Thameslink 2000

Environmental Statement

July 2005

Addendum

Prepared by Temple Environmental Consultants Ltd for Network Rail Infrastructure Limited

Network Rail

Thameslink 2000 Environmental Statement:

Addendum

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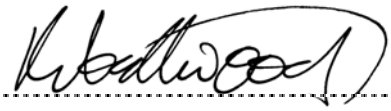 **Date** July 2005

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Non-Technical Summary

I. This ES Addendum provides additional environmental information to Thameslink 2000's Environmental Statement (ES2004), published in June 2004. This information addresses, amongst other things, matters raised by the Secretaries of State and by other key stakeholders. The Addendum forms part of ES2004 and the two documents should be read together.

II. The ES Addendum addresses:

a. the likely significant cumulative environmental effects of Thameslink 2000 and Crossrail;

b. the likely significant environmental effects of the temporary closure of Blackfriars Underground Station;

c. a more detailed assessment of noise effects and mitigation options at Blackfriars;

d. the likely significant cumulative environmental effects of Thameslink 2000 and London Bridge Tower; and

e. the likely significant townscape and built heritage effects of an alternative replacement structure at 16-26 Borough High Street, referred to as the 'Market Hall'.

III. Where likely significant adverse environmental effects are reported in addition to those described in ES2004, a strategy for mitigation is outlined where appropriate.

IV. For the purposes of this assessment, it is assumed that the measures set out in the Planning and Environmental Management Strategy (contained within the Scoping and Methodology Report to ES2004) will be applied to the approvals given for the implementation of Thameslink 2000.

Thameslink 2000 and Crossrail: cumulative effects

V. The assessment of cumulative environmental effects resulting from the construction and operation of Thameslink 2000 and Crossrail has focused on Farringdon, where the two services would cross. In the event that construction of both projects occurs simultaneously, cumulative temporary impacts are likely to result in:

a. increased adversity of effects on townscape character and the settings of two conservation areas and four listed buildings; and

b. increased disruption to the community around Farringdon Station, especially on Cowcross Street, including increased construction noise effects, a greater risk of dust episodes and more greatly adverse effects on visual amenity.

VI. In practice many of the potential significant effects from construction would be mitigated, since each project would work closely with each other and with the relevant local authorities to ensure that construction impacts are managed in a coordinated way so that the most disruptive elements of both projects do not take pace at the same time.

VII. With both schemes completed and in operation, cumulative impacts will all be positive and will include:

a. improved journey opportunities between stations in central London, Docklands and Southeast England;

b. an enhanced contribution to the economic development of Farringdon; and

c. more beneficial effects on the townscape character of Clerkenwell and on the setting of a listed building, and improved visual amenity due to the extensive pedestrianisation of Cowcross Street.

Temporary closure of Blackfriars Underground Station

VIII. The two-year closure to passengers of Blackfriars Underground Station will require many people to use alternative means of transport to and from the area. A survey undertaken for Network Rail has determined how people's travel patterns are likely to change as a result of the closure. Using information about the capabilities of other transport infrastructure to accommodate passengers diverted from Blackfriars Tube Station, an assessment of the likely impacts of closure was undertaken.

IX. The passenger survey found that the majority of people would simply use alternative Tube stations in the area; in particular, Temple, Mansion House and St Paul's. Although it is expected that occasional station management measures may be required, it is considered that these stations will continue to operate safely with the additional passengers.

X. A survey of pedestrians emerging from Temple, Mansion House, St Paul's and Chancery Lane stations in the morning peak, and of the street and footway conditions outside these stations was also undertaken. It is apparent that, with basic management, pedestrians will be able to continue their journeys from these stations relatively easily and safely. An increase in the width of footways on Temple Place, north of Temple Station, will be required however, and at Mansion House, measures to deter people from making hazardous road crossings in preference to using the existing subway, will also be needed.

XI. There will be some increase in bus use to and from the Blackfriars area, but a survey of current bus use concludes that there will be available capacity on those routes likely to be most affected.

Assessment of noise effects at Blackfriars

XII. Steps to reduce construction noise effects will be explored as construction methods are refined during the detailed design phase. No assessment of construction noise effects in addition to that reported within ES2004 has therefore been undertaken for the Addendum.

XIII. Further assessment of operational noise effects at Blackfriars has been undertaken since publication of ES2004, to address the complex nature of railway noise in the area now and in the future. The assessment found that train "wheel squeal" in particular makes a more significant contribution to noise in the area than had been assumed in ES2004. Squeal is often caused when wheels pass over switches and crossings, of which there are many on Blackfriars bridge and on the viaduct to its south. Since many of these switches and crossings will either be removed or upgraded by Thameslink 2000, much of the squeal will be eliminated. This will benefit in particular residents of Falcon Point since the decline in squeal will more than offset any noise increases due to the more frequent trains of the Thameslink 2000 service.

XIV. Building surveys have found that most of the affected commercial properties in the area are far more effectively insulated from external noise than had been assumed by ES2004; for example, due to double glazed windows. The noise increases inside these buildings due to Thameslink 2000 will in fact be significantly less than was reported in ES2004: mostly in the order of 1 dB to 2 dB rather than 5 dB to 6 dB. In all cases, resultant internal noise levels in the offices, at which significant effects were reported in ES2004, will remain at "reasonable" levels, as defined by BS8233.

XV. Overall, there will be no significant residual operation noise effects in the Blackfriars area due to Thameslink 2000. The mitigation options that were listed in ES2004 will not therefore be required.

Thameslink 2000 and London Bridge Tower: cumulative effects

XVI. The likely cumulative effects of the Thameslink 2000 scheme at London Bridge and the London Bridge Tower have been addressed within ES2004 and its supporting specialist reports. For ease of reference this information is consolidated in the Addendum. No significant permanent or operational cumulative effects are predicted. It is likely that significant cumulative effects will result temporarily from the construction of the two schemes; particularly in respect of noise and vibration, air quality, visual amenity and construction traffic. Network Rail has been working closely with the promoters of the London Bridge Tower, Teighmore Ltd, and is committed to continuing this close working relationship with both them and with the London Borough of Southwark in order to ensure that the cumulative impact during construction is kept as low as reasonably practicable.

Option for replacement of 16-26 Borough High Street

XVII. Network Rail is submitting a further planning application for an alternative design for the replacement building at 16-26 Borough High Street. This alternative is referred to as the Market Hall.

XVIII. The impacts from construction of the Market Hall will not be substantially different from those reported in ES2004 for the red brick building. The main differences in environmental effects from those reported in ES2004 are in respect of permanent effects on townscape and built heritage. The Market Hall would have a moderate beneficial effect on the setting of and views of Southwark Cathedral from Borough High Street, as it is 2 m lower than the existing building. Despite the overall adverse effects on townscape character and the setting of the Borough High Street Conservation Area that result from the Thameslink 2000 proposals in this area (as reported in ES2004) the Market Hall would result in a number of benefits. It would extend the influence of Borough Market on to Borough High Street; it would enhance the pattern of pedestrian movement and sense of vitality along Borough High Street; and it would enhance the public realm by the creation of a new route between Borough High Street, Green Dragon Court, Borough Market and Southwark Cathedral. It would also partially restore the street façade and building line along this side of Borough High Street.

1.0 Introduction and Scope

1.1 ES2004 and the ES Addendum

1.1.1 The Thameslink 2000 scheme as now proposed (including London Bridge Masterplan) was subject to environmental impact assessment and the results were reported in an environmental statement published in June 2004 (ES2004). An appendix to ES2004, *Summary of Significant Changes*, sets out the predicted environmental impacts of the project that are significantly different from what was reported in the environmental statements prepared in 1997 and 1999.

1.1.2 Since ES2004 was published, some additional work has been undertaken to provide a more detailed understanding of some issues. This is reported in this ES Addendum.

1.1.3 The environmental statement for Thameslink 2000 now comprises ES1997, ES1999, ES2004, and the ES Addendum. However, a full understanding of the environmental effects of the Thameslink 2000 project as now proposed can be gained by reference to ES2004 and this Addendum.

1.2 Update since ES2004

1.2.1 In January 2005, the First Secretary of State announced his decision to call for a public inquiry into the seven new planning applications and two listed building applications, and for the re-opening of the public inquiry into the two TWA applications and associated planning, listed building consent and conservation area consent applications. With this announcement was issued a joint Statement of Matters about which the First Secretary of State and the Secretary of State for Transport particularly wish to be informed in respect of the application before the re-opened inquiry.

1.2.2 The case of Network Rail and the SRA in respect of the matters to be addressed at the public inquiry is set out in Network Rail's Statement of Case (March 2005). In particular this sets out Network Rail's response to each of the matters listed in the joint Statement of Matters.

1.2.3 To date, third parties who wish to make representations at the Inquiry have submitted 19 statements of case.

1.2.4 In February 2005, the Department of Transport requested that Network Rail produce an addendum to ES2004 that addressed the cumulative effects of Thameslink 2000 and Crossrail, Cross London Rail Links Ltd having addressed this matter in its own ES. While including this issue within the scope of the ES Addendum, Network Rail elected also to provide further environmental information to address, amongst other things, issues raised by the Secretaries of State (in their Statement of Matters) and by other key stakeholders.

1.3 Scope of the ES Addendum

1.3.1 The issues addressed by the ES Addendum are:

i) the likely significant cumulative environmental effects of Thameslink 2000 and Crossrail;

ii) the likely significant environmental effects of the temporary closure of Blackfriars Underground Station;

iii) a more detailed assessment of noise effects and mitigation options at Blackfriars;

iv) the likely significant cumulative environmental effects of Thameslink 2000 and London Bridge Tower; and.

v) the likely significant townscape and built heritage effects of an alternative replacement structure at 16-26 Borough High Street (referred to as the Market Hall), for which a planning application is to be submitted.

1.3.2 Where likely significant adverse environmental effects are reported in addition to those described in ES2004, a strategy for mitigation is outlined where appropriate.

1.3.3 For the purposes of this assessment, it is assumed that the measures set out in the Planning and Environmental Management Strategy (contained within the Scoping and Methodology Report to ES2004) will be applied to the approvals given for the implementation of Thameslink 2000.

2.0 Thameslink 2000 and Crossrail

2.1 Background

2.1.1 Crossrail is a proposal for a major new cross-London rail link. The project comprises new 'twin-bore' tunnels running west-east through central London connecting directly with existing surface rail routes to Maidenhead and Heathrow in the west, and to Shenfield and Abbey Wood in the east. By connecting the major London rail termini of Paddington and Liverpool Street, Crossrail will enable mainline train services to cross the centre of London via a number of new purpose-built stations, one of which will be at Farringdon, where Thameslink 2000 works are also proposed.

2.1.2 The Hybrid Bill for Crossrail had its first reading in Parliament in February 2005; a motion for the carry over of the Bill into the current session of Parliament was agreed in April 2005. An environmental statement was prepared to accompany the Bill.

2.1.3 It is possible that construction of Thameslink 2000 and Crossrail works at Farringdon will be undertaken consecutively, or that some degree of overlap could arise, although of these two scenarios, the second is considered less likely. Working closely with the Crossrail team, an assessment of the cumulative effects of both consecutive construction and of overlapping construction was undertaken. An assessment of the cumulative permanent and operational effects of the two schemes was also carried out.

2.2 Project descriptions at Farringdon

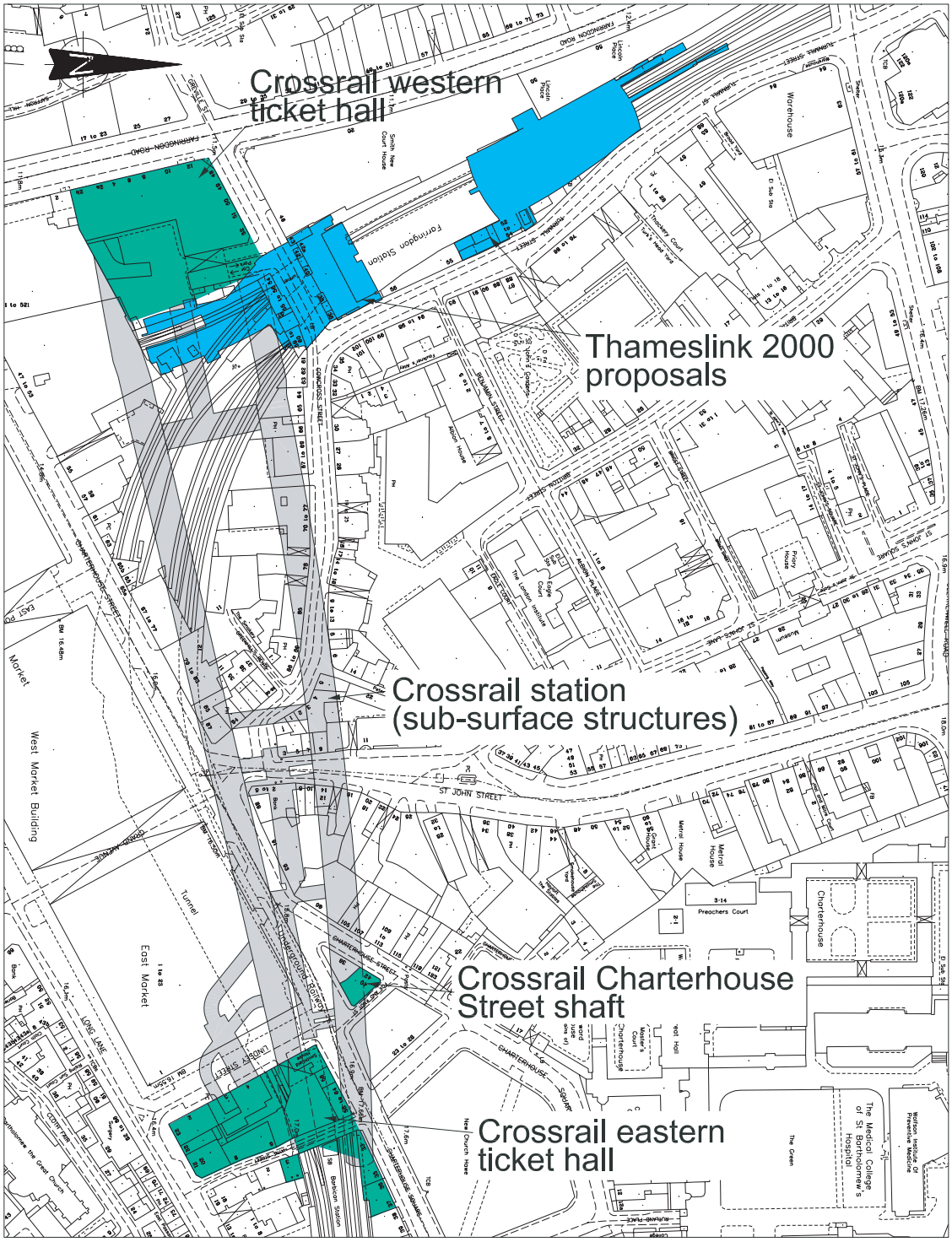
2.2.1 Thameslink 2000 proposals involve constructing a new Thameslink ticket hall and concourse on Cowcross Street in place of an existing listed terrace of buildings; extending existing Thameslink platforms; closing the Thameslink branch to Moorgate; providing new roof canopies over the Thameslink and London Underground platforms; reconstructing the Cowcross Street bridge; and reinstating part of Cowcross Street outside the station as a pedestrian precinct.

2.2.2 Crossrail's sub-surface Farringdon station will comprise western and eastern ticket halls and integrated ventilation and emergency access facilities. The western ticket hall will be constructed on the corner of Cowcross Street and Farringdon Road on the site of the existing Cardinal House[1]. Cowcross Street will be pedestrianised westwards from Thameslink 2000's pedestrianised area as far as Farringdon Road. Crossrail's eastern ticket hall will be about 350 m away, at Lindsey Street (Barbican). The station will consist of two platforms fitted out to 210 m although the tunnel will be constructed to enable possible future extensions to 245 m.

[1] Cardinal House refers to the estate, which includes the high-rise Cardinal Tower. However, the two terms tend to be used interchangeably.

2.2.3 Construction of Thameslink 2000 at Farringdon will take about 36 months to complete. Crossrail works at Farringdon will take about 56 months to complete. It remains the assumption that Thameslink 2000 works will precede Crossrail, but as described under Section 2.4 below, the scenarios of both concurrent construction (where construction of both projects takes place simultaneously) and consecutive construction (where construction of one project immediately precedes the second) are addressed in this section. In the event of concurrent construction, both projects would be developed in a co-ordinated way.

Figure 2.2 (i) Thameslink 2000 and Crossrail proposals at Farringdon



2.3 Consultation and liaison

2.3.1 Crossrail has an established liaison process with Network Rail, including the provision of dedicated individuals within Network Rail to handle Crossrail activity, and vice-versa. A monthly meeting is held between the two project teams and ad-hoc workshops take place as required. Both parties are committed to sharing design and technical information as it becomes available.

2.3.2 At the time of writing, the projects are producing a joint 'statement of common ground'. This sets out the measures that Network Rail and Cross London Rail Links Limited have jointly put in place to ensure that station designs at Farringdon accommodate each other, and that both projects are consistent with one another in terms of the construction programme, control of environmental impacts, communication and liaison with each other and with third parties, and commitments and undertakings.

2.3.3 In the event that construction of both projects takes place at the same time, a site-specific agreement addressing construction management will be entered into prior to commencement of works.

2.3.4 Consultation is ongoing with LB Islington and Transport for London (including LUL) on issues arising with respect to the Crossrail-Thameslink 2000 interface at Farringdon.

2.4 Cumulative environmental effects

2.4.1 Cumulative effects would occur where a named resource or receptor is affected by the impacts of both Crossrail and Thameslink 2000, so that an adverse effect due to one project is exacerbated by the other or that a beneficial effect is enhanced. The ES Addendum addresses temporary cumulative effects of construction, as well as permanent and operational cumulative effects.

2.4.2 The assessment of cumulative effects of Thameslink 2000 and Crossrail is based on the assessments of the two projects as reported within their respective environmental statements and supporting technical reports. The methodologies used in the EIAs of each project are broadly the same, but the Thameslink 2000 EIA methodology has taken precedence where any differences arise.

2.4.3 ES2004 has assumed that construction of Thameslink 2000 precedes that of Crossrail, and this remains the assumption. However, once consents have been received for either project and funding is in place, it is possible that construction programmes may need to be revised. The assessment of cumulative environmental effects during construction has therefore assumed two scenarios: one of consecutive construction, where the construction of one project (either Thameslink 2000 or Crossrail) is immediately followed by construction of the other; and the second of concurrent construction, where construction of both projects takes place at the same time. For the scenario of concurrent construction, it has been assumed for the assessment that the potentially most intrusive activities of each project may take place at the same time, although in practice , the works would be managed so that this situation was avoided wherever possible. Indeed the promoters of both projects are committed to working together to ensure this is the case.

2.4.4 The topics that are considered most relevant with respect to significant cumulative effects are addressed below, in the order in which they are presented in ES2004. Other topics are addressed at the end of this section.

2.4.5 The detailed descriptions of the significant environmental effects of Thameslink 2000 and Crossrail are described in the respective environmental statements. The EIA of Thameslink 2000's proposals at Farringdon is reported in *Chapter 6*, pages 87-97 of ES2004. The EIA of Crossrail's proposals at Farringdon is reported in *Section 8.8* in *Volume 2*, pages 179-210 of the Crossrail ES; this is included at *Appendix A*.

2.5 Townscape and built heritage

Overview

2.5.1 The assessment of likely cumulative effects on landscape, townscape and built heritage has addressed both temporary and permanent effects. It has considered how the visible changes as a result of both projects will affect the character and integrity of the local townscape, considering in particular the intrinsic character and setting of listed buildings and conservation areas and the character and quality of strategic views. It has drawn on the baseline characterisation already undertaken for the Thameslink 2000 EIA, as reported in ES2004.

Sources of cumulative impact during construction

2.5.2 Works associated with Thameslink 2000's redeveloped station at Farringdon would be in close proximity to works for Crossrail's western ticket hall on Farringdon Road. In particular, the demolitions and bridge works and construction of the new Thameslink ticket hall on Cowcross Street would be seen in conjunction with the demolition of Cardinal House that is required for Crossrail.

2.5.3 Crossrail's eastern ticket hall on Lindsey Street will be some 300 m east of the Thameslink 2000 works. Prominent construction plant such as tower cranes at this site and at the Aldersgate crossover works, which is a further 200 m to the east, would be seen in the same views as similar plant associated with Thameslink 2000 works, including its works access on Charterhouse Street. However, the main Thameslink 2000 works on Cowcross Street would be screened from those at Crossrail's eastern ticket hall by buildings on Charterhouse Street, including Smithfield Market.

2.5.4 Much of Crossrail's working areas will not be visible to most people since they will utilise the underground car parks beneath Cardinal House, Caxton House and Smithfield's General Market, and also the basement car park of East Smithfield Market. Other Crossrail worksites will be defined broadly by the footprints of buildings that are to be demolished: i.e. Cardinal House and three groups of buildings off Charterhouse Street/Charterhouse Square and Lindsey Street (see Table 2.5 (i)). Most of Thameslink 2000's works will take place within the existing railway cutting, so much of the construction activity will be screened, at least from street level.

Table 2.5 (i): Demolitions resulting from Thameslink 2000 and Crossrail

Thameslink 2000	Crossrail
For the Thameslink ticket hall and station works: • 54-60 Cowcross Street❶❷ • Cowcross Street Bridge❷ For temporary access to tracks: • 65,65a and 65b Charterhouse Street❷	For the western ticket hall: • Cardinal House For the eastern ticket hall: • 54, 56, 58-64 Charterhouse Street; 3, 8-9, 10 Hayne Street; 2a, 3, 4, 5 Lindsey Street; 20-23 Long Lane • 33-35, 36-37 Charterhouse Square❷ • Charterhouse Street and Hayne Street bridges over Circle and Metropolitan lines For Charterhouse Street escape shaft: • 38, 40-42 Charterhouse Street❷

❶ - listed building/structure

❷ - building/structure in Charterhouse Square Conservation Area

Temporary effects on townscape character

2.5.5 The townscape around Farringdon comprises discrete areas, the character of each being distinguished by a uniformity of elements such as landuse, vitality and culture; architectural styles and materials; scale and density of buildings; vegetation; and views and vistas. Classification of these 'townscape character areas' was undertaken as part of both the Thameslink 2000 and Crossrail EIA; each identified broadly similar areas.

2.5.6 All of the Thameslink 2000 works will take place within the Clerkenwell/ Charterhouse townscape character area. Although the impacts will be small, the area's high sensitivity to change means that the overall effect from Thameslink 2000 on the character of this area will be significant (moderate adverse). The effect of Thameslink 2000's construction on the townscape character of the adjacent areas around Smithfield will be slight (and not significant); on the townscapes of the Farringdon rail corridor area and Hatton Garden area it will be negligible.

2.5.7 Construction of Crossrail's western ticket hall will result in significant adverse impacts on townscape, affecting principally the Farringdon Road and Hatton Garden character areas (broadly the same as the Farringdon Rail Corridor and Hatton Garden character areas defined for ES2004). Impacts from construction of Crossrail's eastern ticket hall will result in adverse townscape impacts of particular importance, affecting principally the Clerkenwell Village and Smithfield character areas (broadly the same as the Clerkenwell/ Charterhouse and Smithfield Market character areas defined for ES2004).

2.5.8 Were construction of the two projects to take place at the same time, the temporary adverse effect on the townscape character of Clerkenwell would be exacerbated due to the greater physical disturbance and the longer duration of the combined works. This effect would however, be limited to the southern edge of this area. The temporary adverse effect on the townscape around Smithfield Market would also be exacerbated, although to a lesser extent.

Temporary effects on conservation areas

2.5.9 Thameslink 2000's and Crossrail's works including demolitions (see *Table 2.5(i)*) will each take place partly within the Charterhouse Square Conservation Area. ES2004 reports a substantial adverse effect on the setting of this conservation area[2], and the Crossrail ES reports an adverse impact of particular importance (see 8.8.51 in *Appendix A*). Were construction of the two projects to take place at the same time, this temporary effect would be exacerbated.

2.5.10 Both Thameslink 2000's and Crossrail's works will also take place close to the Smithfield, Hatton Garden and Clerkenwell Green conservation areas. ES2004 reports significant (moderate adverse) effects on the settings of the Smithfield Conservation Area and of the Clerkenwell Green Conservation Area. The Crossrail ES reports a significant adverse impact on the Smithfield Conservation Area (see 8.8.51 in *Appendix A*), almost entirely due to works associated with the eastern ticket hall. Were construction of the two projects to take place at the same time, the temporary effect on the Smithfield Conservation Area would also be exacerbated.

Temporary effects on settings of listed buildings

2.5.11 ES2004 and the Crossrail ES each report a number of significant temporary effects on the settings of listed buildings. In some cases, construction work associated with each project will affect the same buildings.

2.5.12 ES2004 reports a significant (moderate adverse) temporary effect on the Grade II listed Farringdon Station (including 36-38 and 40-42 Cowcross Street), part of which is concerned with changes to this building's setting. The Crossrail ES also reports a temporary adverse effect on the setting of this building (see 8.8.50 in *Appendix A*). Both ESs also report significant effects on the setting of the Grade II* listed Smithfield Market: ES2004 reports a moderate adverse effect on the setting of the East Building; the Crossrail ES reports an adverse impact of particular importance on the setting of the West and East buildings (see 8.8.52 in *Appendix A*). These adverse effects would be exacerbated in the event that construction of both projects takes place at the same time.

2.5.13 ES2004 reports significant (moderate adverse) temporary effects on the setting of two buildings also affected, albeit not significantly so, by Crossrail's works. These comprise a group of Grade II listed buildings on the corner of Cowcross Street and Turnmill Street (32-35 Cowcross Street, including The Castle Pub, and 101-102 Turnmill Street), and the cold store on Charterhouse Street (51-53). These effects would also be exacerbated were construction of both projects to take place at the same time.

[2] This and all other references to temporary effects of construction of Thameslink 2000 on townscape and built heritage are contained within para. 6.3.3 of the Main Report – Inner Area to ES2004.

The Cold Store on Charterhouse Street

Sources of permanent cumulative impact

2.5.14 The construction of new ticket halls for both the Thameslink 2000 and Crossrail stations at Farringdon will each require demolitions (see *Table 2.5(i)*). Demolitions for Thameslink 2000 will occur along Cowcross Street, with limited demolitions on Charterhouse Street to provide works access. Demolition of Cardinal House (including Cardinal Tower) will be required for Crossrail's western ticket hall. Demolition of three groups of buildings off Charterhouse Street, Charterhouse Square and Lindsey Street will be required for Crossrail's eastern ticket hall and escape shaft.

2.5.15 The Crossrail Bill does not provide powers for any non-operational development over its stations or structures to replace those buildings demolished. In describing the project's likely significant environmental impacts, the Crossrail ES (and therefore this ES Addendum) assumes no such over-site development. However, the Crossrail ES assumes that there is "an overwhelming likelihood ... that some form of over-site development will take place at the same time as the construction of Crossrail, or very soon thereafter". Any over-site development would be applied for and determined through the normal planning process and would, according to the provisions of the Crossrail Bill, be subject to EIA where such development is either integral to the operational works or is likely to have significant environmental impacts.

2.5.16 The other permanent feature of both projects, which will have a bearing on their impacts on townscape and built heritage, is the pedestrianisation of Cowcross Street. Thameslink 2000 will involve the closure of part of the street west of Turnmill Street. Crossrail will involve the closure of the remainder of the street westwards to Farringdon Road.

Permanent effects on townscape character

2.5.17 The only permanent significant effects of Thameslink 2000 on townscape character will be beneficial[3], associated with pedestrianisation of part of Cowcross Street. The extension by Crossrail of this pedestrianised area so that it extends between Turnmill Street and Farringdon Road will, based on the Thameslink 2000 assessment approach, augment this benefit.

2.5.18 The Crossrail ES reports (see 8.8.55 in *Appendix A*) a significant adverse impact on the character and quality of the townscape due to the gap in the streetscape that will be brought about by the demolition of Cardinal House. However, its replacement with a new building would reduce or mitigate this impact, with an opportunity for improvement that would, in principle, reinforce the benefit described above.

Permanent effects on conservation areas

2.5.19 The new Thameslink station, although replacing a listed building, will not diminish the character of the adjacent conservation areas, since it will integrate well with its setting; no significant effects on conservation areas, positive or negative, will occur.

2.5.20 Thameslink 2000 will not worsen the adverse effects on the settings of Charterhouse Square and Smithfield conservation areas that will result from the replacement of buildings off Charterhouse Street and Charterhouse Square with Crossrail's eastern ticket hall and escape shaft. These adverse impacts could, in any case, be mitigated or reduced by the provision of replacement buildings (see 8.8.62 in *Appendix A*).

Permanent effects on listed buildings

2.5.21 No direct cumulative effects on listed structures will occur as a result of both projects.

Listed buildings on corner of Cowcross Street and Turnmill Street

[3] This and all other references to the permanent effects Thameslink 2000 on townscape are contained within para. 6.3.5 of the Main Report – Inner Area to ES2004.

2.5.22 The setting of the Grade II listed buildings on the corner of Cowcross Street and Turnmill Street (32-35 Cowcross Street, including The Castle Pub, and 101-102 Turnmill Street) will be affected beneficially and significantly by Thameslink 2000's partial pedestrianisation of Cowcross Street. Crossrail's extension of this pedestrianisation to Farringdon Road will, based on the Thameslink 2000 assessment approach, enhance this positive effect.

2.6 Air quality

Dust

2.6.1 Dust will be generated by construction works associated with both Thameslink 2000 and Crossrail. Both projects assume that mitigation measures will be used to reduce the risk of dust impacts; these are set out within their respective environmental statements.

2.6.2 The Crossrail ES concludes that works at Farringdon Station have a high risk of giving rise to dust nuisance, but that, assuming explicit dust control measures, no significant effects will occur (see 8.8.124 in *Appendix A*).

2.6.3 Thameslink 2000 will employ a similar level of dust control as Crossrail. However, in using slightly different evaluation criteria, the assessment for ES2004 reports the likelihood of occasional dust episodes (a significant effect) at an estimated 16 properties on Cowcross Street.

2.6.4 Based on Thameslink 2000's approach, it is considered that Thameslink 2000 works on Cowcross Street and Crossrail works at Cardinal House would together increase the risk of dust episodes at properties in their immediate vicinity. However, those properties where combined effects may arise are those that were at no risk or 'low risk' of dust episodes with the Thameslink 2000 scheme and therefore the relative significance is likely to be limited. In the event of concurrent construction each project will work closely to coordinate dust control strategies, including dust monitoring, so that the risk of dust episodes is kept as low as reasonably practicable.

Impacts of traffic

2.6.5 As reported under *Transport and Access* at *Section 2.9*, there are no routes on which construction traffic will increase traffic flows by more than 2%. The Association of Local Government's technical guidance on *Air Quality Assessments for Planning Applications* uses a threshold of 5% to determine where air quality impacts may become significant. On this basis no significant construction effects on air quality are predicted to result from the construction traffic of both schemes.

2.6.6 No significant cumulative effects on air quality are predicted as a result of the operation of both schemes.

2.7 Noise and vibration

Assessment of construction noise effects

2.7.1 During construction, noise and vibration impacts from Thameslink 2000 and Crossrail works would potentially arise principally as a result of:

i) noise from construction sites; and

ii) noise from construction traffic.

2.7.2 Cumulative construction noise and vibration was assessed using the evaluation criteria set out in the *Section 10.8* of the *Scoping and Methodology Report* for ES2004.

2.7.3 Noise levels at construction sites were predicted for each project using the calculation methods set out in the BS 5228. The predicted noise levels from each project were used to assess the cumulative construction noise impacts at specific receptors within the vicinity of Farringdon Station. At this stage it cannot be determined exactly when specific construction activities will occur. Although the scenario of concurrent construction is less likely, for illustrative purposes it has been used for this assessment as the situation that will give rise to the highest cumulative noise levels.

2.7.4 A screening exercise was carried out to determine whether changes in road traffic flow arising from the construction of both projects concurrently are likely to give rise to an increase in noise level of more than 3 dB(A). Given that the traffic increase in the area would be well below +25% over base flows, (see 2.9.2 and 2.9.5) no significant effects from traffic noise would occur.

2.7.5 The assessment of significant effects for residential properties already identified in ES2004 was based on the evaluation of the number of properties affected and the severity of the impact. Significant effects for non-residential properties were determined by considering the severity of the impacts and the quality and utility of the resources affected.

Cumulative construction noise

2.7.6 Of the construction activities associated with Crossrail, only those at Cardinal House would affect receptors around the existing Farringdon Station. The potential for cumulative impacts would be limited to the buildings in the vicinity of both Crossrail's Cardinal House Worksite and the Thameslink 2000 works - on Farringdon Road and Cowcross Street.

2.7.7 The threshold for determining significant effects from construction noise has been set according to the time that they occur and the prevailing noise levels. Ambient noise levels around Farringdon Station are generally high or very high (between 69 and 75 dB $L_{Aeq,16h}$ during the day and between 68 and 72 dB $L_{Aeq,8h}$ during the night).

2.7.8 The cumulative effects described below refer to those caused by noisy construction activities assuming that the construction programmes start at the same time and that noisy activities coincide. In practice, with either consecutive construction or with some degree of overlap, noisy construction activities are not likely to coincide. However, people's perception of more frequent noise episodes and/or of noise episodes taking place over a longer period could be deemed a cumulative effect, although it is unlikely to be significant.

2.7.9 At Farringdon, significant effects are deemed to occur where construction noise is predicted to exceed 75 dB L_{Aeq} during the day, 65 dB L_{Aeq} during the evening or at weekends and 55 dB L_{Aeq} during the night. Assuming that Crossrail and Thameslink 2000 construction occurs at the same time, it is likely that these thresholds would be exceeded for longer periods than reported in ES2004. Significant daytime noise effects at Smith New Court House would be extended by an aggregated period of about 9 weeks over the 16 weeks that are reported in ES2004. Significant daytime noise effects at 46 Cowcross Street would be extended by an aggregated period of about 37 weeks over the 2 weeks that are reported in ES2004. Cumulative noise levels during the day would not cause impacts at any additional locations, however. The significant impacts reported by ES2004 at 52 Cowcross Street and the Cardinal House would, of course, disappear since these buildings are to be demolished by Crossrail.

Smith New Court House

2.7.10 Significant night time noise impacts from both projects could each affect residents at 34/35 Cowcross Street. Concurrent construction would result in higher cumulative noise levels. This would increase the risk of exceeding the evaluation thresholds, resulting in a significant effect over a longer period. This effect would be limited to a few weeks over that which would, based on Thameslink 2000's methodology, occur with Crossrail alone.

2.7.11 The loss of screening brought about by the demolition of Cardinal House would result in significant noise effects at residential apartments at 17-23 and 25-27 Farringdon Road from construction of the Thameslink 2000 ticket hall. However, the noise impacts from construction of Crossrail's western ticket hall would continue to dominate any cumulative impacts because of their scale and proximity to these buildings. Any potential effect from the loss of this screening is likely to be small if not negligible.

Cumulative construction vibration

2.7.12 Only properties within 10 metres of piling are predicted to experience significant vibration impacts. For this reason, no cumulative vibration impacts would occur. The significant vibration impacts reported in ES2004 (para. 6.8.4) for Cardinal House and 52 Cowcross Street would no longer occur if these buildings had already been demolished as a result of Crossrail.

Operational noise

2.7.13 At Farringdon, Thameslink and Underground trains run in open cutting, whereas Crossrail trains will run in approximately 30 metre deep bored tunnels with resilient rail supports. The Crossrail ES predicts no significant impacts from operational vibration or groundborne noise. Similarly, no operational noise impacts are predicted with Thameslink 2000. No significant cumulative railway noise effects will occur.

2.7.14 ES2004 and the Crossrail ES each predict significant beneficial noise effects as a result of reductions in traffic flow along Cowcross Street past the existing Farringdon Station. Each project will bring about permanent closure to traffic of part of Cowcross Street, but the projects will either severely limit (as for Thameslink 2000) or prevent (as for Crossrail) the use of the western part of Cowcross Street by road traffic. The beneficial effects of each project on its own or in combination will therefore be largely similar, and the cumulative benefits will not be significantly different from these.

2.8 Visual amenity

Overview

2.8.1 The assessment of cumulative effects on visual amenity has addressed both temporary and permanent effects. It has drawn on the baseline characterisation already undertaken for the Thameslink 2000 EIA and has used the assumptions set out in the Crossrail ES and ES2004.

Temporary visual effects during construction

2.8.2 The sources of cumulative visual impacts during construction are the same as those described above for townscape and built heritage. Thameslink 2000's works on Cowcross Street would be in close proximity to those for Crossrail's western ticket hall on Cowcross Street and Farringdon Road and any cumulative effects, assuming concurrent construction, would result almost exclusively from these.

2.8.3 Works for Crossrail's eastern ticket hall would make a relatively small contribution; for example, prominent construction plant, such as tower cranes, on Lindsey Street and Aldersgate would be seen in the same views as similar plant on Farringdon Road and Cowcross Street. But such features are not an unusual part of central London's skyline and, separated by at least 300 metres, the respective works would not reinforce their separate visual impacts.

2.8.4 Cumulative visual impacts during construction would therefore result either from the intensification of construction activities, were the two projects undertaken at the same time, or from the lengthening of the construction period, were the two projects undertaken consecutively.

25-27 Farringdon Road

2.8.5 People with the clearest views of construction of both projects would obviously be the main candidates for cumulative visual impacts. These comprise people living, working and travelling on Cowcross Street, including residents at Numbers 14-16, 18, 26-27, 34-35 (Castle Pub) and 86 Cowcross Street. People on Farringdon Road will mostly be screened from the Thameslink 2000 works, but residents of some flats within 25-27 Farringdon Road, on the corner of Greville Street, would look along Cowcross Street to the Thameslink works as well as having direct views of the works at Cardinal House and the movement of construction traffic for both projects. Pedestrians on Greville Street would be similarly affected.

View from Greville Street to Cowcross Street

Permanent visual effects

2.8.6 ES2004 and the Crossrail ES (paras. 6.9.3 and 8.8.70/71 respectively) each report a number of beneficial permanent visual effects, the former due largely to the pedestrianisation of part of Cowcross Street and the latter due to pedestrianisation of the remainder of Cowcross Street to Farringdon Road and/or the opening up of views following the demolition of Cardinal House. The groups of people benefiting from the improved visual amenity of one project will generally not be affected by the benefits from the other, so the scope for cumulative benefits is limited. However, those people on Cowcross Street who will benefit from views of the pedestrianised street outside Farringdon Station will also benefit from the additional pedestrianisation and the creation of new open views associated with the loss of Cardinal House: in particular residents and users of The Castle Pub (34/35 Cowcross Street). The replacement of Cardinal House with a new building may reduce these benefits, but they are likely to remain significant.

2.8.7 No permanent cumulative adverse visual impacts would occur.

2.9 Transport and access

Overview

2.9.1 The assessment of the effect of construction traffic on the existing road network has assumed that the highest levels of impact would occur with peak construction activity for both projects taking place at the same time, although this is considered unlikely.

2.9.2 With respect to operational transport and access effects, impacts from passenger use of Crossrail, Thameslink 2000 and Underground stations at Farringdon is reported within the Crossrail ES (para. 7.77 of *Volume 8b*, the transport assessment). It is repeated below.

Construction traffic

2.9.3 On the assumptions set out in ES2004 and the Crossrail ES (paras. 2.6.14 and 8.8.33 respectively), generated construction traffic flows will be as follows:

Table 2.9 (i): Construction traffic associated with Thameslink 2000 and Crossrail works at Farringdon

Project	Worksite	Max (and average) daily construction vehicles	Affected streets
TL2K	Cowcross Street	25	Turnmill Street and/or Farringdon Road and Cowcross Street
TL2K	Charterhouse Street	24	Farringdon Road and Charterhouse Street
Crossrail	Cardinal House	60 (25)	Ground level: Farringdon Road Basement level: Farringdon Road, West Smithfield, Smithfield Street and Snow Hill
Crossrail	Lindsey Street/Fox and Knot Street	60 (32)	Farringdon Road, West Smithfield, East Poultry Avenue, Charterhouse Street, Lindsey Street, Smithfield Street and Snow Hill

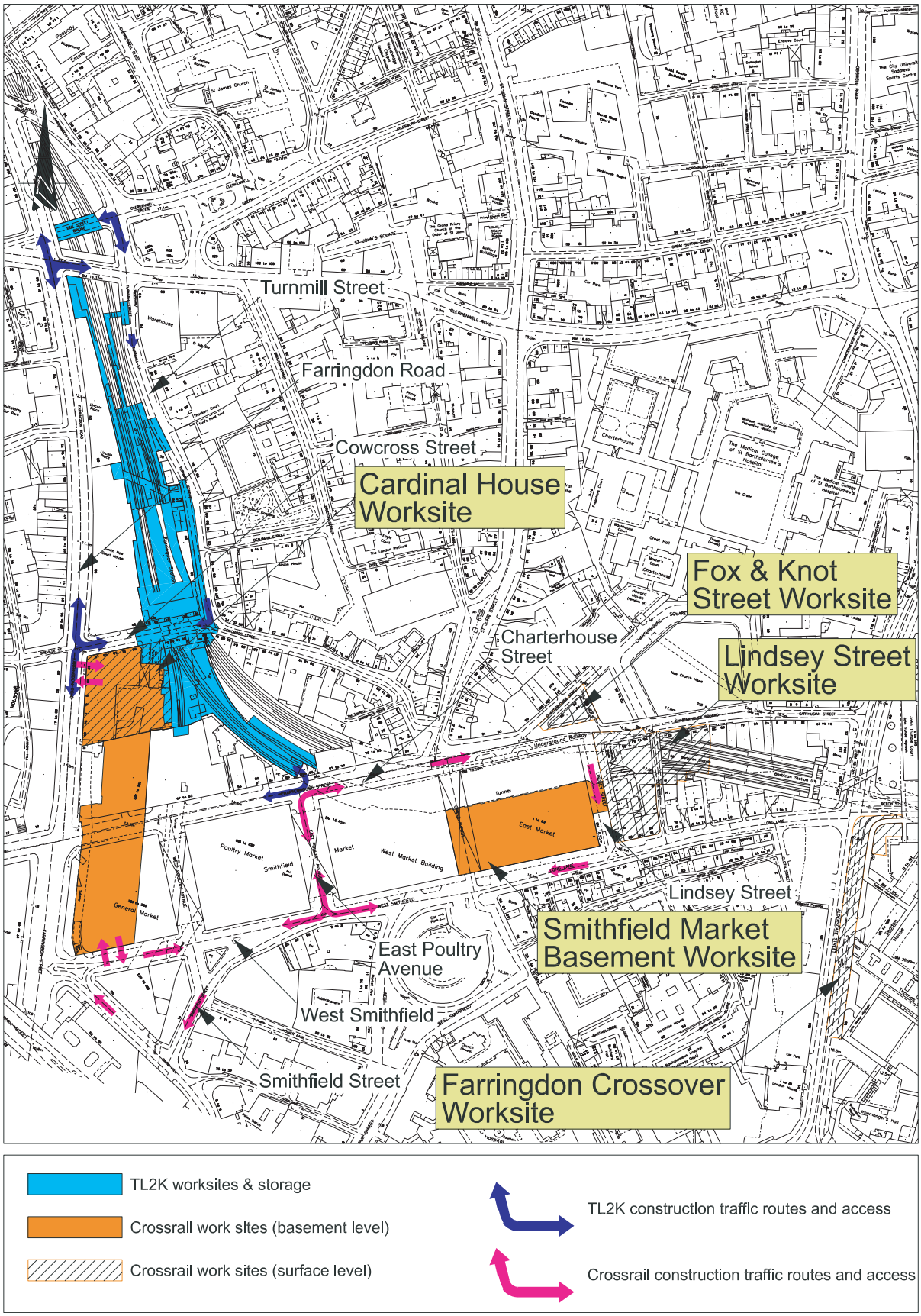
2.9.4 The routes to be used by construction vehicles for the two projects are illustrated in *Figure 2.9 (i)*.

2.9.5 Crossrail's Cardinal House site will have worksites at ground level and basement level. The ground level site will have an access/egress point on Farringdon Road, immediately south of Thameslink 2000's Cowcross Street site. Crossrail's basement worksite for Cardinal House will occupy the existing Cardinal House, Caxton House and Snow Hill car parks. Access and egress will be via West Smithfield, which will not be used by Thameslink 2000 construction traffic.

2.9.6 Crossrail's Lindsey Street and Fox and Knot Street worksites require access from Farringdon Road via West Smithfield, East Poultry Avenue and Charterhouse Street. East Poultry Avenue is located opposite Thameslink 2000's proposed worksite at 65/65a/65b Charterhouse Street, access to which will be along Charterhouse Street to and from Farringdon Road.

View along East Poultry Avenue towards 65/65a/65b Charterhouse Street

Figure 2.9 (i): Thameslink 2000 and Crossrail construction sites and lorry access at Farringdon



2.9.7 The main route for construction traffic for both projects to use to and from the Farringdon area will be Farringdon Road. Traffic surveys undertaken for Thameslink 2000 showed existing levels of traffic on this road in the vicinity of the works to be between about 20,000 and 25,000 over an 18-hour period (0600 to midnight).

2.9.8 The total possible number of Crossrail and Thameslink 2000 construction vehicles on Farringdon Road over this 18-hour period would not exceed about 170 (equal to 340 two-way movements) or an increase of no more than 2% over the existing baseline. This would not be a significant effect. It is highly unlikely that these peak construction periods would coincide and actual numbers of construction vehicles are likely to be considerably lower than this.

2.9.9 Network Rail (through PEMS) is committed to producing traffic management plans in consultation with highway and traffic authorities. Crossrail is currently developing a construction code that also addresses these matters. In the event that construction works for both projects at Farringdon are to coincide, these plans will be developed in tandem in order to develop traffic management strategies that are mutually inclusive; for example with respect to programming of peak activities, routing of construction traffic, use of traffic control measures and use of temporary closures and diversions.

Permanent effects on train passengers and station users

2.9.10 Thameslink 2000 and Crossrail will each offer journey timesavings between stations on their respective routes. These benefits will be enhanced through the provision of interchange between these services at Farringdon, thereby enabling a variety of yet quicker journeys to be made between stations in central London, Docklands and southeast England.

Permanent effects on pedestrian access and amenity

2.9.11 As described above, the changes in the numbers of people entering and leaving the various station entrances at Farringdon has been reported in the Crossrail ES, which assumed that Thameslink 2000 was in operation. For convenience it is repeated here.

2.9.12 Based on the scenario for 2016 it is predicted that the number of people emerging on to the corner of Cowcross Street and Farringdon Road from Crossrail's western ticket hall during the 3-hour morning peak period will be about 9,400; about 550 are expected to enter the station during the same period[4].

2.9.13 At the same time, the number of people leaving and entering the Thameslink and Underground stations to and from Cowcross Street is expected to be around 23,800. This figure would be about 27,250 (or some 3,450 higher) were Crossrail not in operation.

2.9.14 As reported in the Crossrail ES (para. 7.81 in *Volume 8b*), the 24% increase in the number of people using the three Farringdon station entrances in this area in the morning peak would be a significant effect but for the implementation of an appropriate package of mitigation measures. These will be developed by Crossrail in due course to address highway, footway and public transport impacts. The measures would rely on consultation with the highway authority and relevant local authorities and would require Crossrail to seek separate consents.

[4] Given the direct connection between the Crossrail and Thameslink ticket halls (see figure 2.9 (ii)), some of these Crossrail passengers would enter or leave the station via Thameslink's entrance on Cowcross Street.

Figure 2.9 (ii): Interchange at Farringdon between Thameslink 2000 station and Crossrail station (western ticket hall)

Permanent effects on road traffic

2.9.15 Thameslink 2000 and Crossrail will each bring about permanent closure to traffic of different parts of Cowcross Street. These closures, either on their own or in combination, will prevent the use of Cowcross Street by road traffic between Farringdon Road and Turnmill Street. Access to the basement car parks off Cowcross Street will still be possible with Thameslink 2000, but the effect of each project on road traffic will be broadly the same.

2.9.16 ES2004 and the Crossrail ES use different assumptions about how traffic will respond to this closure; ES2004 assumes a greater amount of traffic is diverted south of Cowcross Street, along Charterhouse Street, whereas the Crossrail ES assumes more of this traffic passes to the north along Clerkenwell Road. The impact of closure cannot be precisely predicted and either of these scenarios may be valid. However, the amount of traffic diverted is relatively small and neither scenario will result in a significant residual effect.

2.10 Local community and employment

Socio-economic baseline

2.10.1 The Crossrail and Thameslink 2000 projects both define a 'walk-in' catchment area of 1000 m around the station. The Crossrail ES (para 8.8.138 in *Appendix A*) identifies 180,000 people employed within this catchment area and approximately 4.1million m^2 of commercial floorspace. Farringdon is located close to the core London office markets of the City and 'Midtown'. However, despite its accessibility by train, tube and bus, it has lagged behind the City in terms of development activity.

2.10.2 The 'walk-in' catchment area has a population of 23,900. The economic activity rate is 66% and the unemployment rate is 7% (as compared to 68% and 6% respectively for London as a whole). Of the total population, 13,000 are located within 'regeneration areas', with higher levels of younger people (under 26), fewer qualifications, lower economic activity rates and higher unemployment.

Direct Impacts on jobs

2.10.3 The Crossrail ES estimated that Crossrail construction activity would displace a maximum of 1,100 retail and office jobs and demolish a total of 16,400m^2 of commercial floorspace (para 8.8.140 in *Appendix A*). This would be approximately 0.6% of total jobs and 0.4% of commercial property within the catchment area. ES2004 estimates that Thameslink 2000 construction would displace 75 jobs, of which a maximum of 36 would be at risk in the long term (para. 6.11.5). This amounts to 0.04% of the total jobs within the catchment area. The proportion of potential job losses as a percentage of the total number of jobs within the catchment would not be significant for either project or both.

2.10.4 In conclusion, the potential direct socio-economic impacts of Crossrail and Thameslink 2000 are not considered significant, either in isolation or for construction during the same time period.

Indirect job creation

2.10.5 Crossrail addressed the potential employment benefits of the new station for people living within regeneration areas inside the 1 km 'walk-in' catchment area. On the assumption that the additional jobs attracted to Farringdon would raise the activity rates in regeneration areas to those of non-regeneration areas, it was concluded that Crossrail would provide a potential 1,500 additional jobs in the Farringdon area.

2.10.6 Under route-wide benefits, both the Crossrail ES and ES2004 reported the general benefits that transport improvements could provide. With The London Plan predicting a rise of 25% in public transport trips during the morning peak period by 2016, both ESs conclude that their respective projects would help relieve overcrowding and lift growth constraints on the City, West End and the Docklands. The projects will also increase accessibility to social services, retail, education and health facilities and employment.

2.10.7 The socio-economic technical report to the Crossrail ES concludes that the scheme will greatly enhance the image of Farringdon and assist in overcoming the present negative perception amongst occupiers and investors. Although the function of Thameslink is different, a new Thameslink Station would also contribute to this process.

2.10.8 In conclusion, a new Crossrail station will provide a significant contribution to the economic development of Farringdon as an extension to the City of London, and to the regeneration of the local community. The new Thameslink station would also contribute to this process.

Direct effects on community

2.10.9 The loss of community facilities, such as a butchers, fish shop, health club, bagel shop, food store and chemists due to Thameslink 2000 will not be significant, since there are alternatives within a five minute walk. The demolition of facilities as a result of Crossrail (including the Lindsey Street Hotel, which the Crossrail ES reports as significant at 8.8.136 in *Appendix A*) will not invalidate this conclusion. No adverse cumulative effects will therefore occur.

2.10.10 ES2004 (para. 6.11.4) concluded that the modernisation of the Underground station, a new Thameslink station and pedestrianisation of Cowcross Street would be a significant beneficial effect. The Crossrail ES (para. 8.8.137 in *Appendix A*) also concluded that the pedestrianisation of the western part of Cowcross Street would be a significant beneficial impact on the amenity of pedestrians. The larger pedestrianised area created by both projects would be a significant cumulative benefit.

Cumulative impacts during construction

2.10.11 ES2004 (para. 6.11.3) reported significant cumulative effects on the Cowcross Street and Turnmill Street area during construction. The Crossrail ES (para. 8.8.135 in *Appendix A*) reported significant cumulative impacts on the local community surrounding the eastern ticket hall (at Lindsey Street). If the projects were to be constructed concurrently, these significant adverse effects would be exacerbated, affecting in particular the community at Cowcross Street/ Turnmill Street and at Lindsey Street. Liaison with the local community before and during construction is a key part of the mitigation strategies of both projects, and will help greatly to reduce the community effect.

2.11 Other issues

Archaeology

2.11.1 The impacts of Thameslink 2000 on archaeology will be slight. It is probable that any archaeological remains that might have occurred will have been removed by previous railway construction. This is true also for the area of railway cuttings and the underground car parks below Cardinal House that will be affected by construction of Crossrail's western ticket hall. Ground works for Crossrail's eastern ticket hall are not confined to the railway cutting and are likely to affect archaeological remains.

2.11.2 Neither project is expected to affect archaeological resources of sufficient importance to warrant their preservation *in situ*; in both cases, preservation by record will mitigate any potentially significant effects. No cumulative effects are therefore likely to occur.

Ecology and biodiversity

2.11.3 Neither ES2004 nor the Crossrail ES report significant ecological effects due to works at Farringdon. No cumulative ecological effects will occur from the two projects.

Soil and water resources

2.11.4 Potential impacts of both Thameslink 2000 and Crossrail relate to the creation of pathways between the shallow, potentially contaminated, aquifer and the deep aquifer. Such risks will be controlled through the application of good site practice measures (set out in the respective ESs); no significant effects are therefore predicted.

3.0 Temporary Closure of Blackfriars Underground Station

3.1 Background

3.1.1 It is proposed that Blackfriars Underground Station will need to be closed to passengers for up to two years (subject to LUL access agreement) while the Blackfriars mainline and Underground stations are reconstructed. This is necessary because the safety shield required to separate the works from the running lines will reduce the available platform area to such an extent that the station cannot be operated safely for the majority of the construction period. Further details are set out in Network Rail's *Statement of Case* (para 4.25 et seq).

3.1.2 ES2004 reports the predicted transport and access impacts associated with this closure (para. 7.10.4/5). Since then further studies (including surveys of passengers, stations and buses, the results of which are reported in this chapter) have been undertaken to provide a more detailed understanding of the likely changes in travel patterns of current Blackfriars Underground users faced with this closure, and the ability of existing transport infrastructure to accommodate these changes.

3.1.3 This chapter summarises the information contained in the Transport Assessment prepared by Steer Davies Gleave on behalf of Network Rail.

3.2 Methodology

Consultation

3.2.1 The Blackfriars survey and forecasting methodologies were developed in consultation with London Underground Limited (LUL). LUL has also reviewed the results of the survey and the forecasting work.

3.2.2 Discussions are continuing with the Corporation of London and with Westminster Council regarding the impact of any changes in pedestrian flows around the nearby Underground stations to which some passengers are expected to divert during the temporary closure of Blackfriars Underground Station.

3.2.3 Liaison with Transport for London (TfL) will continue to take place to confirm, amongst other matters, the assessment of impacts on bus capacities.

Blackfriars passenger survey

3.2.4 To understand how passengers may respond to the temporary closure of the Underground station, a survey of passengers entering and leaving the station in the morning peak period (07.00-10.00) was carried out in April 2005. Passengers were questioned through face-to-face interviews or a self-completion questionnaire about their preferred transport alternatives in the event of closure. They were asked to give three options, ranked according to preference.

3.2.5 The survey obtained responses from 592 people entering and 867 exiting during the morning peak period (after records of passengers not stating any alternative mode were removed). A comparison with the gate counts provided by LUL on the days the survey was undertaken indicated a satisfactory overall sample representation of 11%.

3.2.6 Passenger demand levels for the proposed first year of closure, 2007, were forecast. Using LUL RODS (Rolling Origin and Destination Survey) data from 2003 as the baseline, the morning peak demand for 2007 was factored up using approved network-wide annual peak growth factors supplied by LUL. 2007 morning peak forecasts were derived for Blackfriars Underground Station and for those Underground stations which the survey indicated would be most significantly affected.

Bus occupancy surveys

3.2.7 Bus occupancy levels were recorded for bus services at:

i) St Paul's Church Yard (route numbers 4, 11, 15, 17, 23, 26, 76, 100 and 172);

ii) Fleet Street (route numbers 11, 15, 23, 26, 76, 172 and 341); and

iii) Blackfriars Bridge (route numbers 45, 63 and 100).

3.2.8 The survey was undertaken simultaneously at each of the sites on 9th February 2005. Both the morning and evening peak periods were surveyed. Occupancy was evaluated on a scale of 1 to 6 with the following definitions:

i) Virtually empty (0-25% seating used);

ii) Many seats available (25-50%);

iii) Seating available (50-75%);

iv) Little seating available (75-100%);

v) Full, room to stand;

vi) Full and standing to door.

Survey outside Underground stations

3.2.9 To determine the pedestrian flows along different routes from the exits of the potentially most affected Underground stations, counts were undertaken in April 2005. These were based on video footage taken during the morning peak period outside Temple, Chancery Lane and Mansion House stations, and a manual count undertaken outside St. Paul's Station.

3.3 Response of passengers to closure

Overview

3.3.1 Based on the survey, the projected response of passengers to the temporary closure of Blackfriars Underground Station is shown in *Table 3.3 (i).* The RODS data has been factored up to 2007 (which assumes a 2.5% growth from 2003). This provides an indication of the actual numbers of people who would divert to each of the alternative modes.

Table 3.3 (i): Alternative transport modes

Entering Passengers				Exiting Passengers		
Alternative Mode	Survey Count	%	No of Passengers in 2007	Survey Count	%	No of Passengers in 2007
Tube	260	43.9	2,037	644	74.3	7,148
Bus	87	14.7	682	47	5.4	522
Train	46	7.8	360	60	6.9	666
Car	129	21.8	1,011	3	0.3	33
Walk	19	3.2	149	59	6.8	655
Cycle	3	0.5	24	2	0.3	22
Not make journey	25	4.2	196	43	5.0	477
Other	23	3.9	180	9	1.0	100
Total	592	100	4,638	867	100	9,623

3.3.2 The results from the survey indicated that quite a large proportion of people would choose as their first alternative mode to divert from the Underground network. Further consideration of origins and destinations suggested that, for the majority of those who stated that they would journey by car, this would not be a viable long-term alternative and it was believed that most would eventually settle for an alternative non-car mode. As such, the large majority of prospective 'car users' (based on the number who stated Tube as their second alternative) were reallocated into the Tube count. The alternative station choices of these people were allocated on the same basis.

3.3.3 The majority of people would continue to use the Underground network, but would use alternative stations. Of those who enter the network at Blackfriars (most of whom alight currently at Blackfriars from the mainline rail network), the majority (3,009 or 65%) would continue to use the Tube, entering the Underground network at a different station. Of those passengers who currently leave the tube network at Blackfriars, approximately 75% (7,148 people) would continue instead to another Underground station.

Alternative Underground stations

3.3.4 The alternative station choices of the 384 people who are expected to enter the Underground elsewhere are shown below, together with projected passenger numbers for 2007.

Table 3.3 (ii): Alternative Tube station entry points

Survey Result			Demand Impact 2007		
Tube Station	Count	%	Background AM Peak Entry	Additional Blackfriars Passengers	% Increment
Victoria	120	31.2	30,385	940	3.1
London Bridge	44	11.5	21,771	345	1.6
Temple	37	9.6	340	289	85.0
Bank / Monument	32	8.4	14,797	253	1.7
Embankment	29	7.4	4,352	224	5.1
St. Paul's	21	5.4	645	162	25.2
Cannon Street	20	5.2	3,496	158	4.5
Elephant & Castle	11	2.9	4,390	86	2.0
Waterloo	9	2.3	44,812	71	0.2
Farringdon	8	2.0	6,330	59	0.9
Mansion House	7	1.8	421	55	13.1
Other	47	12.2	-	367	-
Total	384	100		3,009	

3.3.5 The alternative station choices of the 644 people who are expected to leave the Underground elsewhere are shown below, together with projected passenger numbers for 2007.

Table 3.3 (iii): Alternative Tube station exit points

Survey Result			Demand Impact 2007		
Tube Station	Count	%	Background AM Peak Entry	Additional Blackfriars Passengers	% Increment
Temple	166	25.8	6,422	1,843	28.7
St. Paul's	132	20.5	8,876	1,465	16.5
Mansion House	84	13.0	4,994	932	18.7
Chancery Lane	47	7.3	11,867	522	4.4
Waterloo	37	5.7	16,897	411	2.4
Bank / Monument	23	3.6	34,428	255	0.7
Liverpool Street	20	3.1	24,437	222	0.9
Farringdon	21	3.3	15,846	233	1.5
Southwark	21	3.3	4,152	233	5.6
Embankment	19	3.0	8,595	211	2.5
London Bridge	12	1.9	17,732	133	0.8
Other	62	9.6	-	688	-
Total	644	100		7,148	

3.3.6 The three stations that are expected to be affected by the largest incremental change in passengers, both entering and leaving, are Temple, St Paul's and Mansion House.

3.4 Impacts at Underground stations

Overview

3.4.1 The passenger survey results were analysed to understand how passengers would choose to continue their journey to the Blackfriars area once they had exited at an alternative Underground station.

3.4.2 The majority (nearly 80%) would choose to walk to their final destination; this number increases to between about 84% and 87% for the four stations affected by the largest numbers of diverted passengers; i.e. Temple, St Paul's, Mansion House and Chancery Lane. The number of people who would use a bus to continue onwards is relatively small: approximately 5% or 355 people. Approximately 7% or 500 people would use a taxi to complete their journey.

3.4.3 Surveys of pedestrian movement outside the four key Underground stations in the morning peak period were undertaken in February 2005. These have helped to provide an understanding of where passengers go currently when they leave the stations, such that any existing or potential constraints in the ability of walkways or crossings to accommodate them can be identified.

Impacts outside Temple Station

3.4.4 Temple Station will need to accommodate 1,843 additional pedestrians exiting the station during the morning peak period; an increase of nearly 29% over current levels. An estimated 289 additional people will also enter the station during the morning peak period.

Temple Station entrance looking north

3.4.5 The station has a single exit onto a courtyard with access to both Temple Place (via stairs) and Victoria Embankment. Those passengers using Temple who would walk towards the Blackfriars area are likely to use both routes.

3.4.6 Currently, only 9% of pedestrians exiting Temple Station in the morning peak turn right when exiting the station towards Victoria Embankment. The majority cross Temple Place via the zebra crossing and proceed north along Arundel Street (57%). The footway along Temple Place is narrow and this currently slows the passage of pedestrians to and from the station. The increase in pedestrians will exacerbate this problem. The footway along Arundel Street is also relatively narrow and has existing capacity problems. A significant number of pedestrians cross the two-lane Temple Place to the west of the zebra crossing (21%).

Footways on Temple Place are currently crowded in the morning peak

3.4.7 Significant effects on pedestrians would be mitigated were the footways both sides of Temple Place to be widened to ensure there is sufficient capacity and to encourage all pedestrians to use the zebra crossing provided. Temple Place is one-way with two lanes of eastbound traffic, and this could be reduced to accommodate widened footways without affecting capacity available for the flow of traffic. This matter has been discussed with Westminster City Council who have indicated that they would require Network Rail to implement these measures.

Impacts outside St Paul's Station

3.4.8 St. Paul's Station is expected to have to deal with over 20% of the displaced passengers who currently exit the Blackfriars Underground Station; this is equivalent to 1,465 additional pedestrians exiting the station during the morning peak period (a 16.5% increase over current numbers).

St Paul's Station entrance on south side of Newgate Street

3.4.9 St. Paul's Station has two exits, the main one being on the south side of Newgate Street, through which pedestrians exit onto a wide footway. There are no evident footway capacity problems, and increased levels of exiting passengers, based on the survey results and site observations, can be accommodated. Pedestrians wishing to approach Blackfriars on foot from St. Paul's can do so through Paternoster Square which provides a large pedestrianised plaza linking to Ludgate Hill and onwards towards New Bridge Street.

Impacts outside Mansion House Station

3.4.10 Mansion House station is expected to have to deal with 13% of the displaced Blackfriars Underground Station passengers; this is equivalent to an additional 932 pedestrians exiting the station during the morning peak period (a 19% increase over current numbers).

3.4.11 Mansion House Station has a series of exits connected via a subway network. The main exit is on the south side of Queen Victoria Street adjacent to the junction with Cannon Street. The others emerge on the north side of Queen Victoria Street and on both sides of Cannon Street. Those passengers displaced by the Blackfriars closure would probably continue along the southern footway of Queen Victoria Street and use the existing zebra crossing facilities at Friday Street. This would be aided by improved pedestrian signage.

Mansion House Station main entrance on Queen Victoria Street

Mansion House Station, entrance on Cannon Street

3.4.12 The footways are wide in the area adjacent to the station exits and there are no significant capacity issues at present. The increased level of exiting passengers that is predicted would not present a significant problem for footway capacity.

3.4.13 Despite the provision of a subway, high levels of pedestrian movements were observed crossing the junction at surface level between the south side of Queen Victoria Street and the southwest side of Cannon Street. Accident statistics for the three years to December 2004 record three car accidents involving pedestrians crossing this junction. Mitigation measures should be focused on encouraging increased use of the existing subway in preference to the non-segregated street crossing; e.g. through improved pedestrian signage within the station and subways.

Impacts outside Chancery Lane Station

3.4.14 Chancery Lane Station is expected to have to deal with an additional 522 diverted Blackfriars passengers, which is 7% of the total diverted passenger flow during the morning peak period. This relatively low number, equivalent to only 4.4% over current passenger numbers using Chancery Lane station, is surprising considering the proximity of the station to the northwest Blackfriars area. However, further assessment has found that for those diverted trips that pass through Liverpool Street it will be more convenient to exit using St Paul's station than to travel an extra stop and walk back.

3.4.15 Chancery Lane station has two stairway exits to the surface on each side of High Holborn. The exit most likely to be used by those approaching the Blackfriars area is that on the south side which opens onto a wide footway. This is generally unobstructed, although it does narrow slightly in the eastbound direction.

Chancery Lane Station, entrance on south side of High Holborn

3.4.16 Given the relatively low increase in footfall expected at Chancery Lane Station, footway capacity issues are not expected to be significant. Extra pedestrian signage indicating the most direct route to the Blackfriars area would aid displaced passengers and minimise the levels of passengers mistakenly exiting onto the northern side of High Holborn.

Effects within Underground stations

3.4.17 The results of the passenger surveys at Blackfriars Underground Station have been discussed with LUL, who are, at the time of writing, examining the likely effects of the additional passengers on the operation of the stations which will experience the greatest relative increase in number of passengers: Temple, Mansion House, St Paul's and Chancery Lane. It is currently considered that these stations will continue to operate safely with the additional passengers, or at least that LUL will be able to divert that additional demand to other stations better able to cope with it. Occasional station management measures may be required but it is not considered that these will give rise to any significant adverse effects.

3.5 Impacts on bus services

3.5.1 *Table 3.3 (i)* shows that an estimated 682 people who currently enter the Underground network at Blackfriars would choose bus as their alternative mode of travel from Blackfriars. An estimated 522 people who currently leave the Underground network at Blackfriars would choose bus as their alternative main mode of travel. This equates to only 5.4% of total exiting passengers during the morning peak period.

3.5.2 In addition, when considering those passengers who will use alternative Underground stations, only 5% of those would opt for bus as their onward mode of travel when leaving the underground network. This is equivalent to 355 passengers. Of these, a total of 89 passengers are forecast to leave the underground network at Liverpool Street and interchange to bus to complete their journey to the Blackfriars area.

3.5.3 The bus occupancy survey found that, of the routes to and from the Blackfriars area (in the morning and evening peaks respectively), most were well used although all had available capacity to accommodate the diverted passenger numbers. Routes across Blackfriars Bridge were busy with little seating available although there were no significant capacity problems when the capacity for standing passengers is taken into account. Routes along Fleet Street had the highest levels of available capacity with few buses having no seating available during the survey periods.

3.5.4 The additional bus passenger levels, when considered over the morning peak period and across the different routes that serve the Blackfriars area, are a very small proportion of the existing bus passenger demand. It is expected that the bus network can easily cope with this increase in passenger levels, especially given the extra capacity highlighted by the bus occupancy survey results.

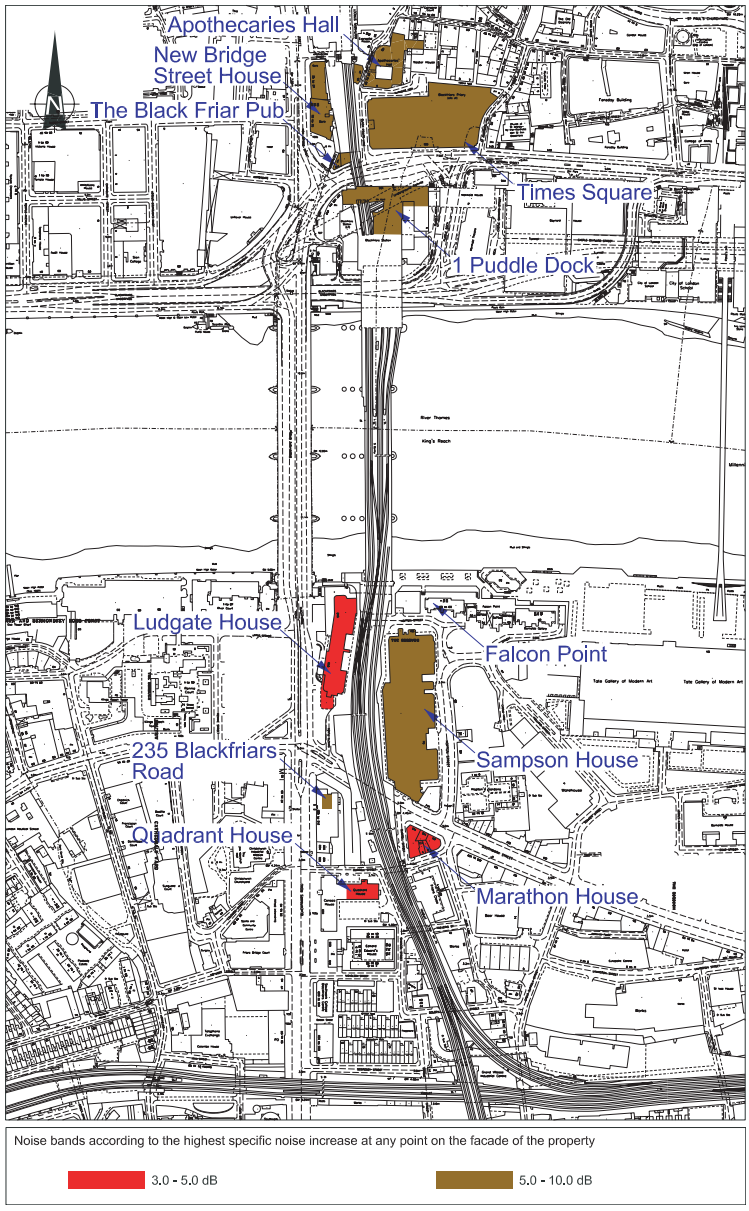
4.0 Operational Noise at Blackfriars

4.1 Background

4.1.1 ES2004 reported significant operational noise effects at Blackfriars (paragraph 7.8.11 *et seq.*) and a number of options for mitigating these (paragraph 13.9.10 *et seq.*).

4.1.2 The significant effects reported by ES2004 will result not from an increase in noise levels but from an increase in the duration and number of events (because of longer and more frequent trains). In preparing the information for ES2004, it was known that some of the commercial properties were likely to have sealed windows and air conditioning and that, in adopting a cautious approach, the incidence of adverse effects was likely to be over-estimated. The further assessment that is reported here confirms that these adverse effects were over-estimated.

Figure 4.1 (i): Predicted operational noise effects as reported in ES2004



4.1.3 Since ES2004, additional work has been undertaken to assess in more detail the composition of existing noise in the area and the actual noise levels inside buildings. This has enabled a more accurate assessment of the operational noise effects of Thameslink 2000. Further work has also been undertaken to assess the effectiveness and feasibility of the mitigation options outlined in ES2004.

4.1.4 The review of operational noise effects is presented below. The likelihood of significant construction noise effects at Blackfriars is reported in ES2004 along with the measures required to mitigate them. Steps to reduce these effects continue to be developed and refined as construction methods are progressed during the detailed design phase; this is set out in paragraph 13.9.7 of the Main Report - Inner Area to ES2004. No further assessment of construction noise effects has therefore been undertaken for the Addendum.

4.1.5 Network Rail has held meetings with the Corporation of London and LB Southwark to discuss this additional assessment work and its results. The officers consulted have expressed their general satisfaction with the approach and with the findings that had emerged.

4.2 Noise from trains

Existing noise sources

4.2.1 Most noise from above-ground trains is 'rolling noise': noise from wheels running over the rail. But receptors can also be affected by joint noise, structure-radiated noise (from bridges and viaducts), and wheel squeal, or different combinations of all of these.

4.2.2 Amongst other things, noise from train movement depends on:

i) the type of track: jointed track is noisier than continuously welded track;

ii) the presence of switches (points) and crossings;

iii) the way that the track is supported; and

iv) the geometry and curvature of the track: trains can make more noise when rounding a bend than they do in a straight line.

4.2.3 Bridges and viaducts can give rise to additional noise, since the structure itself may radiate noise from passing trains. This will depend on the bridge structure; for example, heavy brick or concrete tends to radiate far less noise than steel. It also depends on the way that the track is supported; for example, concrete decks are quieter than steel decks and ballasted track is quieter than track on timber bearings.

4.2.4 The Thameslink line passes over Queen Victoria Street on a steel bridge with a concrete deck. Blackfriars Railway Bridge is also steel as is the bridge over Southwark Street. The viaduct immediately south of the railway bridge is made of brick.

4.2.5 There are numerous switches and crossings on Blackfriars Bridge and the viaduct to its south and these are generally old and their condition reflects this. There are also short sections of track with bolted joints. Because of these factors, railway noise in the Blackfriars area is particularly complex.

Additional assessment

4.2.6 The ES2004 assessment of operational noise was based largely on the standard Calculation of Rail Noise (CRN) Method (see paragraph 10.6.4 of the ES2004 *Scoping and Methodology Report*). Whereas this principally calculates noise levels from rolling noise, much of the noise generated in the Blackfriars area is from other sources, such as wheel squeal, joint noise and bridge (structure-radiated) noise, which will vary at different locations.

4.2.7 A comprehensive set of noise measurements was taken at each of the buildings where a significant noise effect was predicted in ES2004, to evaluate the incidence and relative importance of the different types of noise, and the specific mechanisms that are and will be generating that noise.

4.2.8 Detailed evaluations of the relevant buildings were also carried out. These identified the buildings' uses and any particular sensitivities to noise, and they established the buildings' abilities to resist external noise (e.g. through noise insulation such as double glazing). Simultaneous noise measurements were taken inside and outside the buildings.

4.2.9 Noise modelling was also undertaken. The 'Norbert' model was used to assess the acoustic benefit of removing joints and switches and crossings, which is a key part of the proposed track works in the Blackfriars area. It was also used to assess certain mitigation options such as rail dampers, resilient baseplates and enhanced regimes for wheel and track maintenance. The potential benefits were addressed for Blackfriars Bridge and for the brick viaducts to its south.

4.2.10 The position regarding wheel squeal was studied by observation of track layout and condition, by measurement and calculation, and by research into the body of knowledge and experience about the occurrence and prevention of the phenomenon.

Existing noise levels

4.2.11 Daytime ambient noise levels ($L_{Aeq,16h}$ dB) around Blackfriars Station are generally high due to the busy roads and, at facades facing and close to the railway, due to railway noise. Recorded daytime noise levels outside a number of offices were found to be around 62 to 67 dB, although they were higher (71 dB) at Marathon House (115 Southwark Street).

4.2.12 During the night, ambient noise levels remain high. Measurements ($L_{Aeq,8h}$) taken outside residential buildings for which significant effects had been predicted within ES2004 recorded about 60 dB at Falcon Point, 64 dB at the Black Friar Pub and 60 dB at Quadrant House.

4.3 Evaluation of noise effects at commercial buildings

4.3.1 BS8233 is the British Standard code of practice for sound insulation and noise reduction for new buildings and is concerned with control of indoor ambient noise from external sources such as traffic and mechanical services. This states that levels of 35-40dB L_{Aeq} are "reasonable" inside executive offices and small conference rooms; levels of 40-50dB L_{Aeq} are "reasonable" inside open-plan and cellular offices. A noise level of 51dB L_{Amax} is taken to be appropriate to allow telephone use and general conversation.

4.3.2 The detailed evaluations of the buildings for which significant operational noise effects were predicted have shown nearly all to be double glazed, a major factor in the relatively low ambient

noise levels that have been recorded inside. Measured internal noise levels are set out in *Table 4.3 (i).*

Table 4.3 (i): Internal noise measurements and predicted noise effects for commercial buildings at Blackfriars

	Existing internal ambient noise levels	Predicted internal railway noise levels with Thameslink 2000	internal noise levels in the absence of railway	Total internal ambient noise levels with Thameslink 2000	**Increase to overall noise levels**
Apothecaries Hall	35.7	37.9	33.4	39.2	**3.5**
Times Square	34.9	34.3	33.9	37.1	**2.2**
New Bridge Street House	46.5	35.1	46.4	46.7	**0.2**
1 Puddle Dock (QV Street façade)	40.5	33.5	40.3	41.1	**0.6**
1 Puddle Dock (rear façade)	37.9	33.4	37.5	38.9	**2.0**
Sampson House, 64 Hopton Street	40.2	37.0	39.5	41.4	**1.2**
Ludgate House, 245 Blackfriars Road	38.8	39.1	37.0	41.2	**2.4**
Marathon House, 115 Southwark Street	44.7	34.7	44.6	45.0	**0.3**
235 Blackfriars Road	50.2	32.7	50.2	50.3	**0.1**

Note 1: The predictions assume that windows will be closed. However, not all the offices at Apothecaries Hall have air-conditioning and it is reasonable to expect that the windows to these may be opened for ventilation.

Note 2: The assessment is based upon the increased railway noise levels predicted using the CRN method. The predictions are therefore based on worst case assumptions because the predictions do not account for the reductions in joint noise and squeal noise that will occur with Thameslink 2000.

4.3.3 With this increased knowledge of the sound insulation and ventilation of these buildings, a re-assessment of the noise impacts reported in ES2004 (para. 7.8.11 et seq.) has been undertaken.

4.3.4 The measurements show that the increases in internal ambient noise levels resulting from Thameslink 2000, at no more than 3.5 dB and generally between 1 dB and 2 dB, will be significantly less than the 5 dB to 6 dB increases in external railway noise that were reported in ES2004. In all cases, internal noise levels will remain at "reasonable" levels, as defined by BS8233.

View of Ludgate House

View of rear of 1 Puddle Dock

View of Marathon House

4.3.5 The BS8233 criteria take account of steady noise. The noise surveys within these buildings recorded frequent episodes of "tonal noise" associated with wheel squeal and joint noise, especially in those buildings to the south of the Thames; occupants of these buildings often referred to squeal as the most noticeable noise. Improvements associated with Thameslink 2000 will result in the significant reduction of this tonal noise (as outlined below).

4.4 Noise benefits

4.4.1 Wheel squeal in the Blackfriars area is due in part to the numerous switches and crossings, and portions of jointed track including the spur to London Bridge. The track remodelling brought about by Thameslink 2000 will remove the switches and crossings on the bridge and will either remove or replace most of the old switches and crossings to the south of the bridge. It will also replace the jointed track with continuously welded rail. The new track will, in addition, incorporate modern lubrication methods. These measures will significantly reduce squeal noise in the Blackfriars area.

4.4.2 One of the other causes of wheel squeal is the occurrence of short-radius curves, several which will be removed in the Blackfriars area.

4.4.3 Residential buildings will enjoy the same benefits of reduced wheel squeal as commercial buildings. Noise recordings from the roof of Falcon Point were analysed with and without squeal. These found that railway noise levels dropped by up to 9.3 dB(A) when squeal was removed. Squeal was found to increase the average railway noise level by about 6 dB(A).

4.4.4 Similar analysis of joint noise (the click-clack of wheels as they pass over rail joints) found that it contributed around 3 dB(A) to the general operational noise. The removal of most bolted joints will therefore benefit receptors, especially as it is a subjectively more apparent noise than most other elements of rail noise. Where some joints have to remain, the rail will be pre-curved and the joints maintained to avoid the flange contact that currently occurs when axles run over worn joints.

4.4.5 Overall, the minimisation of squeal and joint noise in the vicinity of Blackfriars Station will offset the predicted increases due to the more frequent train movements of Thameslink 2000. No residual operational noise effects will occur; indeed it is likely that there will be an improvement in the perceived railway noise at Falcon Point.

View over Blackfriars railway bridge from Falcon Point

4.5 Assessment of additional noise mitigation options

4.5.1 Given the absence of operational noise effects that are now predicted, the mitigation options identified in ES2004 will not, in most cases, be necessary. However, for completeness, the evaluation of the potential acoustic benefits of these options is presented in *Appendix B*. The options that have been examined comprise:

i) use of rail dampers;

ii) use of resilient baseplates on the bridge;

iii) use of noise barriers;

iv) implementation of an enhanced wheel maintenance regime; and

v) enhanced rail maintenance.

4.5.2 In summary, the use of rail dampers, resilient baseplates on the bridge and noise barriers will result in little meaningful reduction in operational noise impacts. Network Rail will produce a maintenance manual for Thameslink 2000 to ensure that noise mitigation measures remain effective, and that railway noise is kept as low as reasonably practicable.

4.6 PA noise

Background

4.6.1 The changes at Blackfriars Station reported in ES2004 have not led to any change in the position as regards the effect of the public address (PA) system. A draft planning condition, agreed with the LB Southwark and the City of London at the time of the last Inquiry, would effectively limit and control noise from the PA system so that there is no significant effect. The draft planning condition states:

i) *"The station PA system shall be designed, so far as compatible with any duty imposed by law, so that the sound level solely caused by the PA system as measured at one metre from the outside of the nearest residential premises is no greater than the concurrent sound level due to other noise sources including rail noise.*

ii) *The sound level of the PA system shall be expressed as the* $L_{Aeq,\,1\ minute}$ *and the concurrent sound level excluding the sound of the PA system shall be measured as* $L_{A90,\,5\ minutes}$ *when no train noise is occurring, and as* $L_{Aeq,\,1\ minute}$ *during the passage of trains through the station."*

4.6.2 ES1999 reported that potential significant effects will be mitigated and this remains the case, with mitigation achieved through the design, siting and specification of the PA system and detailed design of the station itself.

4.6.3 Additional information is provided below that sets out the principles of this mitigation, and gives some specific examples of how it will be achieved.

Design requirements

4.6.4 Operators of railway stations are required to communicate with staff and the public in order to maintain a safe environment and to ensure that trains run to timetable. PA announcements have the advantage of being immediate and flexible, allowing important and sometimes complex information to be distributed widely and updated quickly. Crucially, they enable instructions to be given to staff and passengers in times of emergency.

4.6.5 The advantages of PA systems are, however, lost if the announcements are unintelligible. To counter this, significant advances in the intelligibility and quality of PA announcements have been made.

4.6.6 In addition to PA specification, careful setting up, avoidance of electrical distortion and use of trained delivery of the spoken message will improve the effectiveness of most PA systems.

4.6.7 A design objective for all Thameslink 2000 station PA systems (including Blackfriars) is to maximise coverage and intelligibility whilst avoiding both discomfort for passengers and adverse impacts on those outside the station.

PA system design

4.6.8 A number of modern PA systems (such as 'smart-sound') can adapt the PA volume according to the background noise level. These use many, small loudspeakers distributed along each platform which can operate at a lower sound power level than more conventional types of speaker.

4.6.9 These systems rely on sensor microphones located at suitable positions within the station that continuously monitor the ambient noise. Feedback from these enables the PA volume to be varied so that it is only as loud as it needs to be. Field trials have shown that acceptable intelligibility for announcements can be made with the PA volume as little as 5-8 dB above background noise in the station.

4.6.10 Some systems use passive infra-red detector switches: infra-red sensors detect passengers in their zone and activate only those loudspeakers in the vicinity of these passengers on the platform.

4.6.11 The type of loudspeaker used for the PA also plays an important role. These will be designed and located to maximise the direct-to-reverberant ratio; i.e. they will ensure that passengers mostly hear the announcement direct from the speaker rather than its reverberant echo within the station (reverberant sound has the effect of masking speech syllables).

Station design

4.6.12 In addition to the design and specification of the PA system itself, the acoustic condition of the station will be optimised to maximise intelligibility and thus minimise noise overspill to the outside.

4.6.13 The design and selection of station finishes will be chosen so as to adequately control the effects of reverberation. For example, the new roof will incorporate sound absorbent material which will help to reduce reverberation and so lower the necessary volume of PA announcement.

4.6.14 Reducing bridge noise and rolling noise within the station could in the same way allow lower PA volumes. Treatment of decking below the central island platforms would help to reduce the transmission of structure-radiated noise into the station, as will the use of resilient baseplates, although it is possible also that the baseplates might result in increased rolling noise, so negating this benefit. Rolling noise could, however, be controlled by rail dampers.

4.6.15 Noise levels inside and outside the station will depend partly on the degree of ventilation achieved through provision of openings in the steel deck and between the sides of the roof: more openings mean that more bridge noise will escape, potentially affecting surrounding receptors; fewer openings will result in the retention of noise inside the station (which would in turn require the PA volume to be increased in order to be audible to passengers).

4.6.16 Use of localised absorbent screening adjacent to loudspeakers will assist in minimising overspill.

5.0 Thameslink 2000 and London Bridge Tower

5.1 Introduction

5.1.1 London Bridge Tower is a proposed 71 storey, mixed-use building that will be built next to London Bridge Main Line Station. At 306 metres in height it will be the tallest building in Europe.

5.1.2 Following enabling works towards the end of 2005, it is currently proposed that demolition of the existing building, Southwark Towers, takes place during 2006 with construction of the Tower between 2007 and spring 2010. With Thameslink 2000 works proposed to take place at London Bridge between 2007 and 2011, it is likely that environmental impacts from construction of both schemes will have cumulative effects.

5.1.3 The cumulative environmental effects of Thameslink 2000 proposals at London Bridge and London Bridge Tower were addressed in ES2004 and in its supporting specialist reports. This information is consolidated here. The main source of information about the environmental impacts of London Bridge Tower is the London Bridge Tower ES[5].

5.2 Cumulative temporary effects of construction

Overview

5.2.1 The overlapping of the construction programmes of Thameslink 2000 at London Bridge Station and of London Bridge Tower would be likely to give rise to significant cumulative environmental effects. In particular this would concern noise and vibration, air quality, visual amenity and transport and access. These are addressed in turn below.

5.2.2 Under the terms of an Agreement between Network Rail, Teighmore Ltd and others, Network Rail has the right to approve (in specified circumstances) those works relating to the redevelopment of London Bridge Tower and the way in which they are carried out. Accordingly, Network Rail will collaborate with LB Southwark to ensure that all construction works associated with London Bridge Station are carried out in such a way that their adverse effects, and those resulting from the cumulative impacts of both its works and those of London Bridge Tower, are subject to appropriate mitigation and control.

Noise and vibration

5.2.3 The *Noise and Vibration Specialist Report* for ES2004 states, in *Section 8.8.1*, that despite the close proximity of the two developments, the potential for a cumulative increase in noise is limited to two locations.

[5] London Bridge Tower Environmental Statement (March 2001) produced by ENVIRON UK Ltd for Teighmore Ltd.

5.2.4 New London Bridge House would receive a significant increase in daytime noise levels from the construction of both developments. However, since the two projects are likely to affect different façades i.e. the northern facade for Thameslink 2000 and the eastern façade for London Bridge Tower, the cumulative effect would not be significantly worse than those predicted for these projects in isolation. Moreover, this property is already well insulated and therefore internal noise levels will be markedly lower than the external noise levels.

5.2.5 Significant night time construction noise impacts are predicted at Guy's Hospital as a result of Thameslink 2000. The construction of London Bridge Tower will result in significant daytime impacts and night time impacts but the night time impacts would be limited to relatively few nights when long concrete pours may occur during the third phase of the construction of London Bridge Tower, involving pile and substructure forming. Consequently, significant cumulative adverse effects are likely to occur at Guy's Hospital on the façade facing St. Thomas' Street, although the extent of this effect will depend on how closely the two construction programmes coincide.

Guy's Hospital (right) is located close to Southwark Towers (left), which will be demolished to make way for London Bridge Tower

Air quality

5.2.6 The *Air Quality Specialist Report* for ES2004 states, in *Section 5.2.4*, that construction of the two projects could give rise to cumulative effects of dust impacts at sensitive receptors. Of the buildings potentially affected, Guy's Hospital would have the highest risk of dust episodes. The promoters of both schemes have set out in the respective environmental statements the need to implement measures that provide adequate protection from dust impacts at this property.

5.2.7 Although there is the potential for these effects, the use of best practicable means would minimise the extent to which these effects will become significant. The opportunity to co-ordinate specific activities, location and programming will ensure that the risk of effects is low although over a potentially extended period compared to that of each project alone.

Visual amenity

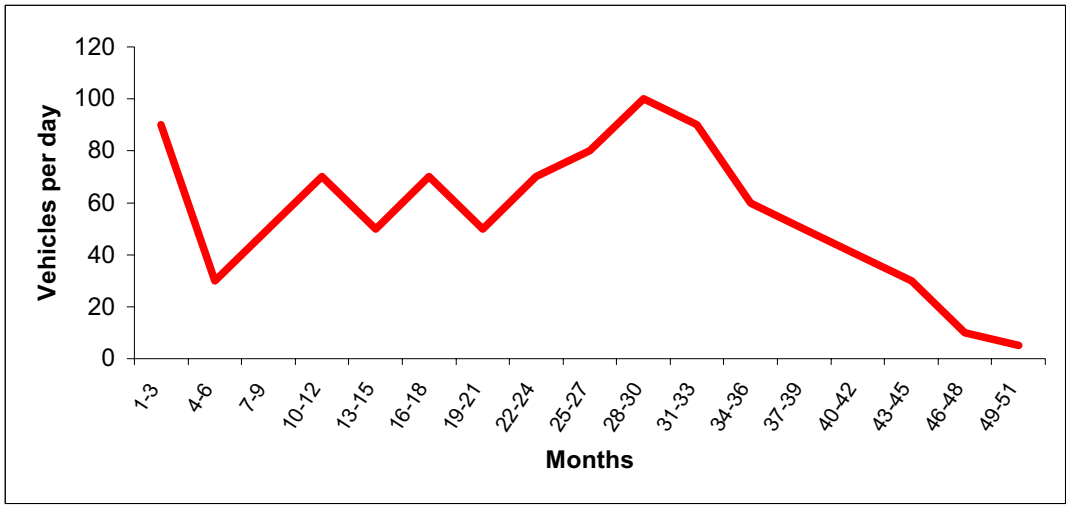
5.2.8 The *Visual Amenity Specialist Report* for ES2004 states, in *Section 5.3.7*, that the visual impact of Thameslink 2000 construction works at London Bridge would be moderated by the presence of similar works for London Bridge Tower. However, cumulative effects on visual amenity from construction of the two schemes would occur. These would affect in particular, people with close views of both works such as small numbers of residents on Tooley Street and St Thomas' Street, and large numbers of pedestrians on the surrounding streets.

Transport and access

Predicted construction traffic volumes

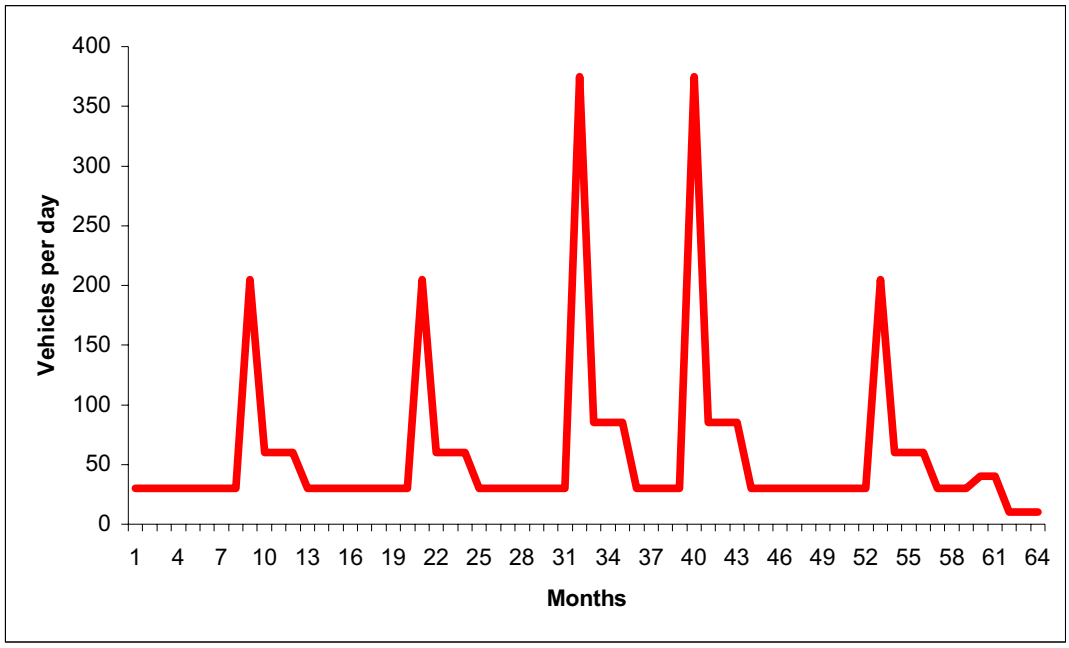
5.2.9 The maximum number of construction vehicles for London Bridge Tower will be between 90 and 100 per day. During the first three months, there will be some 70 to 80 vehicles per day, with a peak of 90 vehicles per day over a two week period. This will then drop to between 50 and 70 vehicles per day for about two years, before rising to a five month period in the middle of the third year when daily vehicle numbers will be between 90 and 100. Numbers will fall to around 40 vehicles per day during the first half of the fourth year, and will fall still further after the third quarter of the fourth year, when vehicle numbers would be less than 10 per day. The number of construction vehicles required over the 51 month construction programme is represented approximately by *Figure 5.2 (i)* below:

Figure 5.2 (i): Indicative number of construction vehicles for London Bridge Tower



5.2.10 Construction of London Bridge Station will involve a period of enabling works (including some demolitions) over six to eight months followed by five stages of construction, lasting 56 months in total. Each of the five stages involves sequential demolition of the arches and the replacement/realignment of the overlying station platforms and tracks, followed by one month of commissioning. The initial demolition stage of each phase requires the highest number of vehicles, with up to 175 HGVs per day required over three weeks, and double this number when two works phases are undertaken simultaneously. The number of construction vehicles required over the 64 month construction programme is represented approximately by *Figure 5.2 (ii)* below:

Figure 5.2 (ii): Indicative number of construction vehicles for London Bridge Station



Cumulative effects of construction traffic

5.2.11 The *Transport and Access Specialist Report* for ES2004 concludes, in *Section 5.5.2* that even the relatively high number of peak construction vehicles [for Thameslink 2000 works] would not result in a significant effect if the flows are spread across the working day, and in particular if the demolition phases are off-set to reduce the main vehicle impacts. However, even if two phases are demolished concurrently it is important to note that the demolition for each phase will be on opposite sides of the station with one phase to the north (accessed off Duke Street Hill) and the other site to the south (accessed off St Thomas' Street). The construction traffic flows will therefore be divided across these two routes.

5.2.12 Assuming some overlap of the construction periods of the two projects, a degree of cumulative impact would occur. Based on the programmes as they are set out above, the initial phase of peak construction activity for London Bridge Tower would take place before the main works for Thameslink 2000 have commenced. The second peak construction phase for the Tower would, however, occur around the same time as one the Thameslink 2000 peaks.

5.2.13 The highest level of construction traffic for the Tower would be in the order of 10 to 12 vehicles arriving per hour. The highest level of construction traffic for Thameslink 2000 would be in then order of 38 vehicles arriving per hour. In total this would equate to 48 to 50 vehicles per hour.

5.2.14 This could result in a significant cumulative effect, especially on St Thomas Street on which will be located the main area for construction vehicles for London Bridge Tower. In practice, however, the promoters of the two projects will work closely with each other and with the local authority in the preparation of their respective traffic management strategies. This would ensure that measures, such as the programming of peak activities, routing of construction traffic, use of traffic control systems, and protection of footways, are developed in tandem, such that the risk of significant effects is minimised.

5.3 Cumulative permanent and operational effects

5.3.1 Cumulative permanent and operational effects are addressed within ES2004 and within the supporting specialist reports. References are given below:

Table 5.3 (i): Cumulative permanent effect references

Topic	ES2004 reference	TL2K specialist report reference
Archaeology	N/A	Section 5.1.4.3
Townscape and Built Heritage	Section 9.3.6	Section 5.4.20
Ecology and biodiversity	N/A	Section 2.4.4 and 2.4.5
Surface water resources	N/A	N/A
Soil and groundwater	N/A	N/A
Air quality	N/A	Section 5.5.4
Noise and vibration	N/A	N/A
Visual amenity	Section 9.9.5	Section 5.3.7 and 5.4.8
Transport and access	Section 9.10.16	Section 5.4.4
Local community	N/A	N/A
Socio-economics	Section 9.11.17	Section 6.8.2

5.3.2 In summary, no significant cumulative permanent and operational effects are considered likely to occur.

6.0 Option for Replacement of 16-26 Borough High Street

6.1 Background

6.1.1 Included within the *Alternatives Report* to ES2004 (page 77) was an alternative design for the replacement building at 16-26 Borough High Street. Although Network Rail does not consider this to be a commercially feasible option, its position with respect to this design is that, "*should the Trustees* [of the Borough Market] *decide …to submit a planning application for the [alternative] extension structure, then Network Rail will not oppose such an application*". In order to assist the Inspector in considering the options, Network Rail has itself submitted the planning application for this alternative design.

Insert Figure 6.1(i): The Market Hall option at 16-26 Borough High Street

6.1.2 In most respects, the environmental effects of this option (referred to as the Market Hall) would not be materially different from those of the design reported in ES2004. Construction effects would be, if anything, less since the structure would require a shorter construction period. The principal differences would be in respect of the townscape and built heritage resource of the Borough Market Area. This has been assessed by Land Use Consultants Ltd and is described below. Since the Market Hall will form one element of the Thameslink 2000 works in this area, it has been assessed together with these other features (as the red brick option was in ES2004).

6.2 Townscape and built heritage assessment

Sources of impact during construction

6.2.1 During construction of the Market Hall option, sources of impact would not differ significantly from those reported in ES2004. Effects during construction have therefore not been re-assessed.

Sources of Impact during Operation

6.2.2 Sources of impact on townscape and built heritage would be the same as listed in ES2004, except the footprint, height and appearance of the replacement building at 16-26 (even) Borough High Street would be slightly different. The Market Hall building would follow the line of the existing façade. It would be 2 m lower in height than the existing building and would be constructed from steel and glass. The function of the building would be as a market hall rather than commercial and office premises.

Effects on listed buildings

6.2.3 Since the proposals would result in the demolition of 16-26 Borough High Street, 7 Bedale Street and 1, 3, and 5 Green Dragon Court there would be direct loss of the historic fabric (including elements of 17th Century origin) for which these buildings are listed Grade II. The demolition would also result in loss of an attractive façade which is valued for the contribution it makes to Borough High Street.

6.2.4 Although the Market Hall building would maintain the building line along Borough High Street and would enclose Green Dragon Court (as the existing buildings do), it would not be able to mitigate the loss of historic fabric. The loss of these listed buildings would therefore result in a large adverse impact on this heritage resource. Since the buildings are considered to have a high sensitivity to change, the overall effect on the listed structures would be very substantially adverse.

Effect on Southwark Cathedral

6.2.5 The Market Hall option would be lower than the existing buildings by 2 m. This would result in improved views of the Cathedral from Borough High Street and would increase appreciation of this important Grade I listed landmark building. The result would be a small improvement in the setting of the Cathedral. Since the Cathedral is considered to have a high sensitivity to change, the overall effect on the setting of the Cathedral would be moderately beneficial.

Effect on Borough Market

6.2.6 Although the historic integrity of the market roof would be compromised by its reconstruction, the Market Hall building would extend the influence of the market onto Borough High Street and enhance the contribution of the market to the local townscape. The new Market Hall would add yet another layer to the history of the market enhancing its *ad hoc* character and visual interest. These benefits could compensate for the reconstruction of the Victorian market roof. Overall, it is considered that the proposals would produce some beneficial and some adverse effects which would combine to result in an overall neutral effect on the market and its contribution to the local townscape.

Effect on the Borough High Street Conservation Area

6.2.7 Construction of the new viaduct would result in the demolition of historic buildings that currently contribute to the historic streetscape along the High Street. The intrinsic character of the area is formed by buildings in juxtaposition which have narrow frontages. The viaduct would dominate this end of Borough High Street and would have an adverse impact on the scale and intricate character of the conservation area. Although the Market Hall building would not strictly follow the morphology of the existing narrow fronted properties, it would extend the influence of Borough Market onto Borough High Street and would increase the visual presence of Southwark Cathedral.

6.2.8 LB Southwark's Borough High Street Conservation Area Appraisal (2003) suggests that although new buildings should follow the basic scale, height and ordering of elements of earlier buildings, their expression can be entirely modern. The Market Hall building would conform to the established street envelope and general height of buildings in this area (being equivalent to a 3-storey building) and would provide references to the 19th Century market roof in its steel and glass construction. Although the Market Hall building would conform to the guidance set out in the Conservation Area Appraisal, it is likely that the introduction of the large scale viaduct and the cumulative effects of replacement buildings in this area would result in a moderate adverse impact on the character of the Borough High Street Conservation Area. Since the conservation area is considered to have a high sensitivity to change the overall effect on the conservation area would be substantial adverse.

Overall effect on the townscape character

6.2.9 Although the permanent loss of historic buildings would adversely affect the character and integrity of this historic area, the pattern of pedestrian movement and sense of vitality along Borough High Street would be enhanced by the presence of the new Market Hall building on Borough High Street, and the public realm would be enhanced by the creation of a new route between Borough High Street and Green Dragon Court, Borough Market & Southwark Cathedral. The replacement buildings (including the new Market Hall) would partially restore the street façade and building line along Borough High Street, but they cannot fully mitigate the loss of historic character and impact of the large scale viaduct on the character of this historic area. Since this character area has a high sensitivity to change, the cumulative effects of the different aspects of the proposals would result in an overall substantial adverse effect on the character of the townscape.

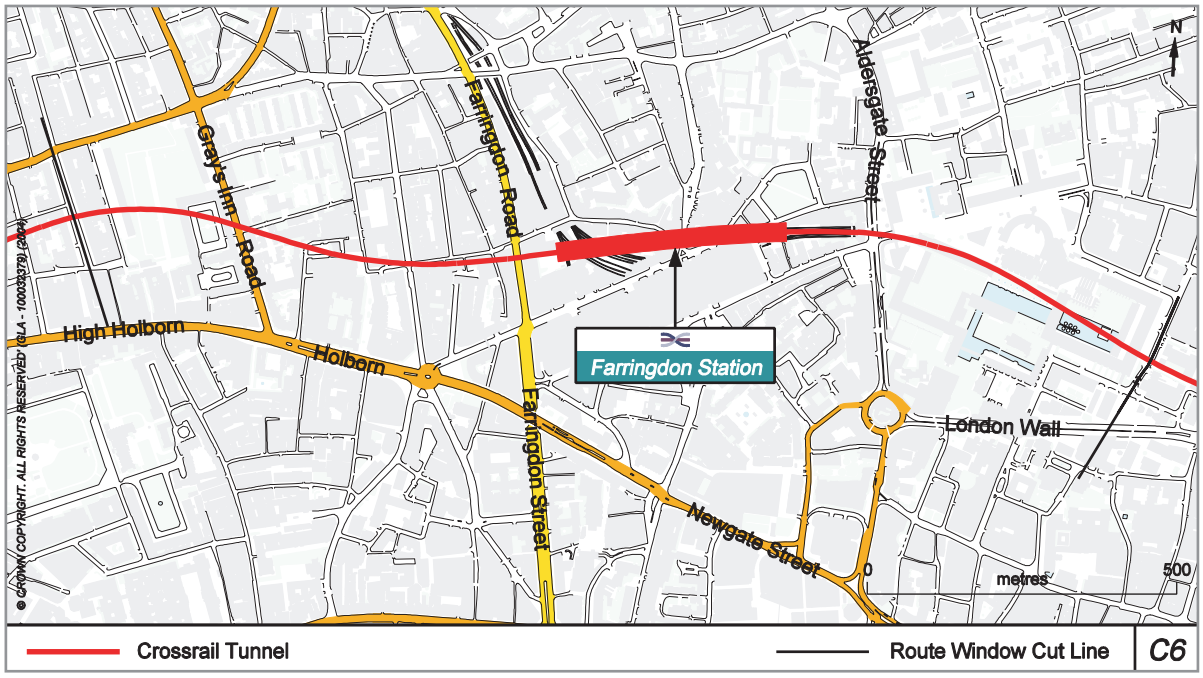
Views, prospects and panoramas

6.2.10 There would be no adverse effects on the background consultation areas of the strategic viewing corridors between Parliament Hill and St Paul's, and Kenwood and St Paul's. There would be no adverse effects on any views identified as part of the London View Protection Framework.

6.2.11 The permanent new viaduct proposed across Borough High Street is a large scale structure which will form a major new component of views northwards along the High Street. Although the new Market Hall proposed to replace 16-26 (even) Borough High Street would have a more modern appearance than the existing buildings, it would be of a similar scale to the original buildings and would retain the building line along Borough High Street. It would also provide a visual presence and focal point on Borough High Street. There would be improved views of Southwark Cathedral from Borough High Street as a result of the lower height of the replacement Market Hall building and its light and transparent structure. Despite the positive features of the replacement buildings, the loss of historic building facades and introduction of the large scale viaduct structure would result in a moderate adverse magnitude of impact on these views. Since these views are considered to have a low sensitivity to change, the effect would be slight and not significant.

Appendix A – Crossrail ES Volume 2, Section 8.8 – Environmental Effects at Farringdon

8.8 Route window C6: Farringdon Station

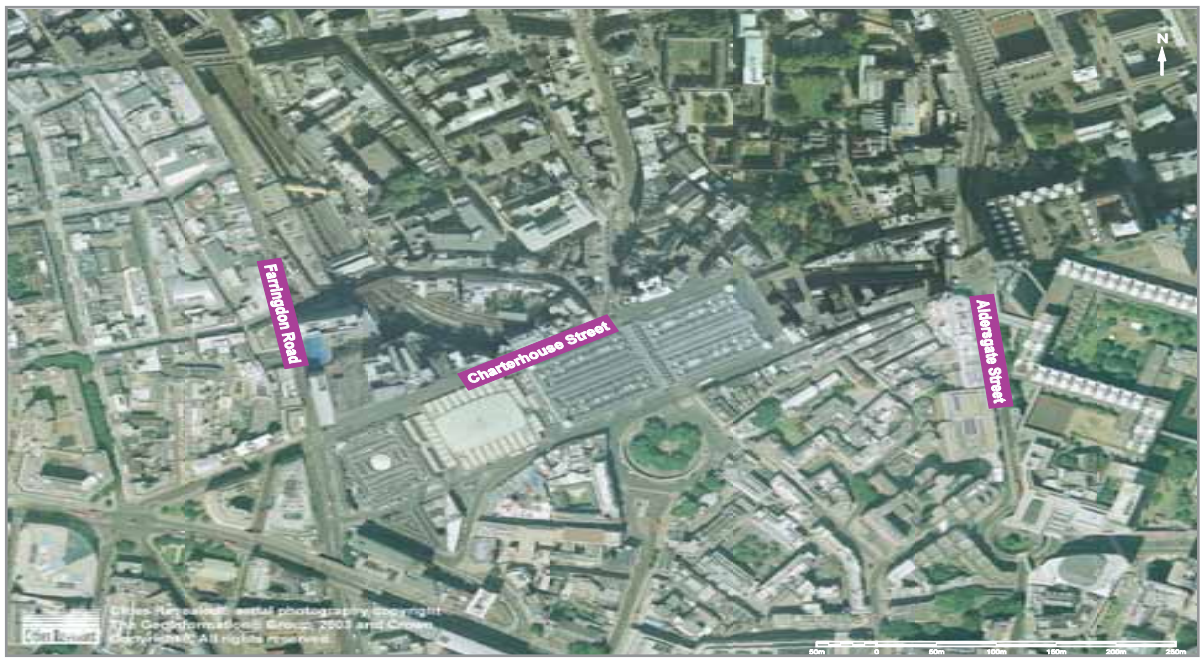


Location plan of Farringdon station

Overview of Route Window C6

8.8.1 The Crossrail tunnels pass from Holborn, beneath the Fleet Valley and Smithfield, and then to Aldersgate and the Barbican, with the rails at a depth of about 31 m. The permanent works will consist of a twin-bore tunnel, and a new station at Farringdon, with western and eastern ticket halls and integrated ventilation and emergency access. A new rail crossover will also be constructed between Farringdon and Liverpool Street stations, beneath the Barbican.

8.8.2 The route window is located within the City of London, the LB Camden and LB Islington. Landuses within this part of London are mixed and include residential, commercial and retail uses. Smithfield Market is adjacent to the site of the eastern ticket hall. It is one of London's oldest markets, where meat has been bought and sold for over 800 years. The Medical College of St Bartholomew's Hospital, and the hospital itself, are located to the north and south of the Smithfield Market, respectively. The Barbican, a major residential and cultural development, is further to the east. The Crossrail station design at Farringdon does not depend on Thameslink 2000 works. It can be constructed independently and is also compatible with current Thameslink 2000 project proposals although both works could be ongoing at the same time.



Aerial view of Farringdon Crossrail station site

8.8.3 This is a busy commercial area: the existing stations and numerous offices give rise to high pedestrian flows, and the main streets, including Holborn and Clerkenwell Road, are heavily trafficked, resulting in generally high noise levels and poor air quality. The heritage of the area, including around Smithfield Market and Grays Inn, is evident in numerous listed buildings. Historic and archaeological remains are likely to survive in the area. Rail activities associated with Farringdon and Barbican stations are likely to have left a legacy of contamination.

Summary of Residual Impacts

8.8.4 The following significant adverse impacts will occur temporarily during construction:

- *Townscape:* impacts on townscape character and on the setting of several listed buildings due to works at the western ticket hall.
- *Townscape:* impacts of particular importance on townscape character and on conservation areas and on the setting of the listed Smithfield Market and The Charterhouse together with significant impacts on character of Charterhouse Square Gardens and the setting of other listed buildings due to works at the eastern ticket hall.
- *Townscape:* impacts on the setting of listed buildings arising from works at Aldersgate Street for the crossover and from compensation grouting works.
- *Visual Amenity:* impacts from construction of tickets halls and associated structures, and from compensation grouting works.

- *Construction Noise:* construction noise impacts will affect occupants at 20 residential properties, one medical facility and a school. One of these residential properties will be likely to qualify for noise insulation.
- *Traffic and Transport:* impacts from the loss of off-street public car parking taken for the worksites for the ticket halls.
- *Traffic and Transport:* impact on the private gated section of Charterhouse Street caused by the closure of Fox and Knot Street.
- *Traffic and Transport:* pedestrian diversions, driver delays and relocation of a police security control point caused by the worksite at Aldersgate Street.
- *Community:* cumulative impact on the community around Lindsey Street and Charterhouse Square due to construction activity.

8.8.5 The following permanent significant impacts will occur:

- *Townscape:* adverse impacts on townscape character and on the setting of several listed buildings due to the western ticket hall.
- *Townscape:* adverse impacts on townscape character, the Charterhouse Square Conservation Area, and the Charterhouse Square Gardens, together with impacts of particular importance on the setting of Smithfield Market and The Charterhouse and significant impacts on the setting of several other listed buildings due to the eastern ticket hall and emergency escape shaft.
- *Visual Amenity:* adverse impacts from tickets halls and associated structures.
- *Visual Amenity:* beneficial impacts from some properties next to the western ticket hall owing to creation of new open views.
- *Traffic and Transport:* benefits from the improved journey times and the provision of additional station capacity, reduced congestion, additional interchange opportunities and improved access for mobility impaired passengers.
- *Operational Noise:* benefits from decreases in roadside noise levels of about 5 dB(A) along Cowcross Street.
- *Community:* permanent loss of the Lindsey Hotel.
- *Community:* improved amenity as a result of the pedestrianisation of Cowcross Street.

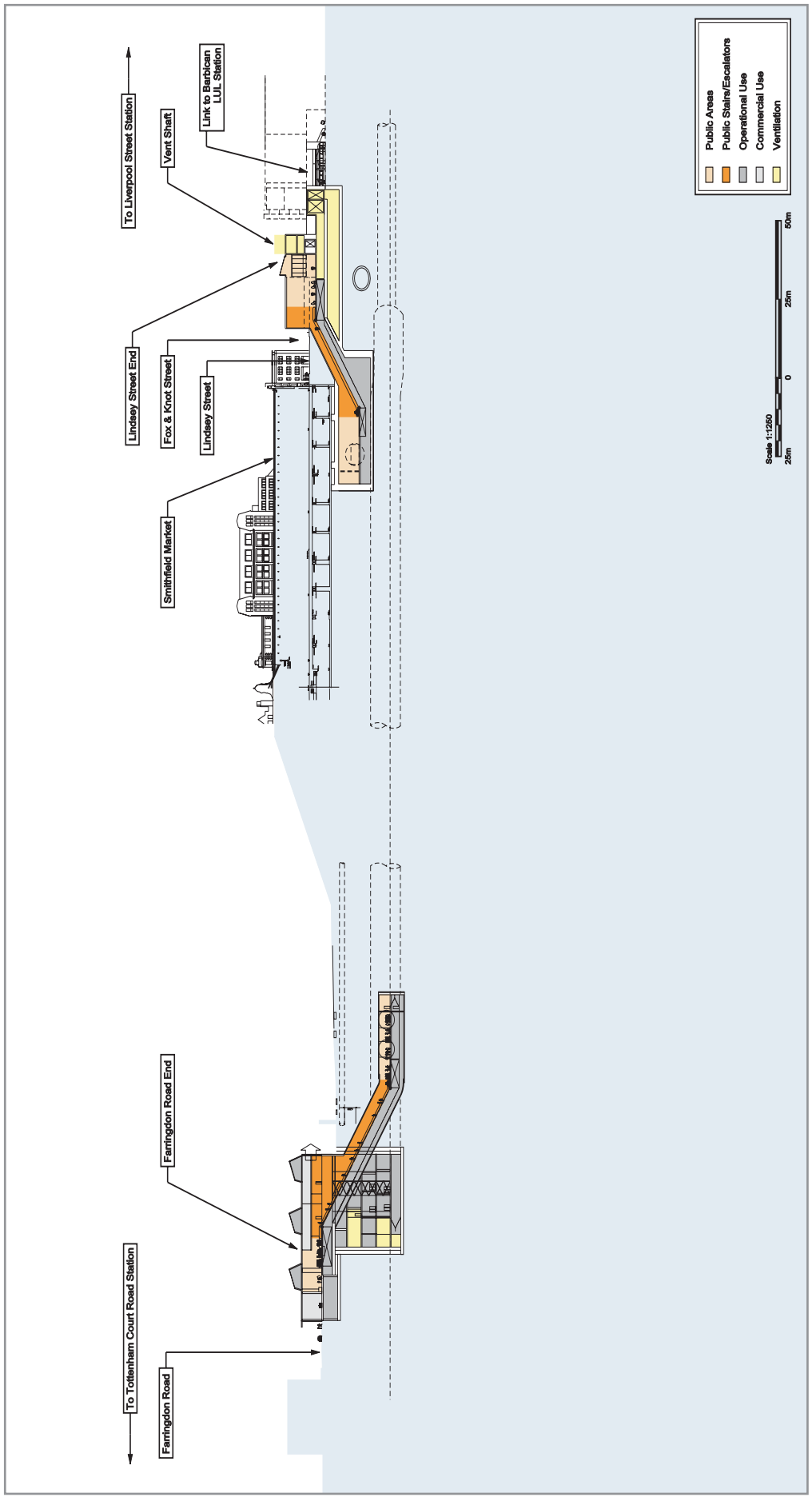


Figure 8.8 Farringdon Crossrail station, long-section

Permanent Works

Overview

8.8.6 The permanent works will consist of new twin-bore tunnels and a new station at Farringdon with two new ticket halls.

Farringdon Station

8.8.7 The station will be constructed to serve the western edge of the city and to provide an interchange with London Underground and Thameslink. The station will be located between Farringdon Road and Lindsey Street. Two new ticket halls will be constructed: a western facility at Farringdon Road and an eastern equivalent at Lindsey Street (Barbican). The station will consist of two platforms fitted out to 210 m although the tunnel will be constructed to facilitate extensions to 245 m should the need to operate longer trains arise. Interchange with London Underground will be provided from Lindsey Street ticket hall. Between the London Underground station at Farringdon and the Crossrail western ticket hall, Cowcross Street will be pedestrianised.

View looking west along West Smithfield towards Smithfield Market

8.8.8 The Bill does not provide powers for development to replace that demolished at Cardinal House (Farringdon Road), Lindsey Street, Charterhouse Street and Charterhouse Square for the reasons described in Section 3.8 of the ES. However, it is extremely unlikely that such development will not be constructed.

Farringdon Road (Western) Ticket Hall

8.8.9 The Farringdon Road ticket hall will be at street level. It will consist of a building built to approximately the same height as the existing London Underground ticket hall (approximately 8 m high) and will be on the site of Cardinal House, which will be demolished. A bank of three escalators will descend from the ticket hall to platform level. The escalators will be housed in a deep box that will also include ventilation and emergency intervention equipment. To the southwest of the structure, a construction shaft will be built and then back filled upon completion of the station works. The layout of the ticket hall is shown in Figure C1.18 in Appendix C1 of the ES; Figure C1.19 provides an elevation.

Looking north on Farringdon Road towards Cardinal House

8.8.10 Figures C2.15 and C2.16 in Appendix C2 of the ES provide elevations of the site with illustrative over-site development in place at the Cardinal House site. The illustrations show a development 48 m high or eleven storeys, falling to 35 m or seven storeys. Construction of this type of over-site development would take approximately 25 months including internal fit-out; it would be feasible to start construction of over-site development of this type up to 18 months before the operation of the first revenue service.

Lindsey Street (Eastern) Ticket Hall

8.8.11 At Lindsey Street, the ticket hall (approximately 8 m high) will be located at street level in a block bounded by Charterhouse Street, Hayne Street, Long Lane and Lindsey Street. A bank of three escalators will descend to an intermediate concourse from where stairs to Barbican Underground station will be provided. A further bank of three escalators will

descend to a further concourse beneath the London Underground and Thameslink tunnels before a third bank connects with the Crossrail platforms. A separate shaft will be constructed on this site that will contain ventilation and emergency intervention access. Emergency escape from the Crossrail platforms will be provided in a new shaft in 38-42 Charterhouse Street (this is also known as Fox and Knot Street). The layout of the ticket hall is shown in Figure C1.20 in Appendix C1 of the ES; Figures C1.21 to C1.25 provide elevations.

38 and 42 Charterhouse Street

8.8.12 Figures C2.17 to C2.20 in Appendix C2 of the ES provide elevations of the site with illustrative over-site development in place at Lindsey Street, Charterhouse Street (aka Fox and Knot Street) and Charterhouse Square respectively.

8.8.13 The illustration of the Lindsey Street development shows a development 25 m or five storeys, reducing to 15 m or three storeys. Construction of this type of over-site development would take approximately 18 months including internal fit-out; it would be feasible to start construction of over-site development of this type up to 27 months before the operation of the first revenue service.

8.8.14 The illustration of the development at Charterhouse Street (aka Fox and Knot Street) shows a four storey building. Construction of this type of over-site development would take approximately 15 months including internal fit out; it would be feasible to start construction of over-site development 24 months before the operation of the first revenue service.

8.8.15 The illustration of the Charterhouse Square development shows a four storey development not exceeding the height of the existing building. Construction of this type of over-site development would take approximately 15 months including internal fit-out; it would be feasible to start construction of over-site development of this type up to 24 months before the operation of the first revenue service.

Twin-bore Tunnels

8.8.16 Six metre diameter twin-bore tunnels will be constructed with the rails at approximately 31 m depth below street level, based on the depth at the western end of Farringdon station. A crossover facility will be provided between Farringdon and Liverpool Street stations. The provision of this cross over will ensure that Crossrail services will continue to run during emergencies and disrupted services.

Construction

Duration of Works

8.8.17 The construction including fitting out and commissioning of Farringdon station will be undertaken over a period of approximately four years and eight months.

8.8.18 The construction including fitting out and commissioning of the Farringdon crossover will be carried out over a period of about three years.

Enabling Works

8.8.19 Enabling works will include utility diversions around Farringdon station, Barbican station (including Charterhouse Square), and Aldergate/Beech Street, including a sewer diversion.

8.8.20 The demolitions that will be undertaken to accommodate the main works during this phase will comprise:

- Cardinal House on the corner of Cowcross Street and Farringdon Road;
- 54, 56 and 58-64 Charterhouse Street, 3, 8 to 9 and 10 Hayne Street, 2a, 3, 4 and 5 Lindsey Street (including Smithfield House), 20 to 23 Long Lane
- 33-35 and 36-37 Charterhouse Square;
- 38-42 Charterhouse Street; and
- Charterhouse Square and Hayne Street bridges spanning Circle and Metropolitan lines.

Main Works

8.8.21 The main construction works for the station will proceed in the order set out below.

- Demolition of the podium at Cardinal House, prior to the construction of the temporary construction shaft and the demolition of Cardinal Tower.
- Piling round the perimeter and subsequent excavation of the boxes taking in total approximately 10 months.
- Excavation of the eastbound and westbound platform tunnels and lining of the cross passages and escalator shafts. These works will be undertaken over one year and five months.
- Tunnel platform lining and installation of mechanical and electrical equipment, ventilation equipment and emergency escape stairs and lifts, and construction of the ticket halls and installation of the escalators. This work will take approximately one year and 10 months.

8.8.22 For the crossover, initially a temporary shaft and adit will be constructed over a period of eight months. Excavation of the crossover cavern and installation of the primary lining and the concrete invert to allow for the passage of the TBMs will take approximately 19 months. To complete the works, including the remaining secondary lining, concrete work and backfilling of the temporary adit and shaft, will take approximately a further 12 months.

8.8.23 In order to mitigate impacts associated with settlement at Farringdon station, it is likely that compensation grouting will be undertaken. This is a technique by which the ground loss arising from the excavation is replaced by material (grout) pumped into the ground. This requires grout shafts in the vicinity of buildings for which the effects of settlement are predicted to be significant. It is likely that compensation grouting will be undertaken from within the Fox and Knot Street worksite. In addition it is likely that additional shafts will be required at the rear of 67-69 Cowcross Street, within Green Hills Rents (a yard off Cowcross Street), within the road at St Johns Street and within the basement of Smithfield Market.

Construction Plant

8.8.24 The main construction plant to be used at the worksites will include cranes and machinery for piling and excavation. Other equipment will include compressors, electrical generators and temporary ventilation fans.

Worksites and Access

8.8.25 Works associated with the station will be undertaken from four worksites, namely:

- Cardinal House worksite;
- Smithfield Market Basement worksite;
- Lindsey Street worksite; and
- Fox and Knot Street worksite.

8.8.26 The Cardinal House worksite will comprise the area to be demolished for the western ticket hall and the basement car park area of Caxton house and the General Market (Smithfield).

Looking west along Long Lane towards Smithfield Market

8.8.27 The main eastern worksite will be between Lindsey Street and Hayne Street. They will be used for the demolition of Hayne Street bridge and properties from the corner of Lindsey Street and Charterhouse Square to Hayne Street and Long Lane. This will eventually form and will be the location of the Lindsey Street ticket hall.

8.8.28 Works to construct the escalator box at the eastern end of the station will be undertaken within the existing basement car park of East Smithfield Market.

8.8.29 Fox and Knot Street worksite is in the area bounded by Charterhouse Square, Charterhouse Street and Fox and Knot Street. This will be used for the construction of an escape shaft from the east end of the Crossrail platforms.

8.8.30 Farringdon crossover will be constructed from a worksite located in Aldersgate Street. The Aldersgate sewer diversion and the crossover will also be undertaken from within and adjacent to the crossover worksite.

8.8.31 All materials going to and from both the worksites areas will be transported by road. Lorries will access the western worksite via the access ramp off Charterhouse Street from the Snow Hill/West Smithfield junction. Lorries will access the eastern worksite via Lindsey Street. Access to the basement carpark of East Smihtfield will be via the existing ramp off Long Lane.

8.8.32 The General Market and Caxton House basement car parks will be temporarily acquired for storage, site accommodation and lorry holding.

8.8.33 During the peak period of construction, 60 lorries per day will access the Lindsey Street worksite, 60 lorries per day will access the Cardinal House worksite and 28 lorries per day will access the Farringdon crossover worksite.

Impacts on Townscape and Built Heritage

Baseline

8.8.34 The varied townscapes within this route window each represent an important element of London's historic development, from the medieval street pattern of Clerkenwell through to the railway and station at Farringdon that emerged from the industrial revolution.

8.8.35 In the west, the route passes beneath Gray's Inn, which was established in the 14th Century and derives much of its present character from the buildings of the 1680s (six of which are Grade II* listed). The Hatton Garden Conservation Area, west of Farringdon Road, is characterised by Georgian terraces, and late 19th and early 20th Century residential blocks, warehouses and workshop buildings.

8.8.36 Farringdon Road is characterised, at least on its east side, by 20th Century office development, Farringdon Road follows, more or less, the alignment of the (now culverted) River Fleet as it descends towards the Thames. The Thameslink and Underground railways run in cutting east of the Farringdon Road, forming a well-defined transport corridor. The facades of offices along Farringdon Road provide an imposing streetscape that separates the rectilinear planned townscape of Hatton Garden to the west from the complex townscape of Clerkenwell to the east. Clerkenwell has become re-vitalised as an 'urban village' whose small-scale and varied architecture adorns an old street pattern of narrow curving lanes and alleyways.

8.8.37 Cowcross Street, at the edge of Clerkenwell contains many 19th Century buildings including the Grade II listed Underground station. Smithfield Market (Grade II*), and buildings related to the meat trade in neighbouring streets are also all mid to late 19th Century.

8.8.38 The 18th Century Charterhouse Square immediately northeast of the proposed eastern ticket hall, is a protected London square and provides an important area of private open space within this densely developed part of London. Smithfield Market to the south is defined by the long spacious building of the Grade II* listed meat market and the wide roads that enclose and traverse it.

View of 33-37 Charterhouse Square

View of Smithfield Market looking east along Charterhouse Street

8.8.39 Contrasts to the prevalent Victorian character of Smithfield and the area to the east is provided by St. Bartholomew-the-Great, one of the most important medieval buildings in London (added to in the 1620s and between 1884 and 1914, but still essentially 12th Century). Further east lies the Barbican Estate, a collection of buildings which is complex in both its architecture and its engineering and which has been listed as a major example of a comprehensively planned residential and cultural development of the post-war period.

8.8.40 Conservation areas which reflect this heritage enclose each of the proposed works, and numerous listed buildings lie in close proximity. Both the western and eastern ticket hall sites lie outside the conservation area. However, buildings at 33-37 Charterhouse Square and 38-42 Charterhouse Street lie within the Charterhouse Square Conservation Area.

8.8.41 Farringdon Road and Cowcross Street form the baseline townscape for the western ticket hall, and have a moderate quality and moderate sensitivity to change. The eastern ticket hall is located adjacent to Smithfield and the Charterhouse Square, this forms a townscape of high quality and high sensitivity to change.

Direct Impacts on Listed Buildings

8.8.42 The basement mezzanine floor which forms part of the curtilage of the East Market car park will be demolished in order to provide sufficient headroom to construct escalators for the Lindsey Street ticket hall. The basement mezzanine floor dates from about 1990 and is of no historical or architectural importance; the impact is not considered to be significant.

8.8.43 Some of the original East Market vaults, which lie under Lindsey Street, are to be demolished in order to construct the new basement level concrete box for the Lindsey Street ticket hall. Prior recording of the existing structure followed by removal and storage of any items of particular interest will ensure that there will be no significant impact to this Grade II* listed building.

8.8.44 Some of the existing columns and walls within the basement of the East building of Smithfield Market will be underpinned. They will then be re-supported on beams that will bridge the new concrete box for the proposed ticket hall at Lindsey Street. Use of appropriate construction techniques and sequencing will provide temporary support to the columns and walls so minimising permanent changes to the historic fabric. No significant impacts will therefore occur.

8.8.45 There is a potential for damage from construction vehicles and plant on 54-60 Cowcross Street and Smithfield Market due to the proximity of the worksites. These impacts will be mitigated through use of construction mitigation measures as set out in Appendix B1.

8.8.46 There is a risk of settlement impacts at a total of 54 listed buildings, which are located within the 10 mm settlement contour; these are listed in Appendix B2. Of these properties, nine are Grade II* listed; none is Grade I listed. Measures to protect the integrity and heritage value of these structures will be implemented as necessary in order to avoid significant adverse impacts; these measures are set out in Appendix B1. However, the construction of the crossover cavern will result in potentially significant impacts on the Barbican, even taking into consideration the mitigation set out in Appendix B1. These impacts are reduced to non-significant in the variation construction method (see Variations in the Project at the end of Chapter 8.8.

8.8.47 There is a potential for the new deep concrete box for the western ticket hall to affect groundwater levels resulting in possible water ingress into basement areas (see Impacts on Water Resources) immediately upstream of the box at:

- Farringdon station, including 36-38 and 40-42 Cowcross Street EC1 (Grade II listed); and
- 25 and 27 Farringdon Road EC1 (Grade II listed).

Looking southeast across Farringdon Road and Cowcross Street Junction towards Cardinal House and Caxton House

8.8.48 However, local water ingress will not affect historically significant parts of these structures, because these are all above ground level. Possible changes in groundwater level will not have any significant impact on building settlement. No significant impacts will, therefore, occur.

8.8.49 One pair of buildings, 74 and 75 Long Lane (Grade II listed), is sensitive to vibration impacts owing to its mediaeval timber frames, one faced with mathematical tiles. Appropriate demolition techniques will be used to limit vibration impacts and no residual impacts will therefore result from vibration. These and other listed buildings subject to potential vibration impacts will be monitored in order that necessary protection of these buildings can be provided.

Mitigation and Temporary Residual Townscape Impacts

8.8.50 Works at the western ticket hall will result in a significant impact on townscape character but will not have a significant impact on the setting of the adjacent Hatton Garden and Smithfield conservation areas. It will also affect adversely and significantly the setting of listed buildings including 25 and 27 Farringdon Road, 54-60 Cowcross Street, and Farringdon station (including 36-38 and 40-42 Cowcross Street).

8.8.51 The temporary works associated with eastern ticket hall, shaft and compensation grouting sites, will together result in adverse impacts of particular importance on local townscape character, including the character and appearance of the Charterhouse Square Conservation Area and adverse impacts on the setting of the adjacent Smithfield Conservation Area. There will be significant adverse impacts on the character of the protected Charterhouse Square Gardens.

8.8.52 These works will also temporarily affect adversely the setting of several listed buildings including 115 Charterhouse Street, 109-113 Charterhouse Street, 119 Charterhouse Street, 2-6 St John Street, 74-75 Long Lane, 4-5, 6-9, 12-13, 12A, 14, 17 and 22 Charterhouse Square, Rutland Place and various structures within Charterhouse Square. There will be impacts of particular importance on the Grade I listed The Charterhouse and Grade II* listed Smithfield Market.

8.8.53 Works at the Aldersgate Street crossover site will result in temporary impacts on the setting of the Grade II listed Barbican, which is also a Grade II* listed historic garden. The compensation grouting site at St John Street, will result in significant impacts on the setting of the Grade II listed 16 to 22 (even) and 26 St John Street.

Mitigation and Residual Permanent Townscape Impacts – Western Ticket Hall

8.8.54 The ticket hall and shaft structures will not relate to the massing and configuration of the present building on the site and the buildings in the locality. The single storey building will create a discontinuity in the streetscape. The utilitarian materials will detract from the sense of quality inherent in the stone, brick and decorative tiling materials used locally.

8.8.55 The mid 20th Century office block (Cardinal House) currently on the site comprises a two-storey podium containing retail, cafes/restaurants and business uses. Above this structure sits a ten storey office. This building overwhelms the townscape of the area, and as such does not make a positive contribution to the townscape. However, the replacement single storey ticket hall and shaft will create a gap in the streetscape, diminishing the coherence of the street. As such it will be significantly detrimental to the values of heritage and architectural quality embodied in the local buildings. On this basis, it will result in a significant adverse impact on the character and quality of the townscape, but will not significantly affect the setting of the adjacent conservation areas. It will also result in a significant impact on the setting of the Grade II listed buildings at 25 and 27 Farringdon Road, Farringdon Underground station (including 36-38 and 40-42 Cowcross Street) and 54-60 Cowcross Street.

8.8.56 At this site, it is likely that impacts can be reduced or mitigated through the provision of a replacement building. Indeed, there are opportunities for improvement arising from the demolition of the unsympathetic Cardinal House. A proposal for this building will be brought forward according to the process described in Section 3.8 of the ES.

Mitigation and Residual Permanent Townscape Impacts – Eastern Ticket Hall

8.8.57 The buildings demolished for the eastern ticket hall are located within a block bounded by Charterhouse Street, Lindsey Street, Hayne Street and Long Lane. These buildings, which lie outside the Conservation Area, generally comprise a broad mix of buildings. On the corner of Long Lane and Lindsey Street is a ground plus four storey decorated inter-war office building. Adjoining this on the Long Lane end of the block are two ground plus three storey office buildings. On the western side of Hayne Street is a ground plus three storey brick built Victorian commercial building.

8.8.58 In addition, there are four buildings demolished within the Charterhouse Square Conservation Area. No. 38 Charterhouse Street is a four storey commercial building dating from circa 1880. Its height, detail and fact that it acts as a vistal focal point means that it contributes positively to the townscape and Conservation Area. The buildings at 33-35, 36-37 Charterhouse Square (together with 39-43 which will not be demolished) form part of a group of buildings. These are commercial buildings dating from circa 1880 which through scale, massing and detail contribute positively to the conservation area. The building at 40-42 Charterhouse Street is an unexceptional building, which though of similar scale to adjacent buildings, its poor detailing, design and materials combine to mean it contributes negatively to the conservation area.

8.8.59 Development of the eastern ticket hall and shaft structures will create a significant void on the principal frontage and also voids above the single storey roof level on the street frontages on part of all four sides. This will be out of keeping with the original massing of the buildings on the site and surrounding buildings. Together with the separate emergency escape shaft on Charterhouse Street, it will result in a significant adverse impact on the character and quality of the local townscape, including the character of Charterhouse Square Gardens, which is a London Protected Square. There will be significant impacts on the Charterhouse Square Conservation Area and on the setting of the adjacent Smithfield Conservation Area, resulting from demolition of buildings currently making a positive contribution to the conservation area and the unsympathetic and utilitarian ticket hall and ventilation structures.

8.8.60 The eastern ticket hall and associated structures will also result in adverse impacts of particular importance on the setting of the Grade II* listed Smithfield Market. They will result also in adverse impacts of particular importance on the setting of Grade I listed The Charterhouse on Charterhouse Square. They will result in significant adverse impacts on the setting of Grade II listed buildings at:

- 109-113, 115 and 119 Charterhouse Street;
- 2-6 St John Street (including 89 Charterhouse Street);
- 4/5, 6-9, 12/13, 12A, 14, 17 and 22 Charterhouse Square;
- Rutland Place (former caretaker's lodge and gate house) on Charterhouse Square; and
- 74 and 75 Long Lane.

8.8.61 The setting of structures within Charterhouse Square will be similarly affected, comprising an 18th Century gate and later cast iron railways; cast iron 19th Century fluted standards; six cast iron 19th Century cannon type bollards; and a telephone kiosk on the south side.

8.8.62 At this site, it is likely that impacts can be reduced or mitigated through the provision of replacement buildings. Proposals for these buildings will be brought forward according to the process described in Section 3.8 of Chapter 3 of the ES.

Impacts on Visual Amenity

Baseline

8.8.63 Visibility around Farringdon is strongly determined by the built environment, buildings along Farringdon Road, Charterhouse Street and Cowcross Street limiting the extent of views. These streets also provide more distant viewing opportunities, as does the existing railway corridor alongside Farringdon Road, which allows more extensive visibility from Turnmill Street.

8.8.64 Mixed landuses present a range of potential receptors, with commercial uses concentrated around Smithfield Market and more residential uses in the Clerkenwell area. Farringdon Road is predominantly office use with some high-rise structures presenting elevated viewing opportunities.

Mitigation and Temporary Residual Impacts

8.8.65 Construction of the western ticket hall will give rise temporarily to adverse impacts for residents of the Castle pub at 34-35 Cowcross Street, as well as for occupants of numerous offices on Cowcross Street, Turnmill Street and Farringdon Road and for pedestrians on Cowcross Street and Farringdon Road.

8.8.66 Construction of the eastern ticket hall will give rise temporarily to significant adverse impacts which will affect residents above Ye Olde Red Cow pub, at Florin Court, 6-9 Charterhouse Square, at 10-11 Charterhouse Square and above The Fox and Knot pub. Occupants of numerous offices and other premises on Charterhouse Square and others on Charterhouse Street, Hayne Street, Long Lane and Aldersgate Street will be similarly affected. Temporary significant visual impacts will also affect pedestrians on Lindsey Street, Fox and Knot Street, Hayne Street and Charterhouse Square, as well as users of the gardens in Charterhouse Square.

8.8.67 Works at Aldersgate Street for the crossover will give rise to temporary visual impacts on residents at Seddon House and Thomas More House in the Barbican, occupants of offices and some other buildings on Aldersgate Street, and pedestrians on Beech Street, Long Lane and Aldersgate Street.

8.8.68 In order to mitigate potential settlement impacts, compensation grouting will be undertaken at Cowcross Street, St John Street and Green Hill Rents. These works will give rise to visual impacts. The impacts associated with these activities are set out below. However, as the scheme design progresses the location of the grout shaft sites may change. Consequently, whilst the scale and significance of the impacts below is correct, their location may vary.

- The site on Cowcross Street site will give rise to visual impacts for occupants at 67-69 Cowcross Street.
- The site on St. John Street site will give rise to visual impacts for pedestrians and occupants of some offices on St. John Street and St John's Lane.
- The site on Green Hills Rents will give rise to visual impacts for pedestrians and people working in a number of buildings on Green Hills Rents.

Mitigation and Permanent Residual Impacts – Western Ticket Hall

8.8.69 The development of the single storey western ticket hall will create new and detrimental views for some people, replacing as it does the existing high-rise Cardinal House. Permanent significant adverse impacts on visual amenity will be experienced by workers in commercial premises at:

- 25-27 Farringdon Road, including the bar and restaurant;
- 17-23 Farringdon Road (to be constructed following recently demolition); and
- 2 Farringdon Road.

8.8.70 Pedestrians on Cowcross Street and Farringdon Road will be similarly affected, as will residents at the new 17-23 Farringdon Road, planning permission for which was granted in November 2004. The pedestrianisation of Cowcross Street will result in improvements in the amenity of pedestrians, however, in the context of the ticket hall and shaft structures, this is not considered to be a significant benefit.

8.8.71 From some viewpoints, the replacement single storey building will be more appropriate in scale and massing to some of the small scale buildings on Cowcross Street. As a result of the improved views and new vistas created by the demolition of Cardinal House, particularly in relation to St Paul's Cathedral, permanent significant beneficial impacts will affect users and residents at the Castle pub at 34-35 Cowcross Street, workers in commercial premises at 75 and 87-100 Turnmill Street and 101-102 Turnmill Street, Farringdon Place, 20 Farringdon Road (southern side), 46 Cowcross Street, 36-43 Cowcross Street; and 29-35 Farringdon Road (The Sir John Old Castle pub and Farringdon Point offices above).

8.8.72 At this site, it is likely that adverse impacts can be reduced or mitigated through the provision of a replacement building. Proposals will be brought forward according to the process described in Section 3.8 of the ES.

Mitigation and Permanent Residual Impacts – Eastern Ticket Hall

8.8.73 The emergency escape building at 38-42 Charterhouse Street will open up views of 23-28 Charterhouse Square when viewed from sections of Charterhouse Street to the southwest. Views from the buildings on the northeast side of Charterhouse Street will be opened up by the permanent removal of 38-42 Charterhouse Street. The single storey eastern ticket hall building will be seen above and to the side of the emergency escape building, when viewed from the northeast side of Charterhouse Street and both Crossrail buildings will be seen against a backdrop of the existing buildings on Long Lane.

8.8.74 Significant adverse impacts will affect people on Charterhouse Square including private users of the gardens; residents above Ye Olde Red Cow, at Florin Court (6-9) and at 10-11; office workers at 10-11, 12-14, 17, 23-28, 99, 105-115, and 117-123; and occupants of City University Medical College (Rutland Place), of Charterhouse College, of Malmaison restaurant (18-21), and of The Fox and Knot pub.

8.8.75 Significant visual impacts will also affect workers at shops and offices on Long Lane including 1-8, 6-12, 18-19, 66-70, 56-64, 73-75, as well as at 2 Hayne Street and at Aldersgate House (135-137 Aldersgate Street).

8.8.76 Pedestrians on Lindsey Street, Fox and Knot Street, Long Lane, Charterhouse Street, Hayne Street and Charterhouse Square will be similarly affected.

8.8.77 At this site, it is likely that impacts can be reduced or mitigated through the provision of replacement buildings. Proposals for the buildings will be brought forward according to the process described in Section 3.8 of the ES.

Impacts on Archaeology

Baseline

8.8.78 Farringdon Crossrail station site is within a LB Islington archaeological priority area and within the City of London, which is considered to be equivalent to an archaeological priority zone. The station site has high potential for the post-medieval urbanisation of the area. It has moderate potential for medieval religious institutions and associated burial grounds; prehistoric, Roman and medieval secular remains; and also for topographic evidence of the Fleet valley. It has a low potential for Early–Middle Saxon burials and possibly occupation. Any Saxon or medieval ecclesiastical evidence would be of high importance. All other remains are of moderate importance.

8.8.79 The Aldersgate Street crossover site is within the City of London. The site has moderate potential for Roman and medieval activity outside the City walls as well as for the Moorfields Marsh. It has low potential for prehistoric, Saxon and medieval ecclesiastical remains. However, it is likely that most archaeological remains were removed by the construction of the Barbican centre. Any medieval ecclesiastical remains would be of high importance; other remains of medium importance.

Mitigation and Temporary and Permanent Residual Impacts

8.8.80 All works within the existing railway cutting will have no impact on archaeological deposits. Ground works for the eastern ticket hall are not confined to the railway cutting and are likely to impact on archaeological remains, as are other associated works including service diversions. Compensation grout shafts would completely remove potential archaeological remains within their footprints.

8.8.81 The shaft in Aldersgate Street, associated with the crossover, is likely to remove all archaeological remains that have survived earlier construction; these would not include the ecclesiastical remains. Other works will involve tunnelling and will take place below all known archaeological deposits.

8.8.82 The archaeological resource is not likely to be of sufficient importance to warrant preservation in situ. Preservation by record will be undertaken, with the results published and deposited in a public archive. With this mitigation, no significant impacts will occur.

Impacts on Ecology

Baseline

8.8.83 Crossrail works at Farringdon are confined to a highly built-up urban area with open space confined to small parks adjacent to works at Charterhouse Square and West Smithfield. No statutory or non-statutory designated sites lie in or immediately adjacent to areas of the works. Surveys did not identify any animal species or communities of note.

Mitigation and Residual Impacts

8.8.84 With the implementation of good site practice measures, as set out in Appendix B1, no significant impacts on ecology will occur in this route window.

Impacts on Water Resources

Baseline

8.8.85 The geology in the area of Farringdon station consists of Thanet Sands, Lambeth Group and London Clay, overlain by Terrace Gravels, Alluvium and Made Ground, which form a shallow aquifer. The Fleet River has eroded into the clay and reduced its thickness in places. Construction is expected to extend into the Thanet Sands at the western end of the new Farringdon station. Groundwater is also contained within the Chalk that underlies all these deposits. Alluvium is mainly associated with the course of the former Fleet River (now the Fleet Sewer) running to the west of the station along Farringdon Road. However, a number of east-west aligned tributaries are known to exist that pass beneath Farringdon station in pipes. One of the tributaries, Faggeswell Brook, passes the southern edge of the western ticket hall.

8.8.86 There are two licensed groundwater abstractions from the deep Chalk aquifer. One of the abstractions is owned by Citigen (London) Ltd (ID Number 2) and lies close to the western ticket hall worksite. The other is owned by St Martins Property Corporation Ltd (ID Number 82). Both abstract water for commercial use. The 50 day and 400 day TTZs to the Citigen abstraction cross the route alignment. Site investigations indicate that the Thanet Sands are mostly dry in the vicinity of Farringdon station.

8.8.87 The groundwater quality in this region is likely to be influenced by the saline intrusion from the River Thames. No river crossings, associated floodplains, surface water or groundwater abstractions have been identified within this route window.

Mitigation and Temporary Residual Impacts

8.8.88 Dewatering of the Chalk aquifer will not be required, therefore no significant impacts will occur on any of the licensed abstractions. The water-bearing layers within the upper beds of the Lambeth Group will be dewatered, but this will not be significant.

8.8.89 Impacts on groundwater quality may result from the use of grouting materials and from the presence of both existing and new soluble contaminants during construction that could migrate into the Chalk aquifer. Natural filtration and attenuation in the Thanet Sands and dilution in the Chalk will significantly reduce any potential impact. Construction methods will prevent significant vertical flows passing from the shallow to the deep aquifer along the outside of the structures. In addition, the application of mitigation measures set out in Appendix B1 will ensure that no significant impacts on groundwater quality will occur.

Mitigation and Permanent Residual Impacts

8.8.90 The Citigen groundwater abstraction is located very close to the western ticket hall basement worksite and tunnelling area. These works may cause settlement damage to the borehole and create a pathway for contamination to pass between the upper and the deep aquifers. The abstraction may, therefore, have to be abandoned. However, the application of the abstraction wells mitigation strategy, set out in Appendix B1, will ensure that no significant residual impacts occur.

8.8.91 The groundwater levels in the superficial deposits around the former Faggeswell Brook will be affected by the construction of the western ticket hall. The width of and potential groundwater flows within the channel deposits will be investigated further and monitored during construction. If excessive changes in groundwater levels are observed, drainage will be provided around the new structure and this will mitigate the changes to groundwater levels, ensuring that no significant adverse impacts occur.

8.8.92 No significant residual permanent impacts on surface water resources will occur for this route window.

Traffic and Transport Impacts

Baseline

8.8.93 The existing Farringdon station is on the north side of Cowcross Street close to its junction with Farringdon Road. It has entrances from Cowcross Street and Turnmill Street and is served by the Circle and Metropolitan lines as well as the Thameslink mainline service. Barbican station is served by the same rail services although Thameslink trains only stop at morning peak times.

8.8.94 Bus routes on Aldersgate Street directly serve the Barbican station. The nearest bus services to the existing Farringdon station are on Farringdon Road to the west and Clerkenwell Road to the north.

8.8.95 Farringdon Road is part of the Transport for London Road Network, which comprises some of the London's busiest roads. Cowcross Street is dominated by pedestrians, with greater pedestrian flows than vehicle flows.

8.8.96 There are a number of large off-street car parks close to the station. On-street parking is limited and mainly short stay. A police security control point is located on Aldersgate Street.

Mitigation and Temporary Residual Impacts

8.8.97 The construction of the ticket halls at Farringdon station will be undertaken at worksites remote from the existing station. Although construction traffic may affect the approaches to the station particularly on Cowcross Street there will be no impact on passengers within the station.

8.8.98 The Cardinal House worksite will be south of Cowcross Street at its junction with Farringdon Road opposite the existing station. The worksite will extend southwards at basement level and will occupy Snow Hill, Cardinal House and Caxton House public car parks. The loss of off-street parking spaces resulting from the use of basement car parks as worksites will be extensive and give rise to a significant impact for the duration of the works.

8.8.99 Access to the worksite will be from Farringdon Road and from West Smithfield close to its junction with Snow Hill. There will be a lorry holding area in the basement and a secondary facility, if required in Snow Hill.

8.8.100 The Lindsey Street worksite will be between Lindsey Street, Charterhouse Street and Long Lane and at basement level will extend into the car park under Smithfield Market. Access will be via West Smithfield, East Poultry Avenue and Lindsey Street for the main worksite and via the existing ramps from Long Lane for the basement area. Lorries will be held in the basement area with the option of using the facility in Snow Hill.

8.8.101 Secondary sites will be at Fox and Knot Street for the construction of the emergency escape shaft, and in half the carriageway width of Aldersgate Street, south of its junction with Beech Street, for the construction of a track crossover.

8.8.102 The use of access routes to these worksites by construction traffic is not predicted to give rise to any significant impacts on road users, pedestrians or cyclists.

8.8.103 The works at the Lindsey Street worksite will require a closure to traffic of a section of Charterhouse Square between Lindsey Street and Hayne Street for some nine months. Local diversions routes are available and the closure is not predicted to cause a significant impact, if it is programmed to occur at a different time from the Farringdon crossover works.

8.8.104 The worksite at Fox and Knot Street will include the whole of Fox and Knot Street and half the width of Charterhouse Street adjacent to the site. Charterhouse Street will remain open to traffic albeit with reduced carriageway width. It will therefore be necessary for vehicles which use this part of Charterhouse Street (a public highway) to travel into the private, gated section of Charterhouse Square to turn or to exit. Had this section of Charterhouse Street not been included in the worksite, it would have been necessary to include part of the roadway on the opposite side of the site, which would have caused a significant impact on lorry delivery arrangements for Smithfield Market.

8.8.105 The worksite on Aldersgate Street has been adjusted to minimise its impact on the junction with Beech Street. However, it still includes the eastern footway on Aldersgate Street and the southern footway on Beech Street, as well as the southbound carriageway in Aldersgate Street. This will have significant impacts on pedestrians and traffic delays.

8.8.106 It will also be necessary to divert a sewer that runs under the site in Aldersgate. This will require work in the junction of Aldersgate Street and Beech Street. Long Lane will be made one way eastbound between Cloth Street and Aldersgate Street. The sewer works will also cause significant traffic delays.

8.8.107 Traffic delays will be compounded by the cumulative impact of the works at Aldersgate Street and the works at Moorgate described in Route Window C7, unless these works can be programmed to occur at different times.

8.8.108 It will be necessary to relocate the police security control point which lies within the worksite. As yet, no suitable alternative location or arrangements have been agreed with the City Police. Relocation of the control point could result in a significant adverse impact on traffic but this cannot be determined until a suitable location is agreed.

Mitigation and Permanent Residual Impacts

8.8.109 Crossrail passengers using Farringdon station will benefit significantly from improved journey times and increased interchange opportunities. Many passengers will benefit from the direct services to destinations to the east and west of London offered by Crossrail. The number of passengers using Farringdon station will increase substantially. This increase will be accommodated by the increase in capacity with the Crossrail station which will be more convenient to use with additional ticket halls and entrances resulting in the dispersal of pedestrians over a wide area. The additional facilities will improve accessibility to the station particularly for those with impaired mobility. Station capacity modelling (PEDROUTE) demonstrates that both the new Crossrail station and the existing station will accommodate the predicted passenger demand. It is estimated that an additional 300,000 people will be within a 60 minute catchment.

8.8.110 As part of the Thameslink 2000 scheme it is proposed that the section of Cowcross Street between the two stations will be closed to traffic and pedestrianised to provide a safe link between the two stations. If, however, Thameslink 2000 does not proceed before Crossrail becomes operational, the closure will be implemented as part of Crossrail and will extend between Farringdon Road and Turnmill Street in order to improve access between the Crossrail station and the Underground station. The Crossrail station can be built without the closure, which could be implemented when the works start or at any time up to the completion of the station construction. No significant adverse traffic and transport impacts will occur.

Noise and Vibration Impacts

Baseline

8.8.111 Baseline noise levels are relatively high and are dominated by road traffic and mechanical services plant, including air conditioning units on building roofs. Night-time noise levels in Cowcross Street are dominated by night-time working at the nearby Smithfield Market and noise from its power station. Table 8.20 shows the baseline noise levels that have been recorded at representative noise-sensitive receptors within this route window.

Table 8.20 Baseline Noise Measurements at Representative Noise-sensitive Receptors

Reference	Receptor	Baseline Noise Level	
		Daytime ($L_{Aeq, 12\ hour}$)	Night-time ($L_{Aeq, 8\ hour}$)
CA04[1]	5 Raymond Buildings	55	
IS01	Cardinal House, Farringdon Street (rear façade)	68	67
IS02	64-65 Cowcross Street	72	67
IS03[1]	79 Charterhouse Street	70	
IS04	99 Charterhouse Square	62	63
IS05[1]	33 Charterhouse Square	68	
CL01	Hayne Street	62	58
CL02[1]	Lindsey Street	74	

1 Short-term monitoring location ($L_{Aeq, 3\ hour}$).

8.8.112 *Noise from Above-ground Construction Activity:* The relevant mitigation measures set out in Appendix B1 will be employed to reduce construction noise impacts. A 3.6 m high hoarding will also be provided around the western ticket hall and eastern ticket hall worksites. Concrete pumps, concrete lorries and compressors will be housed in enclosures when in operation.

8.8.113 Despite these measures, significant noise impacts will affect occupants at 20 properties. Of these properties, one property at 59 Long Lane will be likely to qualify for noise insulation; none will be likely to qualify for temporary rehousing. This property qualifies for noise insulation because construction noise levels will exceed the noise insulation criteria during the daytime period. As discussed in Chapter 3, noise insulation and its installation will result in disruption and inconvenience for the occupants of a building. In addition, it may not always eliminate completely the noise impact. However, whilst it has not been practicable to determine the effectiveness of noise insulation at each individual property, it is likely that noise insulation will be sufficient to mitigate the noise impact of surface construction activity in most cases.

8.8.114 With this mitigation in place, significant residual construction noise impacts will, therefore, affect 19 residential properties, one school and one medical facility. These are shown in Table 8.21.

Table 8.21 Properties Significantly Affected by Noise from Surface Construction Activity

Number of Dwellings	Property Address	Period of Day	Duration of Impact in Months
2	34-35 Cowcross Street	Daytime	1
2	105 Charterhouse Street	Daytime	3
2	121-123 Charterhouse Street	Daytime	3
6	41-41 Charterhouse Square (2nd and 3rd Floors)	Daytime	3
3	41-41 Charterhouse Square (4th Floor)	Daytime	5
3	41-41 Charterhouse Square (5th Floor)	Daytime	8
1	6-7 Florin Court	Daytime	3
1	Charterhouse School*	Daytime	6-46
1	Medical facility at 62-66 Long Lane*	Daytime	2

* In exceptional cases the Secretary of State will consider providing additional assistance.
This is referred to in Chapter 3 of this ES

8.8.115 Planning permission has been granted for an 8-storey building at 17 to 23 Farringdon Road to provide retail, office and residential floorspace. Crossrail construction works associated with the Cardinal House worksite at Farringdon station have the potential to result in significant impacts to the noise sensitive parts of the proposed development. At present, due to uncertainties about the detailed layout of this development, it is not practicable to quantify the magnitude or duration of any impact that might arise should this development come forward.

8.8.116 *Vibration from Above-ground Construction Activity:* Due to the nature of the works, no significant noise and vibration impacts will occur from the works at the Cardinal House and Smithfield Market Basement worksites. The application of mitigation measures set out in Appendix B1 will ensure that impacts from vibration during construction works at the Lindsey Street and Fox and Knot Street worksites are not significant. Impacts on listed buildings are addressed under built heritage. There will be no significant vibration impacts on other receptors in this route window from above-ground construction activity.

8.8.117 *Vibration and Groundborne Noise from Underground Construction Activity:* Adherence to the measures set out in Appendix B1 will ensure that no significant adverse impacts will occur due to the movement of equipment and excavated material trains in the tunnel. These measures include fastening the rail to sleepers using resilient rail pads, or adequate elasticity to the support of the track system between the rail foot and the sleeper, or tunnel invert where reasonably practicable.

8.8.118 Groundborne noise and vibration from the passage of the tunnel boring machines may be perceptible. However, this will be a transient effect lasting only a few days and will not be significant.

8.8.119 *Noise from Construction Road Traffic:* Changes in roadside noise levels resulting from Crossrail construction traffic, at less than 3 dB(A), will not be sufficient to give rise to a significant impact.

Mitigation and Permanent Residual Impacts

8.8.120 *Noise from Ventilation Shafts:* Silencers and other mitigation measures will be incorporated into the design of the ventilation shafts. This will ensure that noise levels generated by the operation of the ventilation shafts will be below the level at which an impact is deemed to occur. No significant residual noise impacts will, therefore, occur.

8.8.121 *Groundborne Noise and Vibration from the Operational Railway:* The mitigation measures that have been incorporated into the design will ensure that there are no significant residual impacts from operational vibration or groundborne noise.

8.8.122 *Noise from Operational Road Traffic:* In almost all cases, changes in roadside noise levels arising from traffic flows once Crossrail is operational will be less than 1 dB(A). This will not be sufficient to give rise to a significant impact. However, the section of Cowcross Street, between Farringdon Road and St John Street will be closed to road traffic as a result of the Crossrail works. This will result in decreases in roadside noise levels of around 5 dB(A), which will be a significant beneficial impact.

Impacts on Air Quality

Baseline

8.8.123 AQMAs extend across the whole of the City of London and the LB Camden. The southern section of LB Islington has been declared an AQMA, together with areas surrounding the major arterial routes in the north of the borough. The AQMAs have been designated because the National Air Quality Objectives for NO_2 and PM_{10} are not likely to be achieved. Although the AQMAs extend across the whole route window, the principal source of these two pollutants is road traffic, with maximum concentrations occurring near to busy roads.

Mitigation and Temporary Residual Impacts

8.8.124 Dust will be generated by construction activity, including the movement of materials. Farringdon Road worksite will have a high potential for dust nuisance, however, with the application of measures defined in Appendix B1, no significant impacts due to dust will occur.

8.8.125 The construction traffic generated by Crossrail will not be sufficient to cause significant impacts from air pollution for a number of reasons, as summarised below.

8.8.126 In 2007, when construction is due to start, the ambient background NO_2 concentration in the route window will breach the National Air Quality Objective of 40 µg/m^3 on all roads. Increases in NO_2 roadside concentrations as a result of Crossrail's construction traffic are forecast to be less than 1 µg/m^3. This increase also only arises during the construction period and is not permanent. As a result the construction of Crossrail is not likely to prejudice the strategy adopted by the local authority to meet the National Air Quality Objective in its Local Air Quality Action Plan.

8.8.127 In 2007, ambient background PM_{10} concentrations within the route window will be less than 70% of the Air Quality Objective Value of 40µg/m^3. A provisional Air Quality Objective Value of 23 µg/m^3 is proposed for 2010. The ambient background concentration for PM_{10} within the route window is forecast to be 23 µg/m^3 in 2010. Increase in PM_{10} roadside concentrations as a result of Crossrail's construction traffic are forecast to be less than 1 µg/m^3. This increase also only arises during the construction period and is not permanent. This increase is not likely to prejudice the strategy adopted by the local authority to meet the National Air Quality Objective in its Local Air Quality Action Plan.

Mitigation and Permanent Residual Impacts

8.8.128 In 2016, ambient background NO_2 concentrations in this route window are expected to exceed the National Air Quality Objective Value of 40 µg/m^3 on approximately half of the roads. Increases in NO_2 roadside concentrations as a result of changes in operational traffic brought about by Crossrail will be less than 1 µg/m^3. This increase is not likely to prejudice the strategy adopted by the local authority to meet the National Air Quality Objective in its Local Air Quality Action Plan.

8.8.129 In 2016, ambient background PM_{10} concentrations in this route window are expected to be less than 70% of the National Air Quality Objective Value of 40 µg/m^3. The forecast ambient PM_{10} background concentration, at 22 µg/m^3, will be less than the 2010 provisional Air Quality Objective Value of 23 µg/m^3 within this route window. Increases in PM_{10} roadside concentrations as a result of changes in operational traffic brought about by Crossrail will be less than 0.2 µg/m^3. As a result, no significant impacts will occur.

8.8.130 The only permanent source of air pollution directly from Crossrail is the ventilation shaft and the potential for PM_{10} arising from train operations and passenger movements being emitted at this point. Monitoring at a ventilation shaft on the Jubilee line recorded no significant emissions of PM_{10}. Crossrail tunnels will be cleaned on a regular basis, Crossrail trains will use regenerative braking reducing the potential for generation of particulates and station platforms will be partitioned from the main tunnels. On this basis it is considered that no significant impacts from emissions of PM_{10} through Crossrail ventilation shafts will occur.

Impacts from Contaminated Land

Baseline

8.8.131 There will be significant ground-breaking required during the construction of Farringdon station; two sites located near to these activities have been identified as having a potential risk of being significantly contaminated owing to their railway and industrial use for about 130 years. These are described in Table 8.22.

Table 8.22 Sites Identified as Having a Significant Contamination Potential

Site Name	Past and Current Uses	Potential Contaminants	Potential Receptors
Barbican Underground station – medium risk	Timber yard from 1873 to 1914 Current use as an Underground station since 1865	Inorganic substances Organic substances Contaminated groundwater	Construction workers and site visitors Confined Chalk aquifer
Farringdon station – medium risk	Station with rail depot and goods yard since 1860s to present day	Inorganic substances. Organic substances Contaminated groundwater	Construction workers and site visitors Confined Chalk aquifer

Mitigation and Residual Impacts

8.8.132 With the application of measures set out in Appendix B1 relating to the handling, treatment and ongoing management of contaminated soil and groundwater, no significant impacts will occur during construction or in the long-term.

Community Impacts

Baseline

8.8.133 Farringdon station is located on Cowcross Street within a mix of offices, restaurants, retail outlets, hotels and the Smithfield wholesale market. The street forms an important pedestrian route linking the station with surrounding shops and offices. St Bartholomew's Hospital and Medical College are located to the north and south of the market and the Barbican residential and cultural complex is to the east.

Mitigation and Temporary Residual Impacts

8.8.134 There will be no temporary significant direct impacts on community facilities.

8.8.135 There will be a cumulative impact on the local community caused by visual impacts on pedestrians and local residents, noise disruption to local residents, Charterhouse school and a surgery, loss of car parking, impacts on pedestrians and traffic delays. This will also include the loss of the Lindsey Street hotel as outline below, the effects of which will commence at the beginning of the construction period.

Mitigation and Permanent Residual impacts

8.8.136 The works at Farringdon station will result in the loss of the Lindsey hotel. As the only hotel in the area providing low cost overnight accommodation, its loss will be a significant adverse impact.

8.8.137 The works at Farringdon station will result in the pedestrianisation of Cowcross Street. This will provide a safer and more amenable environment for pedestrians than currently exists, and will result in a significant beneficial community impact.

Socio-Economic Impacts

Baseline

8.8.138 The central feature of this area is Farringdon station. The surroundings of the station offer a mixture of offices, restaurants, retail outlets along with Smithfield meat market. Farringdon is on the City fringe and presents a typical combination of modern office buildings with small convenience retail units by the station. These employ around 180,000 people. A total of 4.1 million m^2 of commercial floorspace is available within 1 km of the station.

Mitigation and Residual Impacts

8.8.139 The construction of the western entrance and ticket hall to Crossrail (located on Farringdon Road) will require the permanent acquisition of Cardinal House and several retail outlets while to the east some office space, retail, hotel and catering outlets will be affected.

8.8.140 Altogether, the construction of Farringdon station will result in the displacement of between 800 to 1,100 retail and office jobs. It will entail the demolition of commercial premises of around 14,300 m^2 to the west and 2,100m^2 to the east. Although this displacement of jobs will be disruptive for the people affected, the socio-economic impact is not deemed significant as the job loss represents at most 0.6% of jobs and around 0.4% of commercial property stock within 1 km of Farringdon station. In addition office vacancy rates in Midtown are 11%, so there is sufficient capacity for businesses to relocate in the locality.

8.8.141 The Bill does not include powers for replacement development. The loss of commercial floorspace and associated employment capacity at the ticket hall sites will remain until such time as replacement development is provided. It is anticipated that replacement development will reduce or offset this loss of employment capacity. The impact, although not significant, will remain until over-site development is provided.

8.8.142 Approximately half of Smithfield Market's underground car park will be required for the works and construction traffic will have an impact on access to the market. However, this is not predicted to affect the on-going viability of the market, based on consultation with the Corporation of London's Markets Division. The loss of off-street car parking spaces to worksites, as well as local road closures, will have some disruptive impacts on businesses in the area. However, these will not have a significant impact on employment.

Variations in the Project

8.8.143 The crossover structure at Aldersgate Street may be constructed by a different method which has not been fully developed at this stage, but which it is anticipated will be feasible. This method would involve the provision of two pairs of 'trumpet shaped' turnouts between the running tunnels located between Farringdon and Liverpool Street stations. The turnouts would be constructed after the running tunnels have been built in this area. The process would involve the sequential enlargement of short lengths of the running tunnels. The turnouts would be constructed from within the running tunnels, eliminating the need for a temporary construction shaft in Aldersgate Street. Excavated material would be removed back through the running tunnels and Liverpool Street station.

8.8.144 Should this construction method be used, it is anticipated that it would reduce or remove temporary impacts for archaeology, noise and vibration and visual amenity. Temporary traffic and transport impacts associated with the construction of a temporary shaft and associated works in Aldersgate Street would be removed, as well as cumulative impacts arising from worksites in both this and route windows C7. It is anticipated that settlement impacts associated with the Barbican would also be reduced to non-significant, incorporating mitigation measures as set out in Appendix B1.

Design Options

Farringdon Station – Western Ticket Hall

8.8.145 Three options were considered for the western ticket hall.

8.8.146 Option 1: new ticket hall south of Cowcross Street. This was rejected as it would have required the demolition of listed buildings. It was also reliant on the development of Thameslink 2000. The ticket hall could not have been built before Thameslink 2000 works due to the continued operations of the Thameslink Moorgate branch.

8.8.147 Option 2: extension of existing ticket hall at Farringdon station. This was rejected. The existing station is a Grade II listed building and is designated as a 'Heritage Station' by London Underground. Significant alterations or demolitions to the Grade II listed structure would have been necessary for Option 2, to provide the Crossrail ticket hall.

8.8.148 Option 3: new ticket hall at Cardinal House (on the corner of Cowcross Street and Farringdon Road). This was selected. It can be built independently of Thameslink 2000 allowing the required flexibility in construction programming. Thameslink can be integrated with the Crossrail project in the future.

Farringdon Station – Eastern Ticket Hall

8.8.149 Four options were considered for the location of the interchange for the eastern ticket hall.

8.8.150 Option 1: Charterhouse Square gardens. This was rejected because it is a protected London Square. It is also a considerable distance from the platforms, resulting in increased passenger access times.

8.8.151 Option 2: the corner of Lindsey Street/Charterhouse Street. This would have involved significant amounts of night-time and weekend working around the operational railway, and would have resulted in considerable disruption to London Underground. Construction in this location would also have been highly complex and expensive.

8.8.152 Option 3: Lindsey Street Ticket Hall (post Thameslink 2000). This could only be constructed after completion of Thameslink 2000. Crossrail would have used the Thameslink Moorgate branch line for construction, which would have been closed by the Thameslink 2000 scheme. This reliance on the completion of Thameslink 2000 would have imposed unacceptable rigidity and uncertainty on the Crossrail construction programme.

8.8.153 Option 4: Smithfield Market (on the corner of Lindsey Street / Charterhouse Street). This was selected because it provides a direct interchange connection to the Circle line at the western end of the station. It is also independent of Thameslink 2000.

Appendix B – Assessment of Operational Noise Mitigation Options

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B1 Rail dampers

B1.1 Rail dampers can be cost-effective in situations where barriers are relatively ineffective such as urban areas with multiple-track and tall buildings. They are particularly effective for reducing rolling noise where soft pads or resilient baseplates are used. In the Blackfriars area, the rail is currently supported on stiff pads or no pads at all. With Thameslink 2000 rails will continue to be supported on stiff pads.

B1.2 Comparison of the predictions with and without rail dampers shows that no reduction is achieved in the overall noise from the bridge since the rail dampers do not affect the bridge noise component. In other areas, where stiff rail pads are used, only a 0.8 dB(A) reduction is achieved in the direct rolling noise. The use of rail dampers will not therefore provide any appreciable reduction in railway noise in the vicinity of Blackfriars Station.

B2 Resilient baseplates on the bridge

B2.1 On its own, use of vibration-reducing track designs on Blackfriars Bridge would result in some noise reduction, but this would benefit only a small number of dwellings on the west side of Falcon Point. With the noise benefits that are now predicted at Falcon Point as a result of reduced wheel squeal and joint noise, this would not now be necessary.

B3 Noise barriers

B3.1 The new roof and the sides of the new station will provide a limited amount of screening from rolling noise and squeal noise. However, the assessment has identified few situations where specific acoustic screening measures can be justified.

B3.2 Noise barriers work best if they are either close to the noise source or close to the receptor. The effectiveness of noise barriers in the vicinity of Blackfriars Station will be limited because:

i) with between three and five tracks on the bridge and six tracks south of the bridge, it will be difficult to locate barriers close alongside all of the tracks; and

ii) many of the affected facades overlook the track and so would not benefit from the barriers alongside the tracks.

B3.3 Barriers also have other disadvantages such as visual intrusion, maintenance issues and high cost.

B3.4 The potential benefit of fixing a noise barrier to the brick arch viaduct adjacent to Quadrant House was assessed. Although this would result in a significant reduction in operational noise (by 3-4 dB) for eight flats on the two storeys that overlook the tracks, the high cost of installing and maintaining the barrier would make this option impracticable (see *Section 9.6.4* of the *Noise and Vibration Specialist Report*).

B4 Enhanced wheel maintenance

B4.1 An increase in noise from a train occurs if the train wheel develops irregularities. Wheel roughness can be minimised by turning the wheel on a lathe to restore the profile of the wheel and to remove discrete faults, such as "wheel flats[1]".

B4.2 There is little available information about the incidence of wheel irregularities on the current trains operating on the existing (and future) Thameslink lines, and the effect of such irregularities on wayside levels of rolling noise. However, significant variations in recorded noise levels from existing (Class 319) Thameslink trains suggest that wheel condition may have an important influence on wayside noise levels.

B4.3 Modern rail stock requires considerably less frequent wheel turnings than the Class 319 stock. The replacement of the Class 319 units with modern stock will lead to a significant reduction in the incidence of wheel flats.

B4.4 Network Rail will continue to work with the DfT, the SRA and the TOCs to ensure that:

i) wheels are maintained in good condition;

ii) new rolling stock incorporates state-of the-art wheel protection that will reduce still further the frequency of irregularities and faults occurring; and

iii) systems continue to be developed to monitor the condition of wheels running on the lines to be used by the Thameslink services and that action is taken to correct wheel irregularities.

B5 Enhanced rail maintenance

B5.1 The potential noise benefit of reducing rail roughness through more frequent rail grinding has been assessed using the Norbert prediction model. The assessment suggests that an enhanced grinding regime could reduce noise for some flats at Falcon Point by 2.5 dB(A). This is predominantly due to reduced noise from the bridge; the reduction of rolling noise from track immediately south of the bridge shows a smaller reduction of 1.3 dB(A).

B5.2 More frequent grinding of the rail in the vicinity of Blackfriars Station would therefore provide a small benefit, but only then for a few people who are currently affected by bridge noise and so would experience the potential noise reduction of up to 2.5 dB(A). Furthermore the maximum benefit will only be achieved immediately after rail grinding. The grinding process itself is noisy and may cause disturbance in its own right. There is therefore no clear justification for employing an enhanced rail grinding regime in the vicinity of Blackfriars Station.

B6 Rolling stock

B6.1 The SRA's specification for new electrical multiple unit rolling stock requires that all noise levels shall be minimised and all single frequency tones or whines eliminated. It specifies noise limits for trains when moving (at speeds above 30km/h) and when stationary. The SRA (and its successor) will continue to review this specification having regard to emerging national and European noise standards.

[1] Wheel flats are caused when the wheel locks and skids on the track and makes a flat metal edge, causing a clattering noise.

B6.2 Modern rolling stock is already close to the optimum design with respect to rolling noise. However, there are options to reduce high frequency tonal noise from new and existing trains; for example, using wheel damping devices and on-board flange lubricators. Network Rail will continue to work with the SRA (and its successor), the DfT and the TOCs in assessing the potential benefits and practicability of these measures.