the issue of mode integration, nor the legal and financial issues of the proposed Edinburgh network.

tie established a Procurement Working Group, comprising representatives from legal, financial and technical advisors, at the end of 2002 in order to address these issues with respect to Edinburgh. The major strategic risks anticipated by the group were:

- Integration of the tram network with other transport modes;
- Delivery of the tram network within an affordable and certain capital cost;
- Delivery within an acceptable timescale; and
- Minimisation of the impact of tram costs on the finances of CEC.

The group considered a range of potential procurement methods to evaluate the performance of these methods in mitigation of the identified risks, concluding that the early appointment of an Operator as an additional specialist advisor to **tie** would be advantageous.

A briefing paper was presented to the **tie** Board during March 2003 and the Board endorsed a decision to proceed with the early appointment of an Operator, the objectives being:

- To begin development at the earliest practical stage as the basis for a successful operating franchise through efficient procurement;

- To foster intellectual and commercial ownership of the tram system infrastructure and its operational characteristics through **tie**'s partnership with an experienced and incentivised public sector tram operator;
- To achieve tram/bus/heavy rail integration in Edinburgh;
- To make operational expertise available to **tie** in order to refine requirements with regard to system design capacity, expansions and performance and to align procurement expectations with likely market response;
- To help verify and strengthen the economic and technical case to be presented to parliamentary inquiry; and
- To provide continuity in operator support for **tie** in management of the infrastructure procurement process.

A sub-group was appointed by **tie** comprising legal, technical and financial advisors augmented by Partnerships UK to prepare 'Invitation to Negotiate' documentation. This has evolved into an agreement for the Development Partnering and Operating Franchise (DPOF). Market testing suggested considerable support and interest from Operators to this approach which has continued throughout the contract preparation process.

A presentation of the strategic risks associated with the DPOF process was made to CEC officers during May 2003 in order to assure them that issues related to public transport integration were being adequately addressed.

The Operator will be engaged to help development of the scheme throughout the parliamentary approval process and to assist in procurement and commissioning of infrastructure and equipment, thereby mitigating some of the risks associated with these elements of procurement. At the same time, the Operator will develop, in partnership with **tie**, agreed targets for revenue and operating cost, with the payment mechanism dependent upon performance against these figures and other key performance indicators. It is anticipated that this will aid management of risks during the operational phase.

An appointment of the Operator is anticipated during March 2004, prior to the parliamentary inquiry stage.

9.2.7. Infrastructure Procurement

The Procurement Working Group is undertaking a review of issues of risk, timing and funding associated with potential methods of procurement of infrastructure and equipment. Following appointment, the Operator will also become part of this advisory Group.

9.3. Derivation of Costs and Revenues

The technical teams engaged to advise upon the estimation of costs have extensive experience in the development of tram schemes in the United Kingdom and Europe and are thus cognisant of the likely factors and risks that will impact upon outturn costs. Full details of the derivation of costs and revenues can be found in the Project Cost Report, attached as Appendix F.

9.3.1. Capital Costs Base Data

Where practicable and appropriate, the assumptions used to derive costs have been agreed between the Edinburgh Tram Line One and Edinburgh Tram Line Two technical teams, and agreed with **tie** and Grant Thornton, as **tie**'s financial advisors. For example, rates used for vehicle costs, contractors' preliminaries, design costs and contingencies are consistent for both lines One and Two, as agreed between the advisors. For the majority of other factors, the rates and quantities used vary between Edinburgh Tram Line One and Edinburgh Tram Line Two, as the individual characteristics of each Tram Line are taken into consideration. However, the teams have worked closely together to ensure an overall consistency between estimates for Edinburgh Tram Line One and Edinburgh Tram Line Two.

Estimates have been prepared using a combination of benchmarking, previous experience and engineering judgement to define the works elements and to obtain and refine implementation costs.

9.3.2. Operating Costs Base Data

Operating costs have been built up from a detailed appraisal of likely staffing levels, power requirements, maintenance costs and other related costs such as insurance and policing. These in turn are based upon an assumed operational service pattern and frequency.

The ongoing DPOF process will inform the process to confirm or amend these operating assumptions taking into account advice from the system Operator.

9.3.3. Costing Assumptions

Assumptions used in the derivation of capital and operating costs are as attached in Appendix F.

9.3.4. Revenue and Patronage

The projected revenues for the scheme are summarised elsewhere in this report. Assumptions associated with the estimates are provided in the Cost Report provided as Appendix F.

9.3.5. Benchmarking

tie has undertaken a comparison with other operational tram schemes within the United Kingdom to assess the values adopted for the Edinburgh tram projections. These are reported fully in the Business Case. The principle points of note are summarised as follows:

- Project-wide construction cost overruns have been up to 25% of award construction cost. **tie** will manage this risk by structuring and integrated construction and (potentially) maintenance contract. Current optimism bias value is at 31%. See 8.4.2.
- Completed projects have typically overrun by three to six months with minimal Promoter downside risk due to contractual structures used. Current optimism bias suggests a value of 14%, which represents an additional 5 months on a 36-month construction programme.
- **tie** has the benefit of learning from the experience of other Promoters in respect of time delays and costs escalation. This is influencing choice of procurement method and funding options.
- Based upon current practice and expectations, most Promoters would seek a two-contract structure separating infrastructure and operations, as proposed by **tie**.
- Cost escalations in utilities diversion budgets have been recognised by **tie**.
- The potential advantage to be gained from full cooperation of bus and tram operators has not always been forthcoming on other projects. **tie** has progressed the DPOF process to facilitate this.
- **tie** continues to liase with other Promoters to obtain maximum benefit from their experiences.

Tables 9.1 and 9.2 compare the model results with existing LRT systems and with the original Edinburgh LRT Masterplan Feasibility Study Report forecasts.

Table 9.1 - Comparative Annualised Statistics For Existing LRT Systems and Edinburgh Tram Forecasts

System	Route length (km)	No. of stops	Pax boardings (M)	Pax kms (M kms)	Pax boardings per stop (M)	Pax boardings per route km (M)	Pax kms per route km
Manchester Metrolink	30.9	24	13.7	136.1	0.57	0.44	4.40
Bury/Altrincham	9.2	15	2.3	16.2	0.15	0.25	1.76
Eccles							
Croydon Tramlink	28.0	38	16.2	97.0	0.43	0.58	3.46
Sheffield Supertram	29.0	47	11.1	38.0	0.24	0.38	1.31
Midland Metro	20.4	23	5.4	55.8	0.23	0.26	2.74
Edinburgh LRT Masterplan							
Line 1	15.6		11.6	59.5		0.74	3.81
Line 2	16.4		4.2	41.1		0.26	2.51
Line 3	10.1		3.8	19.6		0.38	1.94
Line 2 Study Line 2	17.3	18	5.4	43.7	0.30	0.31	2.52

Sources: Edinburgh LRT Masterplan Feasibility Study Final Report and Line 2 Study model results

This comparison shows that Edinburgh Tram Line Two, on its own, is shorter than existing UK systems. When combined with Edinburgh Tram Line One proposals, Edinburgh tram is comparable in length with existing UK systems.

Edinburgh Tram Line Two boardings are low compared to other systems, though in terms of passengers per route kilometre, Edinburgh Tram Line Two is comparable with Midland Metro and is significantly better than Manchester Metrolink Eccles and Sheffield Supertram.

Edinburgh Tram Line Two passenger kilometres are greater than Sheffield Supertram and over twice that of Manchester Metrolink Eccles. Edinburgh Tram Line Two performs slightly better in terms of passenger kilometres per route kilometre

The implication of comparison with existing services, is that Edinburgh Tram Line Two is rather short for a standalone system. It is likely to be more economic if operated as part of an extended tram system, incorporating Edinburgh Tram Line One at least.

This recent Edinburgh Tram Line Two work is in line with previous work by the Edinburgh LRT Masterplan Study, however where as the initial study assumed tram fares were the same as bus, Edinburgh Tram Line Two assumes a 33% premium, which might have been expected to deter some of the passengers.

Table 9.2 - Benchmark Fare Statistics For Existing LRT Systems and Edinburgh Tram Forecasts (2000)

System	Annual Revenue (£M)	Revenue per passenger (£)	Revenue per tram kilometre (£M)
Manchester Metrolink	15.8	1.15	4.65
Bury/Altrincham	1.9	0.83	1.90
Eccles			
Croydon Tramlink	12.2	0.75	4.36
Sheffield Supertram	7.1	0.64	2.96
Midland Metro	3.1	0.57	1.63
Edinburgh LRT Masterplan			
Line 1	9.6	0.83	6.4
Line 2	6.0	1.42	4.0
Line 3	3.9	1.03	4.3
Line 2 Study Line 2	6.7	1.24	5.7

Sources: Edinburgh LRT Masterplan Feasibility Study Final Report and Line 2 Study model results

Note that Edinburgh LRT Masterplan assumed everyone paid full adult fare and, though patronage forecasts assumed tram fares were the same as bus, the fare values used for part of the revenue calculation were about 50% higher than actual bus fares.

9.4. Optimism Bias

9.4.1. Process

tie and its advisers have considered the implications of the new Green Book Guidance as issued by the Treasury and have discussed the application of this guidance to Edinburgh Tram Line One with PUK and the Scottish Executive.

The Optimism Bias process as required by Scottish Executive for all major public transport schemes is being followed. **tie** 's Risk Manager has taken management control of this process and has consulted both the Executive and the originators of the report developed on Optimism Bias to discuss various aspects of its application to the Edinburgh Tram network.

Optimism Bias provides a methodology to determine what level of additional cost and programme delay should be applied to a project given its particular stage of development. A project at the stage of developing a business case is inherently less certain, in terms of its cost envelope, than one which is close to contract signature. The Optimism Bias adjustment allows a factor to be applied to the capital costs of a project to reflect this and the costs involved in mitigating the impact of this. Standard factors are given dependent upon the nature of the project based on analysis of previous schemes. This Optimism Bias adjustment sits as a percentage factor above any specific contingencies identified for the particular scheme. It is not therefore a predictor of where the costs might finally end up. No Optimism Bias adjustments exist at present to cover operating costs, lifecycle costs or revenue.

Steps involved are:

- Determine capital expenditure;
- Determine works duration;
- Identify project risks;
- Confirm the impact of risks on capital expenditure and programme
- Determine risk mitigation strategies
- Determine the cost of managing risks
- Review the implementation of risk management
- Allocate risks to Optimism Bias
- Review the scope of the Risk Register
- Assess the Project Type
- Determine starting values for Optimism Bias
- Determine the mitigation Factor for each risk
- Independent review of evidence to support mitigation factor
- Determine Optimism Bias
- Check lower bound is not below recommended values
- Final estimate of Optimism Bias incorporating risk management
- Consider need for further mitigation

- Incorporate capital expenditure including Optimism Bias and risk management costs in financial model.

9.4.2. Benchmarking / Factors Adopted

As there are a number of light rail or tram schemes either in operation or under development in the United Kingdom, it is considered that the starting Optimism Bias factors to be adopted for Edinburgh Tram Line Two are those appropriate to a 'Standard Civil Engineering' project, i.e.

Works duration	20%
Capital expenditure	44%

Various actions to mitigate these factors have been undertaken.

Optimism Bias does not appear to account for the rigorous capital costing methodology employed by **tie**'s technical advisors, that is, determining the cost from the out-turn costs of a number of recent tram schemes. It is therefore considered that the capital costs (net of contingency) include for a portion of Optimism Bias. It has not been possible to quantify this portion and therefore it may be considered that the Capital Cost Optimism Bias is conservative.

9.4.3. Independent Review

The factors adopted as the staring point for the Optimism Bias process have been discussed and agreed with the originators of the report prepared for the Treasury.

9.5. Current Risk Status

9.5.1. Risk Identification

tie and its advisors have identified project risks through workshops, strategic reviews, experience of other UK tram schemes and recording of risks throughout the development process. These risks have been recorded on a register which has been further developed from checklists contained in the following published industry guidance.

- RAMP Risk Analysis and Management for Projects;
- CIRIA Funders Report: Developing a risk communication tool (RiskCom); and
- HM Treasury Review of Large Public Procurement in the UK.

9.5.2. Risk Matrix

A consolidated risk register has been prepared for the tram network and is attached as Appendix G.

For each risk identified, the register identifies:

- The stage of scheme development at which the risk might materialise;
- The underlying nature of the risk (procedural, specification, external influence, etc)
- Elements impacted by the risk (capital expenditure, operating expenditure, revenue, programme, quality, etc)
- Likelihood of realisation prior to mitigation and following mitigation
- Mitigation strategy
- Responsibility for mitigation management
- Mitigation factor achieved
- Status of risk; and
- Dates for action.

In order to review timing, the risks have been categorised in order to identify the risk level of each of the following five stages of the project and to ensure risks are reviewed and mitigated for each stage of the project.

- Planning – STAG AST2 and business case preparation;
- Application for Powers – Private Bill preparation;
- Procurement – Operator and Infrastructure Contracts;
- Construction; and
- Operation.

tie and advisers identified all potential risks. These risks were categorised into the following groups in accordance with HM Treasury guidance:-

- Procurement;
- Project Specific;
- Client Specific;

- Environment; and
- External Influences.

Each of the project risks have been assessed against the following principle impacts.

- Capital Costs;
- Operating Costs;
- Revenue;
- Programme;
- Quality;
- Functionality; and
- Approvability.

Of these areas, capital costs, operating costs and works duration (programme) have been shown to lie within Optimism Bias considerations. Two strategies have been adopted to quantify the impact of risk, in accordance with Green Book guidance. The first, has been to calculate the Optimism Bias to be applied to Capital Costs and Works Duration. The second, has been to appraise the risks associated with operating costs (and revenue) through sensitivity analysis.

The significance of each risk is classified by means of a 5-point AS/NZS system for combining 'impact' and 'likelihood' aspects of each risk in order to prioritise actions.

Table 9.3 - Financial and Programme Tolerances

Level	Impact	CAPEX (£)	OPEX/ Life-cycle/ Revenue (£ per annum)	Programme
1	Insignificant	Up to £25k	Up to £25k	Up to 1 week
2	Minor	>£25k to £100k	>£25k to £100k	>1 week to 2 weeks
3	Moderate	>£100k to £500k	>£100k to £500k	>2 weeks to 1 month

The following range of likelihoods are proposed:

Table 9.4 - Proposed Likelihoods

Level	Likelihood
1	Remote
2	Unusual
3	Possible
4	Probable

The likelihood of risks and impacts can e combined in a 2-dimensional table as follows:

Table 9.5 - Likelihood of Risks and Impacts

Likelihood/ Impact	Insignificant	Minor	Moderate	Significant	Major
Remote	1	2	3	4	5
Unusual	2	4	6	8	10
Possible	3	6	9	12	15
Probable	4	8	12	16	20

The following significance of risk has been adopted:

Table 9.6 - Significance of Risk

Significance	Range		Colour
Negligible Risk	>=0	<4	WHITE
Low Risk	>=4	<8	WHITE
Medium Risk	>=8	<12	ORANGE
High Risk	>=12	<16	ORANGE

9.5.3. Key Risks

tie has developed clear and active processes to prevent and mitigate project risks in accordance with industry best practice. Through this management, a total of 101 risks have been identified.

A number of lessons have also been learnt from the previous UK tram schemes. The following key risks occurred on other UK tram schemes have been recognised and duly mitigated through **tie**'s procurement strategy, consultations and design and cost assumptions.

- Revenue – reduction in tram capacity, negative PR, bus competition (fares and coverage) and overestimated revenues;
- Capital Costs – underestimated costs due to utility diversions, compliance with planning, traffic management and bid costs;
- Approvability – planning issues and negative PR; and
- Operating Costs – lack of tram priority and reduced operational performance.

Utilising the ranking process identified above the principle very high risks arising from this exercise can be summarised as follows:

- SE funding availability is less than **tie** requires to proceed - A key element of this Business Case is to demonstrate the requirement for a minimum amount of SE funding to enable the project to proceed.
- Delay in securing other funding sources beyond SE funding – **tie** have mitigated this risk through review of alternative funding options by **tie**'s financial advisors and discussions with potential lenders.
- Passenger numbers are lower than forecast – **tie** and their technical advisors have established a conservative and credible base model and reviewed the factors affecting revenue, assumptions and sensitivities. Further comfort will be gained through early involvement of an experienced Operator.
- Delay and cost increases due to CEC Planning requirements – **tie** have significantly mitigated this risk through convening a Planning and Environment Working Group who have held regular meetings with Planning Department and sought approvals of Design Manual and proposals to account for the World Heritage Site.
- Inclusion of CETM influence on the Project – **tie** and their advisors have considered the influence of CETM and discussed this with CEC;
- Delays due to lack of Parliamentary time with other Bills under consideration, Bus Operator Objections or change of Transport Minister,– **tie** and their Parliamentary Legal Advisors have discussed protocol with Parliamentary Bills Unit and commenced procurement of a tram Operator to bring about integration with Bus Operators.
- Capital costs associated with land purchase, contractor's area and compensation, Network Rail, unforeseen ground conditions, vehicle costs, CEC/**tie** instructed changes and utility diversion costs exceed current forecasts following completion of the DPOF process and breach the contingency level included within the model. This risk should be mitigated through the level of work undertaken to date by the technical advisers and inclusion of Optimism Bias to account for further design development.
- Operating costs exceed current projections due to lack of priority to tram at junctions. The DPOF process will identify cost issues but not until after completion of considerable further work by the selected partner. This could be influenced by specification issues, such as staffing levels.

The risks listed above represent, in some instances, those considered as most serious to the success of the project in the short term and also certain ongoing risks which will require management as the project progresses. **tie** will use the risk mitigation summary as a means to undertake this process through regular reviews and updates of the risk documentation and proactive management of the risks.

9.5.4. Treatment of Contingency

The technical advisors have included where appropriate a contingency allowance against possible increases in capital costs. It should be noted that such allowances are deemed to be included within the allowance for Optimism Bias.

9.5.5. Residual Optimism Bias Factors

The extent to which risks have been mitigated is measured by a mitigation factor, that is, 0.0 means that risks in a project risk area are not mitigated and 1.0 means all the risks in a project risk area are fully mitigated. **tie** has ensured that clear and tangible evidence has been observed prior to reducing the Optimism Bias.

Responsibilities were allocated amongst **tie**, various **tie** Working Groups and advisers for each risk and, in particular, to develop a risk mitigation strategy. The risk mitigation strategy sets out an understanding of the risk identified, the actions to be taken to minimise the impact of the risk, by whom and to an agreed timescale. Furthermore, the list of risks was reviewed to identify the "critical path" risks, being either fundamental in principle, or time critical to the success of the project. These risks have been managed by **tie** to ensure risks are addressed in an ongoing positive manner. It is intended that the risk register will be updated regularly as the project progresses, and will be a utilised by **tie** as a live risk management tool.

Given the level of development the project has reached, together with the amount of mitigation that has been carried out across the range of risk areas identified by Optimism Bias, it is considered appropriate to use lower factors of 31% for Capital Cost Optimism Bias and 14% Works Duration Optimism Bias.

9.6. Sensitivity Analysis

A number of sensitivities have been tested within the financial modelling exercise, designed to simulate a number of the key project risks. These sensitivities are designed to test the overall financial robustness of the project, and to give an indication of the impact of key project risks on the financial structure proposed.

Base data used for revenue and operating costs in 2011 and 2026 is as follows:

Table 9.7 – Base Data

Year	Revenue	Operating Cost	Operating Surplus/Deficit
2011	£6.36M	£5.71M	£0.65M
2026	£8.31M	£6.12M	£2.19M

All costs and revenues are adjusted to 2003 prices. The increase in operating costs between 2011 and 2026 arises as a result of an assumed increase in salaries above inflation.

Revenues for 2011 are adjusted for an anticipated ramp-up to forecast levels within the early years of system operation. Revenues for both 2011 and 2026 take account of assumed losses due to concessionary fares and fare evasion.

The principle sensitivity tests are summarised below.

9.6.1. Newbridge Shuttle

An obvious option for phased construction of Edinburgh Tram Line Two is to curtail the initial phase at the Airport, omitting the section between Ingliston and Newbridge. A number of possible scenarios were considered varying the eastern termination of the shuttle and the availability or size of a possible park-and-ride site at Newbridge.

Under these circumstances:

- Operating costs in 2011 and 2026 would reduce by £1.01M and £1.09M respectively.

Revenues in 2011 and 2026 would reduce by £0.38M and £0.35M respectively.

9.6.2. Congestion Charging

The main purpose of congestion charging is to reduce traffic delays in the city. Tests for this study show charging to be successful in this respect, increasing both highway speeds and bus speeds, though where greenways already exist, the impact on buses is negligible as they are already largely protected from traffic delays. The consequence of congestion charging on tram is that buses become faster and are better able to compete with tram. As a result this test causes tram patronage and revenue to reduce in 2011.

Tram does extend beyond the congestion charging area. The stops at Gogar Burn, Ingliston, Airport, Ratho Station and Newbridge become more attractive to car users as an alternative to paying the congestion charge.

By 2026 there is more development along the A8 corridor outside the congestion charging border, so movements across this border become more important. As a result, the impact of cross-boundary trips becomes more important than the impact of improved bus competition.

The tests indicate a reduction in revenue of 8.1% in 2011 and an increase of 1.8% in 2026.

9.6.3. Bus Competition

It is acknowledged by **tie** that the integration of bus and tram services is critical to successful operation and CEC/**tie** are seeking to ensure maximum cooperation of the bus operators through the DPOF process. However, it is realistic to assume that bus operators might act competitively or in cooperation.

From a base scenario which is perceived to be neutral, a competitive case was tested assuming increased frequency of bus services on the A8 and A71 corridors

The impact on revenue arising from this test indicated a potential fall in revenue of 18.3% in 2011 and 11.5% in 2026.

9.6.4. Bus Co-operation

Similarly, it was assumed that if bus operators are cooperative, there would be a reduction in bus services which on their present routing would compete directly with the tram.

Under the assumed scenario, tram revenues would increase by 13.4% in 2011 and 12.5% in 2026.

9.6.5. Airport Heavy Rail Link

Proposals to divert the Edinburgh – Glasgow main railway line to pass beneath and interchange with Edinburgh Airport are being taken forward for further development.

There are a number of variables such as the frequency of the heavy rail service and the level of fare to be applied which would affect the tram patronage and several tests were done to examine this. For the purposes of this report a probable scenario assuming 5 trains per hour and standard rail fares has been used.

9.6.6. Tram Fare Adjustment

Tram Fare is assumed to be 33% greater than bus fares. The tram fares for existing systems in other UK cities range between 0% to around 35%, so the assumption for Edinburgh is at the upper range of existing practice.

Model tests were done varying the tram fare by plus and minus 10%. The Airport premium fare was kept constant.

Table 9.8 – Tram Fare Adjustment

	-10% tram fare (+20% over bus fare)		**+10% tram fare (+46% over bus fare)**	
	2011	**2026**	**2011**	**2026**
Patronage	0.9%	5.9%	-11.0%	-2.5%
Revenue	-5.1%	-3.1%	-5.3%	2.7%

This shows that the current fare assumption of +33% over bus fares provides about the best return in terms of revenue optimisation in 2011. However, by 2026 passengers are less sensitive and a higher fare may generate more revenue, despite the loss in patronage.

The adjustment of tram fares is within the purview of **tie** and the Operator and it may be assumed that any change is unlikely if it were to result in reduced revenue.

9.6.7. Tram Frequency

The tram has been evaluated on the assumption of 6 trams per hour, which is adequate for providing enough supply to meet the forecast demand, as long as the vehicles are large enough and it is the minimum frequency generally considered reasonable for a mass transit system such as tram.

The impact of higher frequency services has been tested. For 8 trams per hour, similar to the frequency proposed for Edinburgh Tram Line One, revenues would increase by 8.2% in 2011 and 16.0% in 2026.

This is an additional operating cost (and capital cost). The estimated increase in cost is about £0.45M in 2011 and £0.49M in 2026.

9.6.8. Worst Credible Scenario

As the initial omission of the Newbridge shuttle is a major factor in determination of likely outturn costs and revenues, results for the worst and best credible combination of circumstances are presented for the situation both with and without Newbridge shuttle.

This section suggests a worst possible combination of circumstances for tram operation, namely that which assumes congestion charging, a competitive bus response and the implementation of a heavy rail link. Changes in tram fare are not considered as it is unlikely they would be implemented if it would reduce revenues.

The impacts are summarised as follows:

Table 9.9 – Worst Credible Scenario Including Newbridge Shuttle

Year	Base Revenue	Congestion Charging Impact	Bus Competition Impact	Airport Rail Link Impact	Combined Impact	Adjusted Revenue	Operating Surplus / Deficit
2011	£6.36M	-8.3%	-18.3%	-25.1%	-43.9%	£3.57M	-£2.14M
2026	£8.31M	+1.8%	-11.5%	-14.4%	-22.9%	£6.41M	+£0.28M

Table 9.10 – Worst Credible Scenario Excluding Newbridge Shuttle

Year	Base Revenue	Congestion Charging Impact	Bus Competition Impact	Airport Rail Link Impact	Combined Impact	Adjusted Revenue	Operating Surplus / Deficit
2011	£5.98M	-8.3%	-18.3%	-25.1%	-43.9%	£3.36M	-£1.34M
2026	£7.96M	+1.8%	-11.5%	-14.4%	-22.9%	£6.14M	+£1.11M

Clearly the major impacts are from Bus Competition and the Airport Rail Link. An operating surplus will require that these two adverse impacts do not occur together, particularly in the early years of tram operation.

CEC and **tie** are working to minimise the possibility of excessive competition from the bus operators through the DPOF process. Other action may be possible through the introduction of quality bus contracts should the DPOF process not produce the desired effect, but such action may not be practical or desirable.

The implementation of the heavy rail link is not committed. If implemented it will be appropriate to investigate the extent of any resultant benefits which would offset the potential disbenefit to the tram.

9.6.9. Best Credible Scenario

The probable best option for the tram would be operation of an increased frequency in a cooperative bus environment. Again, the potential long-tern benefit from fare increases is ignored in this combination, which also assumes that neither congestion charging nor the Airport rail link would be implemented.

The impacts are summarised as follows:

Table 9.11 – Best Credible Scenario Including Newbridge Shuttle

Year	Base Revenue	Bus Competition Impact	Tram Frequency Impact	Combined Impact	Adjusted Revenue	Adjusted Operating cost	Operating Surplus / Deficit
2011	£6.36M	+13.4%	+8.2%	+22.7%	£7.80M	£6.13M	+£1.64M
2026	£8.31M	+12.5%	+16.0%	+30.5%	£10.85M	£6.61M	+£4.24M

Table 9.12 – Best Credible Scenario Excluding Newbridge Shuttle

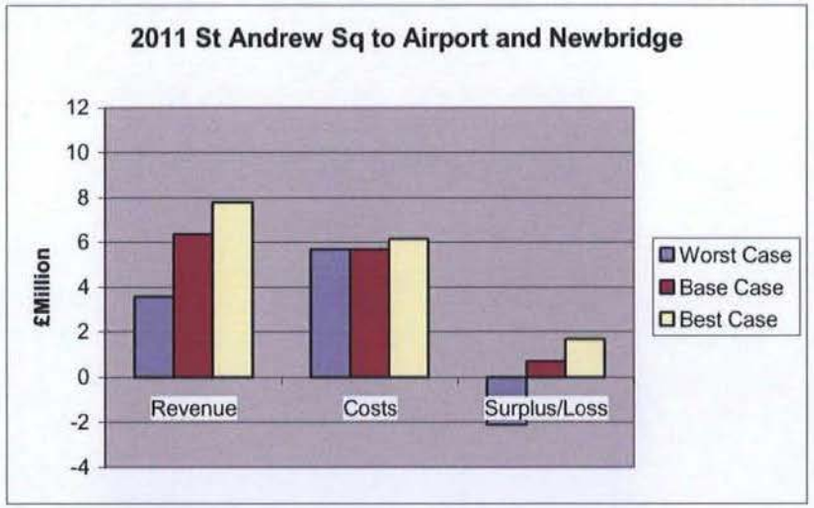
Year	Base Revenue	Bus Competition Impact	Tram Frequency Impact	Combined Impact	Adjusted Revenue	Adjusted Operating cost	Operating Surplus / Deficit
2011	£5.98M	+13.4%	+8.2%	+22.7%	£7.34M	£5.12M	+£2.18M
2026	£7.96M	+12.5%	+16.0%	+30.5%	£10.39M	£5.52M	+£4.87M

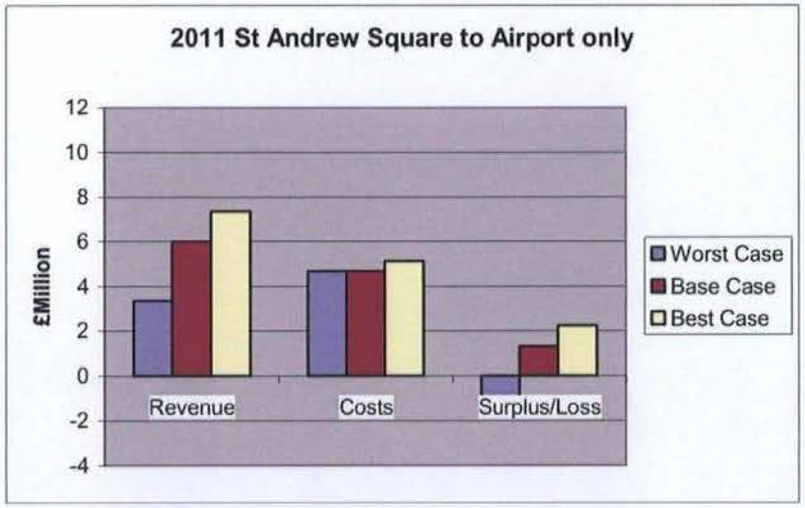
Should congestion charging be introduced to the above combination, it is noted that there would continue to be an operating surplus in 2011 and 2026 with or without the Newbridge shuttle.

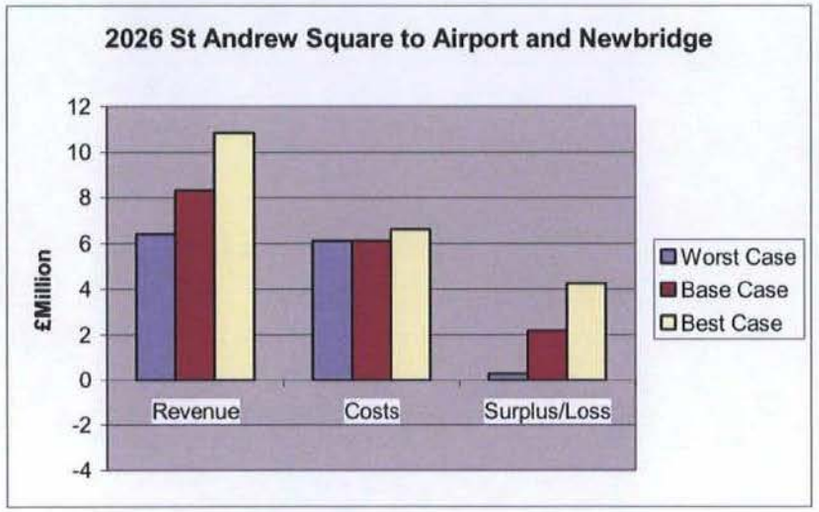
Introduction of the Airport Rail Link would lead to an operating loss with the Newbridge shuttle of about £0.6M in 2011 which would convert to a surplus of about £2.7M in 2026. Without the shuttle the tram would break even in 2011 converting to a surplus of about £3.4M in 2026.

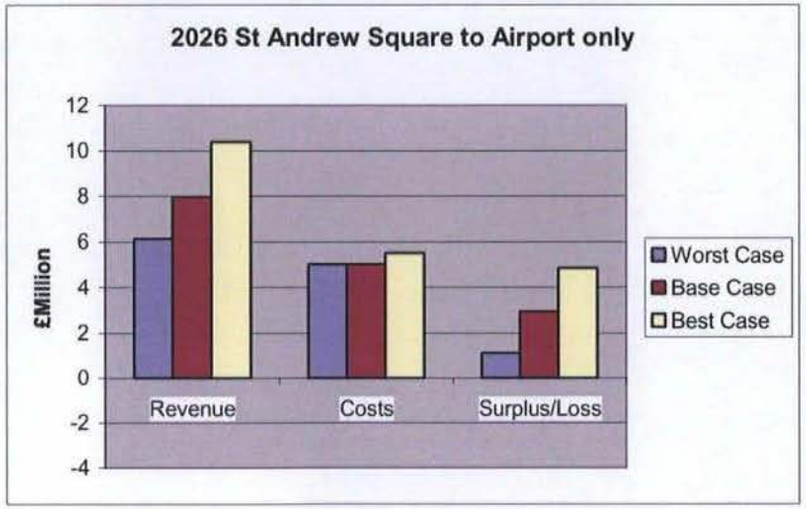
The revenues, operating costs and surplus/loss figures for 2011 and 2026, with and without the Newbridge shuttle are presented graphically in the following diagram:

Operating Revenues, Costs and Surplus/Loss in 2011 and 2026 for Worst Credible, Base Case and Best Credible Sensitivity Combinations









9.7. Ongoing Risk Management Process

9.7.1. TIE Risk Management Structure

Ultimate responsibility for risk is taken by the **tie** Board, with responsibility delegated to the Projects Director. He has appointed a Risk Working Group comprising advisors covering technical, legal and financial issues, together with **tie**'s appointed Risk Manager. He is responsible for executing or overseeing actions necessary to mitigate risk on the tram scheme.

9.7.2. Development Partnering and Operating Franchise Agreement

It is expected that the DPOF Agreement will be signed with the selected Operator about March or April 2004. During Phases A and B of this agreement, the Operator will work in conjunction with **tie** and **tie**'s other advisors to agree contractual target costs and revenues, based upon accepted operating assumptions. Target costs will be based upon information submitted in a competitive tendering situation, adjusted as appropriate to accommodate any agreed changes in operating assumptions.

During Phases A and B, the Operator will also be advising upon the extent and quality of the infrastructure and equipment to be procured under the Infrastructure Delivery Agreements.

9.7.3. Further Work

It is clear from the above results that many of the potential risks will have negative impacts on the patronage and revenues for the Tram. Further work is being undertaken to provide further detail on the level of these impacts and to take steps to ensure that the possibility of these risks occurring are minimised. For example, as indicated above, work is ongoing to ensure that the existing bus operators respond in a cooperative way to the introduction of the Tram rather than in a competitive manner. Further work is also being undertaken to understand more fully the impacts of congestion charging particularly in the light of the evolution of the form of that system.

10 MONITORING AND EVALUATION



10. Monitoring and Evaluation

10.1. Introduction

10.1.1. Requirements of Stag

STAG guidance requires that a new project be subject to planned evaluation and monitoring, in addition to regular revalidation of the project throughout its development.

STAG defines Monitoring as *"an on-going process of watching over the performance of a project identifying problems as these arise and taking appropriate action"*, while Evaluation is used for *"specific, post-implementation events, designed to assess the project performance against established objectives and to provide in-depth diagnosis of successes as well as deficiencies"*. Therefore, by gathering and interpreting information, monitoring and evaluation will demonstrate how the project performs against its objectives, identify any deficiencies and allow adjustments to be made.

Soon after implementation, the performance of the project should be assessed against the specified objectives – the process evaluation. Recognising that certain projects, including public transport projects, require time before the full benefits can be realised, a further evaluation – the outcome evaluation – is required some time after implementation.

In addition, regular monitoring of the project is essential against specified Key Performance Indicators (KPIs) to assess the ongoing effectiveness of the scheme.

This Chapter describes the measures put in place by **tie** to meet the requirements of the STAG guidance with respect to evaluation and monitoring.

10.1.2. Stages of the Project

There are five phases of the project which require consideration during the monitoring and evaluation process, namely:

- Scheme development;
- Infrastructure procurement;
- Construction;
- Testing and Commissioning; and
- Operations.

The STAG requirements for monitoring and evaluation are principally associated with the operational phase, following scheme implementation. However, it is also necessary to assess and re-appraise the project during phases prior to implementation. Actions to be undertaken by **tie** during scheme development, procurement and construction to assess impacts on programme, costs and potential revenues are also described below.

10.2. Objectives

10.2.1. Introduction

The objectives for this scheme are described in Chapter 2 of this report. The specific project objectives are derived from a range of national, regional and local objectives reflecting transport and more diverse government and local authority strategies.

10.2.2. Project Objectives

The specific scheme objectives developed for the tram project as listed in Chapter 2 are as follows:

- Accessibility
    - To improve access to the public transport network;
    - To improve access to employment opportunities; and
    - To support economic development.
- Environment
    - To increase the proportion of journeys made by public transport, walking and cycling;
    - To improve local air quality;
    - To reduce emissions of greenhouse gases

- Traffic congestion
    - Reduce the number of private vehicle kilometres; and
    - Reduce traffic volumes on key routes.
- Safety
    - Reduce the number of road traffic accidents; and
    - Improve personal security when using the transport system.

10.2.3. Project Stage Influences

All development work undertaken to date has been done with the above objectives in mind. The choice of alignment and development of the design and specification has been directed towards meeting or aiding these objectives. The following are amongst the factors taken into account during scheme development to date:

- The introduction of the tram will improve travel mode choice for Edinburgh, providing a fast, clean and efficient service as an attractive alternative to the private car which should help reduction of congestion both on public transport and in general traffic;
- Design proposals have considered the interface between trams, buses and other transport modes, with the objective of favouring public transport, thereby encouraging an increase in the use of public transport and reducing the need for car travel;
- In turn, it is anticipated that the reduction will lead to improvements in road traffic accidents and in some environmental criteria such as air quality;
- The proposals to accommodate the tram on Princes Street have also been developed with the intention of improving the pedestrian environment in this well-used area of the city;
- A Design Manual has been developed for the tram and its immediate environment which will undergo periodic revision to reflect and enhance the city streetscape;
- Route options considered have been chosen to penetrate population centres in socially disadvantaged areas, thereby increasing access for low income groups;
- Specifications for infrastructure and equipment are being developed to cater for the mobility impaired.

During future scheme development, the scheme objectives will continue to be under review and re-appraisal where appropriate. As examples, the following are cited:

- Operating patterns will be reviewed in conjunction with the Operator (appointed through the Development, Partnering and Operating Franchise – DPOF – Agreement) to establish the optimum service pattern and frequencies;
- The Service Integration Plan will be finalised between the tram Operator and bus companies to encourage optimum use of public transport;
- Junction operation will be reviewed with the Operator and CEC to optimise priorities for public transport modes and minimise congestion;
- Operating plans will be developed with the Operator covering all aspects of operational safety;
- The Design Manual will continue to be developed to reflect the wishes of CEC and the community with respect to streetscape;
- Specifications for infrastructure and equipment will be developed in conjunction with the Operator to obtain benefits with respect to safety, passenger security, system accessibility, etc all leading to improved public perception and system attractiveness;

Proposals will be agreed with CEC and the Operator for future fares policies, possibly including discounted fares which will encourage tram use by low-income groups.

10.3. Base Case

STAG guidance recognises the problems associated with establishing a valid Base Case against which the performance of the scheme may be judged. In the case of the tram scheme, there is an additional difficulty introduced by the length of the lead time prior to implementation of tram operations, which is unlikely to be before 2009. It is also possible that tram introduction may be phased.

Under these circumstances it is premature to be prescriptive in terms of the establishment of the collection and organisation of the data that will provide the Base Case. It is anticipated that this will be developed and agreed by **tie** with CEC and the Scottish Executive for execution during the period immediately prior to initial operation on any part of the tram network. In the case of environmental base data, it will also be necessary to consult with other heritage and conservation bodies to ensure that any changes in the environment since production of the Environmental Statement can be accommodated.

It is likely that the baseline data will include but will not necessarily be limited to:

- Data on noise, water quality, air quality, ecology, tree surveys and the like;
- Passenger usage on public transport, particularly buses and heavy rail services upon which patronage may be affected by the introduction of the tram;
- Junction performance, queue lengths, etc at critical locations;
- Mode choice survey;
- Safety records.

It will be important to establish through discussions with other organisations (e.g. CEC, train and bus operators) what information is available as part of their regular data gathering functions at that time, to avoid incurring additional cost and to limit the collection of new information to that which is strictly necessary to establish performance against scheme objectives.

It is also noted that it may be necessary to obtain some base line data prior to start of construction to be certain that construction activities do not adversely impact the validity of any changes measured.

10.4. Project Development, Procurement and Construction

10.4.1. Project Validation

There is a five to six year period required for scheme development, approval and construction. It is possible that circumstances may change within that time, which could affect the assumptions made regarding the scheme. For example, CEC will be implementing various Integrated Transport Initiative projects during that period and it will be necessary to keep under review the tram objectives, taking into account any changes in the underlying transport situation resulting from these and other measures.

Future changes in planning and transportation strategies as proposed or implemented by CEC would also result in a re-assessment of the tram proposals. Such changes might influence phasing of the network, detailed design or planned service pattern and frequency which would be assessed by **tie** and its advisors.

10.4.2. Cost and Revenue Review

The DPOF contract through which the Operator will be appointed, will be initiated during the spring of 2004. The initial phases of this contract, in place during 2004 and 2005, cover continuing development of the scheme leading to procurement of the infrastructure and equipment. It is a requirement of the contract during these phases that the Operator reviews the operating assumptions leading to existing estimates of patronage, revenue and operating costs. Any changes to the factors which affect these estimates must be agreed between **tie**, its advisors and the Operator. The DPOF Target Costs will be adjusted using the cost build-up submitted by the Operator as part of his Bid as a basis. Similarly any change in revenue estimates will be agreed.

DPOF also recognises that there may be subsequent changes to infrastructure and/or operating plans which could lead to changes in agreed costs and revenues, both before and after the start of operations. The DPOF Agreement includes a mechanism for adjustment of target costs and revenues and incentivises the Operator to achieve these targets through a pain/gain sharing formula during operations.

Thus the operating costs and revenues will be under continual review throughout the project development and operating phases.

In addition, **tie** will instigate a regular review of the costs associated with infrastructure and equipment during the development, procurement, construction and commissioning phases to confirm the ongoing validity of estimates and underlying assumptions.

10.4.3. Programme Monitoring

tie will lead a project management team comprising various advisors throughout scheme development and construction. In addition to monitoring changes in capital and operating costs and revenues, the same team will also regularly review progress against the assumed project programme, thereby evaluating any potential for changes in project costs and associated risks.

10.5. Operations

10.5.1. Process Evaluation

Evaluations are specific post-implementation events designed to identify whether:

- A project has performed as intended (or under or beyond expectations);
- Established objectives have been achieved (fully or partially, and the reasons for any failures); and
- The project continues to represent value for money (also considering actual cost budget).

The Process Evaluation is conducted straight after the implementation. It will draw lessons for on-going implementation and for the design, management and implementation of future projects.

For the reasons given above with respect to Base Case data, it is not possible at this stage to be specific about the nature of the process evaluation. It seems likely at this stage that there will be a need to provide data which will measure changes in the baseline parameters mentioned above such as various environmental parameters, public transport passenger counts, mode choice surveys and junction performance. Particularly in the case of the last of these, it would be prudent to ensure that junction performance is optimised to benefit the public transport modes without excessive inconvenience to general traffic. The introduction of additional minor traffic control measures to assist this process might be desirable and a process evaluation soon after implementation would provide information to justify any such action.

Table 10.1, below, summarises a possible example which might be employed as the basis for the process evaluation:

Table 10.1 - Evaluation Performance Indicators

Objective	Performance indicator/measure	Performance target	Source of indicator	Monitoring method and frequency
Costs	Proportion of actual costs over budget	• X% of budget exceedance	Project costs	Budget and cost comparison – after implementation
	Proportion of budget allocated to the CEC which was actually spent within timescale	• X% budget spent by completion	Project costs by time	Project costs by time – after implementation
Views	The extent to which (stakeholder, public) consultation influenced outcomes	Significant number of views taken into account	Consultation process	Qualitative examination of consultation, by group
	Stakeholder's views on how well the project was designed and implemented	Overall positive views	Stakeholder interviews	Qualitative survey results by group – after implementation
Transport	The extent to which public transport model results reflected reality	• Travel time • Patronage • No bus services withdrawn or modified	PT model, TIMS, bus operator timetable and after surveys	Comparison between modelled and actual – after implementation and again one year later
	The extent to which highway model results reflect reality	• Traffic diversion • Congestion • Delays	Highway model and traffic surveys	Comparison between modelled and actual – after implementation and again one year later
Local economy	Actual impact on economic activity	• Employment • Commerce • Tourism	Before and after surveys	Comparison between before and one year after implementation, by location and activity

10.5.2. Outcome Evaluation

It is recognised that the full potential of a new transport mode will only be realised some time (perhaps 2 to 3 years) after its introduction. It is for this reason that the DPOF contract proposes a review and possible revision of Target Costs and Revenues after such a period. The outcome evaluation would probably be undertaken as part of the process to be followed prior to agreeing any change of the targets and would be based on similar data to that collected for the baseline survey and process evaluation mentioned above.

10.5.3. Monitoring

The payment mechanism within the DPOF contract for the tram project includes four discrete elements related to payment during the Operations phase:

- Operating costs and profit element;
- Performance regime;
- Pain/gain share mechanism;
- Vision achievement bonus.

The evaluation of payments due will require a degree of monitoring to be undertaken as a regular function of operations. The pain/gain share payment will be dependent upon the financial performance of the tram and will offer the Operator and **tie** the opportunity to share in savings on operating costs below the agreed Target Operating Cost and in any revenues generated in excess of the Target Revenues. The performance of the system with respect to operating costs and revenues will be undertaken on a daily basis and evaluated at no greater an interval than 28 days.

In addition, a significant proportion of payment is linked to the Performance Regime and the Vision Achievement Bonus. The Performance Regime is the day-to-day mechanism through which **tie** will monitor and incentivise the Operator to deliver a high quality and attractive tram scheme which will satisfy

the primary scheme objectives, by increasing public transport use and reducing car use. Deductions will be applied to payments in the event of unsatisfactory performance against 7 Key Performance Indicators (KPIs).

The KPIs against which the service will be measured are:

- Headway – measuring performance against scheduled service intervals;
- First and last tram – punctuality of first and last services;
- Cleanliness of tram interiors and stops fulfilment of maintenance obligations;
- Security – to gauge personal security, equipment and incident responses;
- Information and signage – currency and coverage of service information;
- Revenue generation and protection – availability of ticket sales points and minimisation of fare evasion;
- Customer satisfaction – to indicate a measure of good performance in public perception.

These KPIs have been selected as being the aspects of service most likely to influence the attractiveness of the system to users, which in turn will assist achievement of the objectives set down for the tram.

The Vision Achievement Bonus is also payable dependent upon a consistent performance against these KPIs over time, promoting continued high quality service.

It is recognised that monitoring of these KPIs will not address all the expectations of the STAG guidance in assessing the performance against the scheme objectives and additional monitoring will be required for this purpose. It is proposed that the details of such performance indicators be developed in conjunction with interested parties closer to the date of service introduction. Nonetheless, based upon the planning objectives discussed in Chapter 2 of this report, the following performance indicators could be appropriate:

- Accessibility:
  - Improve access to public transport network;
  - Improve access to employment opportunities.
- Environment:
  - Increased use of sustainable modes;
  - Reduce local and global emissions, improving air quality.
- Traffic congestion:
  - Reduce traffic volume on key routes;
  - Reduce traffic delays.
- Safety:
  - Reduce traffic accidents.

A monitoring survey framework could be generated, which will encompass the collection, analysis and interpretation of data generated by:

- Traffic count surveys (e.g. cordon and screen line, but first checking the availability of any on-going traffic surveys by CEC or any national data sources);
- Data collection from Ticketing Information Management System (TIMS);
- Air quality monitoring equipment (first verify whether any air quality monitoring is already in place);
- Safety records from the Police; and
- Household and employee monitoring survey (first verify whether employee and school travel plans already exist).

Table 10.2, on the following page, summarises these performance indicators and a possible monitoring programme:

Table 10.2 – Performance Indicators and Possible Monitoring Programme

Objective	Performance indicator	Definition of indicator	Performance target	Source of indicator/target	Monitoring metho and frequency
Accessibility	Access to transport network	• Percentage of population within 400 metres walk distance from a public transport stop/service • Public transport use	• X% by 2014 (5 years after opening) • X million per year by 2014	• Population (from Scottish General Registry Office) • TIMS	• Yearly populatic and distributic updates by ward • Continuous monitoring of bus an tram ticketing
	Access to employment opportunities	• Transport connections to employment and regeneration areas	• X% employees at key locations accessing jobs by public transport by 2014	• Employee survey	• Annual survey wi employees from ke employment locations.
Environment	Use of sustainable transport modes	• Increased modal share on sustainable modes (i.e. walking, cycling, public transport)	• X% increase on PT by 2014 • Y% reduction on cars by 2014	• Household survey	• Citywide household surve every 5 years
	Air quality - pollutant concentrations	• Various pollutant concentration targets	• Meet all NAQS targets	• UK National Air Quality Strategy (NAQS)	• Changes in a quality wi monitoring equipme – weekly/monthly allow for season variations
Traffic Congestion	Traffic volumes - key routes	• Average AM/PM, daily, weekly, monthly and annual traffic volumes on key routes • Growth in car traffic	• Road Traffic Reduction Act (RTRA) local targets • Car traffic growth not to exceed X% in 2014	• Road Traffic Reduction Act UK Government's 1st Report	• Permanent/tempc ary si automatic/manual traffic cou programme
	Traffic delays	• Changes in journey times by car	• No change in delays by 2014	• Household survey	• Citywide household surve every 5 years
Safety	Road traffic accidents and casualties	• Total number of people killed or injured in road accidents	• X% reduction by 2014	• Tomorrow's roads: safer for everyone (UK Road Safety Strategy)	• Road traf accident databas Annual records fro local Police and loc authorities

Before the monitoring programme is agreed upon, consideration must be given to the actual availability of the data, practicalities from collecting new data, its format, whether it will properly reflect the indicators proposed and cost from obtaining it. Indicators and targets should be subject to regular reviews to ensure that they continue to properly reflect the performance of the project against its objectives, throughout the monitoring period.

Emphasis has been placed in the DPOF contract on the need for electronic data gathering to be employed as the preferred method wherever possible. This will also apply to data gathered outside the DPOF contract for monitoring purposes.

10.6. Conclusion

The paragraphs above demonstrate that **tie** has been, is and will continue to take steps to validate and evaluate the scheme (both before and after implementation) and to monitor its performance in the operational phase.

The project objectives are set out together with actions to be taken during the various phases from scheme development through to operations. A key factor in this process is the appointment of an Operator using the DPOF procedure. This action alone will contribute significantly to minimisation of risk and regular review of the project in that:

- Forecasts for operating costs and revenues will be validated during the scheme development phase;
- Operator advice on equipment and infrastructure will inform the procurement process and assist project validation;
- The operator will manage the commissioning and testing process, thereby exercising some degree of coordination between operator and infrastructure supplier; and
- An extensive, regular (and where possible automated) monitoring procedure will be followed during operations, with contracted parties incentivised to achieve KPIs targeted towards meeting scheme objectives

11 CONCLUSIONS



11. Conclusions

11.1. Introduction

This STAG Report summarises the work that has been undertaken in developing the case for a Tram Line in West Edinburgh. Initially the case for a network of Tram Lines was established within the Integrated Transport Initiative for Edinburgh and South East Scotland, which was examined as part of a package aimed at addressing the congestion problems in Edinburgh. This together with the North Edinburgh Rapid Transit Solution Feasibility Study and the Edinburgh LRT Masterplan study confirmed the priority of developing a new high quality Tram in West Edinburgh. Subsequently FaberMaunsell and their sub-consultants have developed a Preferred Route and Operating System for the Edinburgh Tram Line Two. During this time the engineering feasibility, environmental impact and revenue/patronage forecasting has been undertaken for a variety of options seeking to provide a first class public transport system from the city centre to the western edge of the city.

11.2. Pre-Appraisal Process

The Planning Objectives for this work have been established from a review of the City of Edinburgh Council's own aims and objectives for transport contained within their Local Transport Strategy. The planning objectives have been used consistently throughout the STAG process and are as follows:

- **To improve accessibility** – improvements, particularly for people without access to a car, on low incomes or whose mobility is impaired are fundamental to the achievement of both the social inclusion and economic development elements of the transport vision. Specific objectives are:
  - To improve access to the public transport network;
  - To improve access to employment opportunities; and
  - To support economic development.

- **To reduce pollution and environmental damage caused by traffic** – this is fundamental to the achievement of the environmental / sustainability aspiration and will contribute to the achievement of the safety element of the transport vision. Specific objectives are:
  - To increase the proportion of journeys made by public transport, walking and cycling;
  - To improve local air quality;
  - To reduce emissions of greenhouse gases

- **To reduce traffic congestion** – this is fundamental to the achievement of economic development and environmental aims. Specifically the scheme should:
  - Reduce the number of private vehicle kilometres; and
  - Reduce traffic volumes on key routes.

- **To make the transport system safer and more secure for both users and non-users** – this is fundamental to the achievement of the safety and community elements of the vision and will contribute towards achieving the environmental and social inclusion elements. Specific objectives are to:
  - Reduce the number of road traffic accidents; and
  - Improve personal security when using the transport system.

Edinburgh's economic success as a growing region for employment and increasing population has led to many pressures arising in it's transport networks. This together with increasing demands for new developments, particularly in the West Edinburgh area, will mean that this congestion is likely to increase further with a knock on impact on the local economy and the environment.

11.3. Project History (Option Generating, Sifting, Development and AST1 Work)

The ITI Vision for Edinburgh was submitted to the Scottish Executive in September 2002. This was approved in principle and therefore provided the initial justification for a package of schemes, including a network of Tram Lines serving the North, West and South East of the City. This network was explored further in the LRT Masterplan study undertaken by Arup, which confirmed that the Northern Loop should receive the highest priority followed by the Western and South-Eastern lines. In addition, the Feasibility Study for a North Edinburgh Rapid Transit Solution undertaken by Andersen examined the wide range of different technologies available in the Public Transport market before concluding that LRT or Tram based technology was the best solution for a network in Edinburgh.

These studies form the basis of the STAG Part 1 Appraisal and support the case for a LRT or Tram based system serving western Edinburgh.

The West Edinburgh Corridor
FaberMaunsell have undertaken more detailed work to choose a Preferred Route Corridor for Edinburgh Tram Line Two. From a wide selection of options a "Central" corridor based largely on the previous CERT corridor was chosen using the following criteria:

- Engineering;
- Traffic and Transportation;
- Safety;
- Environment;
- Economy/Development;
- Accessibility; and
- Integration.

11.4. Consultation

The Preferred Corridor together with local options were the subject of an extensive public consultation process that included:

- Client consultations;
- Public consultations; and
- Stakeholder consultations.

This informed major stakeholders and the residents of Edinburgh about the proposals and it provided the opportunity to comment in a variety of ways.

The results of the consultation show that there is broad support in Edinburgh for the tram proposals and preferences for each of the options presented was expressed. Further technical work and focussed consultation was undertaken to address specific issues arising from the consultation before the Preferred Route was determined.

11.5. STAG Part 2 Appraisal

Following the pre-appraisal process, Part 1 AST, extensive consultations and focused option analysis a total of twelve proposal options were subject to Part 2 AST. Completed AST2 tables are contained within Appendix B for all twelve options. The AST2 process appraised all twelve proposals based on the September 2003 guidance document and in particular against the planning objectives for the proposal and the Government's five objectives:

- Environment
- Safety
- Economy
- Integration
- Accessibility

Following the completion of the Part 2 AST process, a preferred route alignment has been selected for Edinburgh Tram Line Two. The preferred route alignment was considered to best satisfy the planning objectives set out that the beginning and adopted throughout the STAG process.

11.6. Preferred Scheme Description

The Preferred Route begins at St Andrew Square before travelling along Princes Street and Shandwick Place to Haymarket. It then runs parallel to the main Edinburgh to Glasgow railway line, initially on the north side but crossing over the railway to run on the south side as far as the new Edinburgh Park Rail Station.

From this point it crosses the rail line once more and runs northwards through the Edinburgh Park and Gyle Shopping Centre. After crossing under the A8 to the east of Gogar roundabout, the Tram passes close to the new Royal Bank of Scotland Headquarters (albeit on the other side of the A8) before reaching the new Park and Ride site at Ingliston. At this point the line swings northwards to Edinburgh Airport where it will terminate.

A second Line (the Newbridge spur) will run between the Ingliston Park and Ride stop westwards towards Ratho Station and the new developments at Newbridge where it will terminate. The point of termination has been chosen to allow for future extension of the line. The Newbridge spur was introduced as a branch line, instead of a direct extension of the main route, as a result of the patronage estimates and planning difficulties arising from uncertainties regarding the future expansion of the Airport and its impact on Royal Highland Showground land.

The frequency of both the main line and the Newbridge Spur will see 6 trams running in each direction in each hour during the peak. Each tram will have a capacity of up to 300 passengers giving an overall capacity for the system of 1,800 passengers per hour in each direction. It is proposed that the Tram depot will be located at Gogar and there will be stops located at the following locations:

Main Line
St. Andrew Square
Princes Street
Shandwick Place
Haymarket
Murrayfield
Balgreen Road
Saughton Road North
South Gyle Access
Edinburgh Park Station
Edinburgh Park
The Gyle
Gogarburn
Ingliston Park & Ride
Airport

Newbridge Spur
Ingliston Park & Ride (interchange with the main line)
Ingliston West
Ratho Station
Newbridge South
Newbridge North

11.7. Scheme Costs

The costs developed for this study include capital costs, operating costs and life cycle costs.

Capital cost estimates for Edinburgh Tram Line Two have been prepared using a combination of benchmarking, previous experience and engineering judgement.

The capital costs are estimated at £336.3M (including 31% optimism bias), based on 2Q 2003 prices. Costs have been derived from a comprehensive database compiled from analyses of costs for the infrastructure works of completed and proposed LRT schemes throughout the UK, currently advised prices from vehicle manufacturers and preliminary diversionary works estimates obtained from utilities companies. The resulting estimates take account of the prevailing factors influencing this particular scheme including location, relative complexity, environment and anticipated programme.

Operating costs, which include the cost of operating the system, maintenance and lifecycle costs, are expected to be around £5.7 million pounds per annum.

The Tram is expected to carry around 5 million passengers in the opening years, which will grow to around 7 million passengers some 15 years later. The revenue expected from this level of demand will be £6 million in the early years, growing to over £8 million. These figures assume an allowance for fare evasion and a variety of ticket types.

Summary of Cost-Benefit Appraisal

Present Value of Benefits (PVB)	£275 million
Present Value of Costs (PVC)	£199 million
Net Present Value (NPV)	£76 million
Benefit Cost Ratio (BCR)	1.38

tie has developed clear and active processes to identify and mitigate project risks in accordance with industry best practice. The **tie** Board takes ultimate responsibility for risk, with responsibility delegated to the Project Director.

There are five phases of the project which require consideration during the monitoring and evaluation process, namely:

- Scheme development;
- Infrastructure procurement;
- Construction;
- Testing and Commissioning; and
- Operations.

The STAG requirements for monitoring and evaluation are principally associated with the operational phase, following scheme implementation. However, it is also necessary to assess and re-appraise the project during phases prior to implementation. **tie** has been, is, and will continue to take steps to validate and evaluate the scheme (both before and after implementation) and to monitor its performance in the operational phase.

This work has concluded that the introduction of a tram into West Edinburgh is consistent with the objectives of the City Council and will contribute to the realisation of the Vision for Edinburgh.

11.8. Contribution to Meeting Planning Objectives

Table 11.1 below summarises the Planning Objectives for the scheme and the extent to which the appraisal has shown that it meets them.

Table 11.1 Contribution to Meeting Planning Objectives

Planning Objective	Contribution of Scheme
Improve access to public transport	Accessibility improves, with a saving in generalised journey time worth £168 million over the scheme life
Improve access to employment opportunities	Journey times from residential areas and transport interchanges generally show a reduction, with limited exceptions
Support economic development	The scheme would unlock additional development potential in the corridor and could assist in attracting major new developments
Increase proportion of journeys made by public transport, walking and cycling	There is a significant transfer from car to tram
Improve local air quality	Local air quality would be improved for 176,000 residents in 2011 and 165,000 in 2026 as compared with 101,000 and 106,000 respectively who would suffer worse air quality
Reduce greenhouse gas emissions	Greenhouse gas emissions in the study area would reduce by 3% in 2011 and 9% in 2026 relative to the do-minimum
Reduce number of private vehicle kilometres	There is a reduction in peak vehicle kilometres and an increase in off peak trips. This is due to a combination of increased economic activity, generating extra highway trips, and modal transfer to tram. The latter is greater in the peak due to higher congestion levels. This leads to a reduction in peak and an increase in off peak traffic volumes. There is a small increase in road traffic accidents. These objectives are met in the peak but not in the off peak or overall. However this is due to the increased economic activity that the scheme induces. If this did not occur, the objectives would be met
Reduce traffic volumes on key routes	
Reduce number of road traffic accidents	
Improve personal security	Tram will provide improved personal security relative to other public transport options.

The table shows that the scheme would make a significant contribution to meeting the majority of the Planning Objectives. However the increased economic activity that would be generated by the scheme leads to an overall increase in travel. As much of this would be made by car, the aims of reducing road traffic and associated road traffic accidents would not be met. The scheme has the potential to support economic development or to reduce car trips, but these objectives are in conflict with each other. In consequence, there is a policy choice to be made. Planning controls could be used to suppress development and achieve the reduction in car trips. Conversely, development could be permitted, resulting in additional car trips. However, it is important to recognise that, in the latter scenario, the level of car travel would be less than if the same level of development had been achieved through other – non-transport related - policy measures. Accordingly the traffic reduction objectives would be met in relative, though not absolute, terms,

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Our Ref: 07.01.03.08

Date: 1st April 2004

Dear Neill

Edinburgh Tram: Line 2

Please find enclosed 2 hard copies of the revised STAG Report for Line 2. I have also included a version of this on CD Rom.

Perhaps it may be useful for our team to meet again with you and your colleagues once you have had an opportunity to review the report.

Thank you for your assistance with this matter.

Yours sincerely

[redacted]

Alex Macaulay
Projects Director

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