SILVERTOWN TUNNEL

SUPPORTING TECHNICAL DOCUMENTATION

PRELIMINARY ENVIRONMENTAL INFORMATION REPORT

October 2015

This Preliminary Environmental Information Report describes the Scheme and the main alternatives considered. It sets out the environmental baseline information, provides an assessment of likely environmental effects and where necessary describes mitigation measures that would avoid, reduce or offset the adverse environmental effects.

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This report forms part of a suite of documents that support the statutory public consultation for Silvertown Tunnel in October – November 2015. This document should be read in conjunction with other documents in the suite that provide evidential inputs and/or rely on outputs or findings.

The suite of documents with brief descriptions is listed below:-

- **Preliminary Case for the Scheme**
    - Preliminary Monitoring and Mitigation Strategy
- **Preliminary Charging Report**
- **Preliminary Transport Assessment**
- **Preliminary Design and Access Statement**
- **Preliminary Engineering Report**
- **Preliminary Maps, Plans and Drawings**
- **Preliminary Environmental Information Report (PEIR)**
    - Preliminary Non Technical Summary
    - Preliminary Code of Construction Practice
    - Preliminary Site Waste Management Plan
    - Preliminary Energy Statement
- **Preliminary Sustainability Statement**
- **Preliminary Equality Impact Assessment**
- **Preliminary Health Impact Assessment**
- **Preliminary Outline Business Case**
    - Preliminary Distributional Impacts Appraisal
    - Preliminary Social Impacts Appraisal
    - Preliminary Economic Assessment Report
    - Preliminary Regeneration and Development Impact Assessment

SILVERTOWN TUNNEL

Preliminary Environmental Information Report

Volume 1: Main Text

October 2015

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Silvertown Tunnel

Preliminary Environmental Information Report

Volume 1: Main Text

Planning Act 2008

Infrastructure Planning

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

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List of Abbreviations

A	Anadromous
AADT	Annual Average Daily Traffic
AAWT	Annual Average Weekday Traffic.
ABPmer	ABP Marine Environmental Research
AEP	Annual Exceedance Probability
AM	Morning peak traffic period
AOD	Above Ordnance Datum
APIS	Air Pollution Information System
AQ	Air Quality
AQAP	Air Quality Action Plan
AQFA	Air Quality Focus Area
AQMA	Air Quality Management Area
AQS	Air Quality Strategy
ARN	Affected Road Network

AURN	Automatic Urban and Rural Network
BAP	Biodiversity Action Plan
BGS	British Geological Survey
BNL	Basic Noise Level
BOD	Biological Oxygen Demand
BPM	Best Practicable Means
BSI	British Standards Institute
C	Catadromous
CAMS	Catchment Abstraction Management Strategy
CBD	Convention on Biological Diversity
CCMP	Carbon Calculation for Major Projects
CD&E	Construction, demolition and excavation
CDM	Construction Design and Management Regulations (2015)
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CEMP	Construction Environmental Management Plan

CFA	Continuous Flight Auger
CHaMP	Coastal Habitat Management Plan
CIEEM	Chartered Institute for Ecology and Environmental Management
CIRIA	Construction Industry Research and Information Association
CoC	Contaminants of Concern
CoCP	Code of Construction Practice
COD	chemical oxygen demand
CoP	Code of Practice
COSHH	Control of Substances Hazardous to Health
CPET	Central Point of Expertise in Timber
CRoW	The Countryside and Rights of Way Act 2000
CRRN	Compliance Risk Road Network
CRTN	Calculation of Road Traffic Noise
CSM	Conceptual Site Model

DBFM	Design Build Finance and Maintain
DCO	Development Consent Order
DECC	Department of Energy & Climate Change
Defra	Department for the Environment, Food and Rural Affairs
DfT	Department for Transport
DLR	Docklands Light Railway
DMRB	Design Manual for Roads and Bridges
DTI	Department of Trade and Industry
EA	Environment Agency
EAL	Emirates Air Line
EAR	Economic Assessment Report
EC	European Commission
EcIA	Ecological Impact Assessment
EFT	Emissions Factor Toolkit
EHO	Environmental Health Officer

EIA	Environmental Impact Assessment
EMS	Environmental Method Statement
EOD	Explosive Ordnance Disposal
EqIA	Equalities Impact Assessment
EQS	Environmental Quality Standard
ER	Estuarine residents
ERM	Environmental Resources Management
ES	Environmental Statement
ESRP	Emergency Spill Response Plan
EU	European Union
EU LV	European Union Limit Value
FRA	Flood Risk Assessment
FS	Freshwater stragglers
FSC	Forestry Stewardship Council
GES	good environmental status

GHGs	Greenhouse gases
GiGL	Greenspace Information for Greater London
GIS	Geographic Information System
GLA	Greater London Authority
GLAAS	Greater London Archaeological Advisory Service
GPLC	Guiding Principles for Land Contamination
GVA	Gross Value Added
HA	Highways Agency (now known as Highways England)
HCA	Homes and Communities Agency
HDV	Heavy Duty Vehicle
HE	Highways England (formerly Highways Agency)
HER	Historical Environment Record
HGV	Heavy Goods Vehicle
HIA	Health Impact Assessment

HSE	Health and Safety Executive
IAN	Interim Advice Note
IAQM	Institute of Air Quality Management
IDA	International Dark Sky Association
IDB	Internal Drainage Board
IEEM	Institute of Ecology and Environmental Management
IER	Interim Environmental Report
ILE	Institution of Lighting Engineers
ILP	Institution of Lighting Professionals
IMD	Index of Multiple Deprivation
IP	Inter peak traffic period
IPC	Infrastructure Planning Commission (referred to as PINS post April, 2012)
IUCN	International Union for Conservation of Nature
LAEI	London Atmospheric Emissions Inventory

LAQM	Local Air Quality Management
LBAP	Local Biodiversity Action Plan
LBN	London Borough of Newham
LBTH	London Borough of Tower Hamlets
LEA	Local Economic Assessment
LLAU	Limit of Land to be Acquired or Used
LLFA	Lead Local Flood Authority
LOAEL	Lowest Observed Adverse Effect Level
LoD	Limits of Deviation
LSOA	Lower Super Output Area
LTTE6	Long Term Trends projections from HA IAN 170/12v3
LTVS	Longitudinal Tunnel Ventilation System
LU	London Underground
M&E	Mechanical & Electrical
MAGIC	Multi-Agency Geographic Information

	for the Countryside
MarLIN	The Marine Life Information Network
MCZ	Marine Conservation Zone
MMD	Marine migrant dependent
MMO	Marine Management Organisation
MMOS	Marine Migrant Opportunistic Species
MOL	Metropolitan Open Land
MoU	Measure of Uncertainty
MPA	Marine Protected Area
MPS	Marine Policy Statement
MS	Marine stragglers
MSFD	The Marine Strategy Framework Directive
MTS	Mayor's Transport Strategy
NABSA	Not Afloat but Safely Aground
NCN	National Cycle Network

NE	Natural England
NERC	The Natural Environment and Rural Communities
NFFO	National Federation of Fishermen's Organisations
NJUG	National Joint Utilities Group
NM	Nautical Mile
NML	Noise Monitoring Location
NMU	Non-Motorised Users
NN NPS	National Planning Policy Statement for National Networks
NNR	National Nature Reserve
NNSS	Non-Native Species Secretariat
NO2	Nitrogen Dioxide
NOBANIS	The European Network on Invasive Alien Species
NOEL	No Observed Effect Level
NOx	Nitrogen Oxides

NPPF	National Planning Policy Framework
NPPG	National Planning Practice Guidance
NPS	National Policy Statement
NPS NN	National Policy Statement for National Networks
NPSE	Noise Policy Statement for England
NRMM	Non-road mobile machinery
NSIP	Nationally Significant Infrastructure Project
OBC	Outline Business Case
ONS	Office for National Statistics
OP	Off peak traffic period
OS	Ordnance Survey
OSPAR	The Convention for the Protection of the Marine Environment of the North-East Atlantic
PAH	polyaromatic hydrocarbons
PCBs	Polychlorinated biphenyl

PCM	Pollution Climate Mapping
PEIR	Preliminary Environmental Information Report
PER	Preliminary Engineering Report
PEVS	Portal Extract Ventilation System
PHE	Public Health England
PINS	Planning Inspectorate
PLA	Port of London Authority
PM	Evening peak traffic period
PM10	Particulate matter less than 10 microns in diameter
PM2.5	Particulate matter less than 2.5 microns in diameter
pMCZ	proposed Marine Conservation Zone
PNNL	Pacific Northwest National Laboratory
PPG	Planning Policy Guidance
PPS	Planning Policy Statements

ppv	Peak Particle Velocity
PRoW	Public Rights of Way
PTS	permanent threshold shift
RA	Regeneration Area
RBG	Royal Borough of Greenwich
rMCZ	recommended Marine Conservation Zone
RPS	Rural Planning Services
RR	Regeneration Report
RUC	Road User Charging
SAC	Special Area of Conservation
SAF	Strategic Assessment Framework
SAQAP	Scheme Air Quality Action Plan
SCANS	Small Cetacean Abundance in the European Atlantic and North Sea
SCOS	Special Committee on Seals
SDC SPG	Sustainable Design and Construction Supplementary Planning Guidance

SEA	Strategic Environmental Assessment
SFF	Scottish Fishermen's Association
SFRA	Strategic Flood Risk Assessment
SINC	Site of Interest for Nature Conservation
SL	Source Level
SLM	Sound Level Meter
SMRU	Sea Mammal Research Unit
SOAEL	Significant Observed Adverse Effect Level
SoS	Secretary of State
SPA	Special Protection Areas
SPZ	Source Protection Zone
SSC	suspended sediment concentrations
SSD	Stopping Sight Distance
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage Systems

SVOCs	Semi-volatile Organic Compounds
SWMP	Site Waste Management Plan
TAG	Transport Analysis Guidance
TBM	Tunnel Boring Machine
TEBP	Thames Estuary Benthic Programme
TfL	Transport for London
TG	Technical Guidance
TLRN	Transport for London Road Network
TraC	Transitional and Coastal Water Bodies
TRL	Transport Research Laboratory
TTS	temporary threshold shift
TTWA	Travel to Work Area
TVIA	Townscape and Visual Impact Assessment
UK	United Kingdom
UK BAP	UK Biodiversity Action Plan

UKOOA	UK Offshore Operator's Association
ULSD	Ultra-low Sulphur tax-exempt diesel
UNESCO	United Nations Educational Scientific and Cultural Organisation
UXO	Unexploded Ordnance
VMS	Variable Message Signs
VOCs	Volatile Organic Compounds
WCA	Wildlife and Countryside Act
WFD	Water Framework Directive
WSVs	Water Screening Values
ZoI	Zone of Influence
ZSL	Zoological Society London
ZVI	Zone of Visual Influence

Glossary of Terms

Abstraction	Removal of water from surface water or groundwater, usually by pumping.
Ambient Noise	Ambient noise is the total sound in a given situation at a given time usually composed of sound from many sources, near and far.
Annual chance	Floods are described according to an 'annual chance'. Meaning the chance of a particular flood occurring in any one year. This is directly linked to the probability of a flood. For example, a flood with an annual chance of 1 in 100 (a 1 in 100 chance of occurring in any one year), has an annual probability of 1%.
Aquifer	A body of permeable rock that is capable of storing significant quantities of water; is underlain by impermeable material, and through which groundwater moves.
Artificial refuge	A rectangle of roofing felt or corrugated metal, usually 0.25m^2, used for attracting reptiles.
Assessed Case	Scenario adopted for assessment of likely effects of the proposed scheme, with user charges set so as to balance the scheme's traffic, environmental, socio-economic and financial objectives.
Balancing Pond	A balancing Pond is a drainage system used to control flooding by temporarily storing flood waters.
Basic Noise Level (BNL)	The BNL is a measure of source noise at a reference distance of 10m from the nearside carriageway edge. It is determined from obtaining the estimated noise level from the 18 hour flow and then applying corrections for vehicle speed, percentage of heavy vehicles, gradient and road surface as described in CRTN.
Bat activity survey	Bat activity survey is a standard technique used to assess how bats use a particular site. Some of the information sought includes the distribution and relative extent of the activity, as well as the bat species and their behaviour.
Bat Emergence Survey	Bat emergence survey is a standard technique used to help determine presence/likely absence of roosting bats within a suitable feature such as a building or tree. It usually involves observing potential bat access points prior to dusk for approximately two hours to see if any bats emerge.
Blackwall Tunnel	A road tunnel underneath the River Thames in east London, linking the London Borough of Tower Hamlets with the Royal Borough of Greenwich, comprising two bores each with two

	lanes of traffic. The tunnel was originally opened as a single bore in 1897, as a major transport project to improve commerce and trade in London's east end. By the 1930s, capacity was becoming inadequate, and consequently, a second bore opened in 1967, handling southbound traffic while the earlier 19th century tunnel handled northbound.
Breach scenario	A Breach scenario is when a flood defences overtops or fails
Bronze Age periods	2,500 BC to 700 BC;
Bund	A barrier, dam or mound used to contain or exclude water (or other liquids). Can either refer to a bund made from earthworks material, sand etc. or a metal/concrete structure surrounding, for example, a fuel tank.
Bus and Goods Vehicle Lane	A dedicated highway lane that has restricted occupancy, available for use by buses, Heavy Goods Vehicles and taxis.
Bus Gate	Bus gates are traffic signals often provided within bus priority schemes to assist buses and other permitted traffic when leaving a bus lane to enter or cross the general flow of traffic or to meter the flow of general traffic as it enters the road link downstream of the bus lane. Depending on their purpose, bus gates can be located remote from other signals or they can be positioned immediately upstream of a signal controlled junction, as a bus pre-signal.
Carbon	'Carbon' is used as short hand to refer to the basket of six greenhouse gases (GHGs) recognised by the Kyoto Protocol. GHGs are converted to carbon dioxide equivalents (CO_2e) based on their global warming potential per unit as compared to one unit of CO_2.
CDM (2015)	The Construction (Design and Management) Regulations 2015 set out the roles and responsibilities of parties involved in construction projects in relation to health and safety during the project life cycle including design, construction operation and maintenance stages.
Contaminants of Concern	Chemical substances found at site that have been determined to pose an unacceptable risk to human health or the environment.
Contractor	Anyone who directly employs or engages construction workers or manages construction work. Contractors include sub-contractors, any individual self-employed worker or

	business that carries out, manages or controls construction work
Control Centre	Facility to deal with issues with over-height, illegal and unsafe vehicles going through Blackwall and Silvertown tunnels, and help manage traffic
Core Strategy	The Core Strategy sets out the vision, key objectives and strategic planning policies for the area.
Cumulative Effects	The summation of effects that result from changes caused by a development in conjunction with other past, present, or reasonably foreseeable actions
Cut and Cover	A method of construction for shallow tunnels where a trench is excavated and roofed over with an overhead support system strong enough to carry the load of what is to be built above the tunnel
Decibel	Sound pressure levels and noise levels are usually quoted in decibels (dB). The decibel scale is logarithmic rather than linear. The threshold of hearing is zero decibels while, at the other extreme, the threshold of pain is about 130 decibels. In practice these limits are seldom experienced and typical levels lie within the range of 30 dB(A) (a quiet night time level in a bedroom) to 90 dB(A) (at the kerbside of a busy street).
Department for Transport (DfT)	The government department responsible for the English transport network and a limited number of transport matters in Scotland, Wales and Northern Ireland that have not been devolved.
Design Manual forRoads and Bridges	A series of 15 volumes that provide official standards, advice notes and other documents relating to the design, assessment and operation of trunk roads, including motorways in the United Kingdom.
Design, Build, Finance and Maintain (DBFM)	A DBFM company is typically a consortium of private sector companies, formed for the specific purpose of providing the services under the DBFM contract. This is also technically known as a Special Purpose Vehicle (SPV). The DBFM Company will obtain funding to design and build the new facilities and then undertake routine maintenance and capital replacement during the contract period, which is typically 25 to 30 years. The DBFM Company will repay funders from payments received from TfL during the lifespan of the contract. Receipt of payments from TfL will depend on the ability of the DBFM Company to deliver the services in accordance with the output specified in the contract and will be subject to deductions if

	performance is not satisfactory.
Desk-based Assessment	A data collection exercise using existing sources of data. The purpose is to identify relevant known resources.
Detailed Design	The design that defines precisely the works that are to be constructed to meet the specified outputs.
Development Consent Order (DCO)	This is a statutory order which provides consent for the project and means that a range of other consents, such as planning permission and listed building consent, will not be required. A DCO can also include provisions authorising the compulsory acquisition of land or of interests in or rights over land which is the subject of an application. http://infrastructure.planninginspectorate.gov.uk/help/glossary-of-terms/
Dewatering	The process of removing groundwater from an aquifer
Docklands Light Railway (DLR)	An automated light metro system serving the Docklands and east London area. The DLR is operated under concession awarded by Transport for London to KeolisAmey Docklands, a joint venture between transport operator Keolis and infrastructure specialists Amey plc
Drawdown	Drawdown is the change in head or water level relative to background condition, indicating the difference in head which has occurred at a given location relative to an initial time at the same location.
Dwelling	A building used for living purposes. A mobile home used for permanent living should be included in an assessment. If calculations are being conducted for compensation purposes then some mobile homes are dealt with under the Highways Noise Payments and Moveable Homes Regulations.
Earth Pressure Balance (EPB) Tunnel Boring Machine	A type of tunnel boring machine used in soft ground. The machine uses the excavated material to balance the pressure at the tunnel face. Pressure is maintained in the cutter head by controlling the rate of extraction of spoil through the removal Archimedes screw and the advance rate of the machine
Embodied Carbon	Embodied carbon dioxide (CO_2) emissions of a material is the total carbon dioxide equivalent emissions released prior to it leaving the factory gate.

Emirates Air Line (EAL)	A cable car service across the River Thames in east London, linking the Greenwich peninsula to the Royal Victoria Dock. The service is managed by TfL, and is part of the TfL transport network
Extended Phase 1 Habitat Survey	Phase 1 habitat survey is a standard technique for rapidly obtaining baseline ecological information over a large area of land. Habitats are mapped based on the vegetation present. The technique is often extended to give further consideration to the potential of habitats to support protected species and species of conservation concern
Façade Sound Level	A façade sound level is that determined 1 metre in front of a window or door in a facade. Sound is reflected from hard surfaces in a similar manner to light by a mirror and the effect is to produce a slightly higher (about 2.5 dB) sound level than would occur if the building was not there. For façade levels at dwellings required for this assessment process, the level 1 metre from the façade should be calculated with a reflection correction.
FINDWAVE	A Finite Difference Model for predicting vibration of structures, re-radiated noise and ground borne propagation of vibration at acoustic frequencies.
Flood gates	Flood gates used to control water flow in flood barriers, reservoir, river, stream, or levee systems.
Floodplain compensation	An artificially excavated, hydraulically equivalent volume of floodplain storage sufficient to offset a reduction in floodplain storage resulting from filling or construction within the local regulatory floodplain.
Free-Field Sound Level	The sound level which is measured or calculated, in the open, without any reflections from nearby surfaces. For free-field levels at dwellings required for this assessment process, the level one metre from the most exposed façade should be calculated without a reflection correction.
Future assessment year	The future assessment year is the year between opening and the 15th year where the maximum impact from the road project would occur.
Gasholder	A large container in which natural gas is stored near atmospheric pressure at ambient temperatures
Greenwave	Coordinated control of a series of traffic signals to allow continuous traffic flow in a given direction.
Groundwater	Defined by the European Commission groundwater Directive (80/68/EEC) as "all water which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil".

Heavy Goods Vehicle (HGV)	European Union term for any vehicle with a gross combination mass of over 3500kg
Heritage Asset	A heritage asset is defined as '*A building, monument, site, place, area or landscape identified as having a degree of significance meriting consideration in planning decisions, because of its heritage interest. Heritage asset includes designated heritage assets and assets identified by the local planning authority (including local listing)*'.
Hydrogeology	Hydrogeology is the area of geology that deals with the distribution and movement of groundwater in the soil and rocks of the Earth's crust
Illustrative Design	An example of how the proposals could be developed at the next stage of design as a result of engagement with the DBFM contractor, planning authority and other relevant stakeholders.
Indirect Effects	The combined action of different environmental topic-specific impacts upon a single resource/receptor.
Inert materials	Inert material is material which is neither chemically or biologically reactive and will not decompose. Examples of this are sand, drywall, and concrete. This has particular relevance to landfills as inert materials typically require lower disposal fees than biodegradable waste or hazardous waste.
Iron Age	800 BC to AD 43.
LA10 index	LA10 is the A-weighted sound level in dB that is exceeded 10% of the measurement period. This is the standard index used within the UK to describe traffic noise.
LA10,18h index	The LA10,18h noise level is arithmetic mean of all the levels of LA10 during the period from 06:00 to 24:00. From research it has been found that subjective response to road traffic noise is closely linked to higher noise levels experienced and is correlated well with the LA10,18h index.
LA90 index	The background noise level is commonly quoted using the LA90 index. This is the A-weighted sound level in dB that is exceeded 90% of the measurement period.
LAeq index	The equivalent continuous sound level LAeq is the level of a notional steady sound, which at a given position and over a defined period of time, would have the same A-weighted acoustic energy as the fluctuating noise.
LAmax index	The maximum A-weighted level measured during a given time period.

Level of Effect	Determined through the combination of sensitivity of the receptor and the proposed magnitude of change brought about by the development
Limits of Land to be Acquired and Used (LLAU)	The extent of land and rights over land that will be needed temporarily to construct the Scheme, and permanently to operate, maintain and safeguard the Scheme (often referred to as 'the red line boundary')
Listed Buildings	Grade I buildings are of exceptional interest, sometimes considered to be internationally important. Grade II* buildings are particularly important buildings of more than special interest. Grade II buildings are nationally important and of special interest.
Lnight index	For the purpose of night-time noise assessment in this document, the Lnight, outside index is the equivalent continuous sound level LAeq,8h for the period 23:00 to 07:00 hours assessed outside a dwelling and is free-field.
Local Geological Site	A designation recognising areas of geological or geomorphological significance at a local scale
London Streets Tunnels Operations Centre (LSTOC)	LSTOC operates the traffic and tunnel safety systems for various road tunnels in London operated by Transport for London. LSTOC operations are fundamental to the safe and reliable operation of TfL's tunnels and performance of the corridors serviced by the London streets traffic control system
Made ground	An area of land that has been man-made, generally through the reclamation of marshes, lakes, or shorelines. An artificial fill is used, consisting of materials, refuse, etc.
Magnitude	A combination of the scale, extent, and duration of an effect also defined as 'degree of change'
Material resources	Material resources include primary raw materials, such as aggregates and minerals, and manufactured construction products which include recycled and secondary aggregates.
Medieval period	AD 1066 to AD 1540.
Mesolithic period	10,000 BC to 3,500 BC.
Millennium Exhibition Site (MES)	The Millennium Dome is the original name of a large dome-shaped building, originally used to house a major exhibition celebrating the beginning of the third millennium. Located on the Greenwich Peninsula the exhibition was open to the public from 1 January to 31 December 2000. All of the original exhibition and associated complex has since been demolished. The dome still exists, and it is now a key exterior

	feature of The O2. The Millennium Exhibition Site comprises of the O2 and the surrounding buildings and infrastructure.
Mitigation	Measures including any process, activity, or design to avoid, reduce, remedy or compensate for negative environmental impact or effects of a development
Modern period	AD 1900 to present.
Neolithic period	4,000 BC to 2,200 BC.
Outline Design	Defines the design principles and freezes the scope of the project
Polyaromatic hydrocarbons (PAH)	PAHs, also polyaromatic hydrocarbons are hydrocarbons organic compounds containing only carbon and hydrogen that are composed of multiple aromatic rings. They are found in fossil fuels (oil and coal) and in tar deposits, and are produced, generally, when insufficient oxygen or other factors result in incomplete combustion of organic matter.
Palaeoenvironmental	The determination of the prehistoric environment of an archaeological site. Paleoenvironmental reconstruction refers to the investigations which are undertaken to reconstruct the climate and vegetation of a specific time and place.
Pathway	The route by which potential contaminants may reach receptors.
Polychlorinated biphenyl (PCBs)	A polychlorinated biphenyl is a synthetic organic chemical compound of chlorine attached to biphenyl, which is a molecule composed of two benzene rings.
Pollution Pathway	The retraceable route of a pollutant, from its source, through its interactions with the environment, and finally to its effect upon a target ecosystem or organisms.
Pollution Prevention Guidelines	Best practice guidelines set out by the Environment Agency to advise industry and public on legal responsibilities and good environmental practice.
Post-medieval period	AD1540 to 1914.
Prehistoric period	Pre 30,000BC to AD43.
Receptor	A receptor is defined as living organisms, ecological systems or property that may be harmed by contamination or hazards.

Reference Case	An assumed 'future baseline' scenario, which represents the circumstances and conditions that we would anticipate in the future year without the implementation of the scheme, taking account of trends (for example in population and employment growth) and relevant developments (such as other committed transport schemes). The reference case is frequently used as a comparator for the 'with scheme' case, to show the effect of the scheme against the appropriate reference point.
Reference Design	Design proposals that the consultation and DCO application will refer to.
Roman period	AD 43 to AD 410.
Secant Piles	Piles are vertical structural elements of deep foundations. Secant pile walls are formed by constructing intersecting reinforced concrete piles. The secant piles are reinforced with either steel rebar or with steel beams and are constructed by either drilling under mud or auguring. Primary piles are installed first with secondary piles constructed in between primary piles once the latter gain sufficient strength
Semi-improved grassland	Grasslands can be classified in terms of their 'improvement' by natural or artificial nutrients such as manure or agricultural fertilisers. Grasslands with high levels of nitrification, such as pasture, tend to have low species-diversity and are referred to as improved.
Semi-natural habitat	Generally considered to be any naturally occurring vegetative habitat that has been affected by human actions, and includes most, if not all, habitats in the UK
Sensitive receptor (SR)	Receptors which are potentially sensitive to noise and vibration. Examples include dwellings, hospitals, schools, community facilities, designated areas (e.g. AONB, National Park, SAC, SPA, SSSI, SAM), and public rights of way.
Service Building, Tunnel Service Building, Portal Building	The building housing all control, power supply, and other essential equipment for the operation of the tunnel. Also houses firefighting control and ventilation equipment. Serves as a maintenance base and has the facility to become a standby operations room.
Sheet Pile	Sheet piles can be a temporary or permanent earth retention solution, providing support and reducing groundwater ingress. Steel sheets are driven into the ground, interlocking with neighbouring piles in order to create a continuous wall.
Significant Effects	It is a requirement of the EIA Regulations to determine the likely significant effects of the development on the environment which should relate to the level of an effect and the type of effect. Where possible significant effects should

	be mitigated. The significance of an effect gives an indication as to the degree of importance (based on the magnitude of the impact and the sensitivity of the receptor) that should be attached to the impact described. Whether or not an effect should be considered significant is not absolute and requires the application of professional judgement. Significant – 'noteworthy, of considerable amount or effect or importance, not insignificant or negligible'.
Silt	The generic term for particles with a grain size of 4-63mm, i.e. between clay and sand.
Site Waste Management Plan (SWMP)	A document that outlines how the Scheme will reduce, manage, and dispose of its solid waste.
Slurry Shield (SS) Tunnel Boring Machine	A type of tunnel boring machine used in soft ground with very high water pressure or where ground conditions are granular (sands and gravels) such that a plug cannot be formed in the removal Archimedes screw. The cutter head is filled with pressurised slurry which applies hydrostatic pressure to the excavation face. The slurry also acts as a transport medium by mixing with the excavated material before being pumped out of the cutter head back to a slurry separation plant
Solid (bedrock) geology	Consolidated material that underlies superficial geology; bedrock
Source	A source is a contaminant or industrial activity which produces a contaminant which is likely to cause harm to people or the environment.
Source Protection Zone	An Environment Agency designation to identify and protect groundwater supplies. There are 3 zones – Inner (defined as the 50 day travel time from any point below the water table to the source), Outer (defined by a 400 day travel time from a point below the water table) and Source Catchment (defined as the area around a source within which all groundwater recharge is presumed to be discharged at that source)
Spoil	The material excavated by the Tunnel Boring Machine during the construction of the tunnel.
Strata	A layer of rock or soil.

SuDS	Sustainable Drainage Systems (SuDS) are water management solutions designed to reduce the impact of surface water runoff from new and existing developments to the natural environment. The purpose of such systems is to improve water quality and store or reuse surface runoff to reduce the discharge rate to the watercourse.
Superficial geology	Unconsolidated material, usually recent, occurring at the Earth's surface (as distinct from solid geology)
Surface Water	Water that appears on the land surface that has not seeped into the ground, i.e. lakes, rivers, streams, standing water, ponds, precipitation.
Target Note	A target note is a method of showing the location of an ecologically significant feature, for example a badger sett, on a Phase 1 habitat map.
Tension Piles	Piles are vertical structural elements of deep foundations. Tension piles used to resist uplift/pull-out loads
The O2	A large entertainment complex on the Greenwich peninsular, including an indoor arena, cinema, bars and restaurants. It is built largely within the former Millennium Dome
The Scheme	The construction of a new bored tunnel under the River Thames between the Greenwich peninsula and Silvertown, as well as necessary alterations to the connecting road network and the introduction of user charging at both Silvertown and Blackwall tunnels
The Tunnel, Silvertown Tunnel	A new bored tunnel under the River Thames between the Greenwich peninsula and Silvertown
Total Petroleum Hydrocarbon (TPH) TPH Criteria Working Group	Total petroleum hydrocarbon is a term used for any mixture of hydrocarbons that are found in crude oil. TPH criteria working group (CWG) is an analytical method to screen the criteria of carbon chains grouped into 13 fractions.
Toucan Crossing	A signal controlled crossing that allows pedestrians and cyclists to cross a road safely.
Transport for London (TfL)	A local government body responsible for most aspects of the transport system in Greater London. Its role is to implement transport strategy and to manage transport services across London. These services include: buses, the Underground network, Docklands Light Railway, Overground and Trams. TfL also runs Santander Cycles, London River Services, Victoria

	Coach Station and the Emirates Air Line. As well as controlling a 580km network of main roads and the city's 6,000 traffic lights, TfL regulates London's private hire vehicles and the Congestion Charge scheme.
Tunnel Boring Machine (TBM)	A machine used to excavate tunnels with a circular cross section. There are two main types of closed face TBMs: Earth Pressure Balance (EPB) and Slurry Shield (SS). Please see those terms for further explanation
Unexploded Ordnance	Unexploded ordnance are explosive weapons (bombs, shells, grenades, land mines, naval mines, etc.) that did not explode when they were employed and still pose a risk of detonation, potentially many decades after they were used or discarded.
Ventilation Building	Surface level structure housing ventilation equipment, fans and an exhaust shaft, used to move fresh air underground by drawing air from the tunnel and venting it to the atmosphere. Located adjacent to and integral with the Service Buildings.
VOCs	Volatile organic compounds (VOCs) are organic chemicals that have a high vapour pressure at ordinary room temperature Some VOCs are dangerous to human health or cause harm to the environment.
Waste	Waste is defined in Article 1(a) of the European Waste Framework Directive 2008/98/EC (Ref 13-3) as ‘any substance or object in the categories set out in Annex I which the holder discards or intends to discard or is required to discard’. The term ‘holder’ is defined as the producer of the waste or the person who is in possession of it and ‘producer’ is defined as anyone whose activities produce waste. Waste can be further classified as hazardous, non-hazardous or inert.
Watching brief	The watching of a situation by a suitably qualified person to ensure that works (e.g. an excavation) are being done correctly.
Water Screening Values (WSVs)	Water Screening Values assess the chronic human health exposure from inhalation of vapours from contaminants within shallow groundwater or perched water.
WHO	World Health Organisation
World Heritage Site	Places of 'outstanding universal value' selected by the United Nations Educational, Scientific and Cultural Organisation. Sites can be selected because they contain important cultural or natural features.

Zone of Visual Influence (ZVI)	The approximate area from which the operational Scheme is anticipated to be visible.

References

Ref 1-1 Design Manual of Roads and Bridges (DMRB)

Ref 1-2 TfL River Crossings programme – Silvertown Tunnel, Responses to issues raised report, Consultation Oct-Dec 2014, Transport for London (Jun 2015) https://consultations.tfl.gov.uk/roads/river-crossings/user_uploads/east-of-silvertown-responses-to-issues-raised.pdf

Ref 2-1 Greenwich Peninsula Master Plan, 2004

Ref 3-1 Silvertown tunnel Preliminary Case for the Scheme, TfL (October 2015)

Ref 3-2 Silvertown Crossing Study Tunnel Engineering, Mott MacDonald (Jun 2012)

Ref 3-3 East London River Crossings Assessment of Options, Transport for London (Dec 2012)

Ref 3-4 Summary and Comparison of Tunnel Options, Transport for London (Dec 2013)

Ref 3-5 TfL River Crossings programme – Silvertown Tunnel, Responses to issues raised report, Consultation Oct-Dec 2014, Transport for London (Jun 2015) https://consultations.tfl.gov.uk/roads/river-crossings/user_uploads/east-of-silvertown-responses-to-issues-raised.pdf

Ref 4-1 Advice note nine: Rochdale Envelope, The Planning Inspectorate. 2011.

Ref 4-2 National Joint Utilities Group (NJUG) guidelines. http://www.njug.org.uk/publications/

Ref 5-1 Volume 11 of Design Manual of Roads and Bridges (DMRB) guidance on the EIA methodologies for highway projects and Volume 10 environmental design guidance.

Ref 6-1 IAN 185/15 Updated traffic, air quality and noise advice on the assessment of link speeds and generation of vehicle data into ‘speed-bands’ for users of DMRB Volume 11, Section 3, Part 1 ‘Air Quality and Volume 11, Section 3. Part 7 Noise, 2015

Ref 6-2 The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, Department for the Environment, Food and Rural Affairs (Defra), 2007

Ref 6-3 Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe, Council of European Communities, 2008

Ref 6-4 Consultation on draft plans to improve air quality, Tackling nitrogen dioxide in our towns and cities, UK overview document, Department for the Environment, Food and Rural Affairs (Defra), 2015

Ref 6-5 Easter Ter [2015] UKSC 28, JUDGMENT R (on the application of ClientEarth) (Appellant) v Secretary of State for the Environment, Food and Rural Affairs (Respondent). The Supreme Court, 2015

Ref 6-6 HA207/07 Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 1, The Highways Agency, 2007

Ref 6-7 IAN 175/13 Updated advice on risk assessment related to compliance with the EU Directive on ambient air quality and on the production of Scheme Air Quality Action Plans for users of DMRB Volume 11, Section 3, Part 1 Air Quality (HA207/07), Highways Agency, 2013

Ref 6-8 Part IV of the Environment Act, 1995

Ref 6-9 Statutory Instruments No. 1001, the Air Quality Standards Regulations 2010, The Stationery Office Ltd, 2010

Ref 6-10 Statutory Instruments No. 928, the Air Quality (England) Regulations 2000, The Stationery Office Ltd, 2000

Ref 6-11 Planning Act 2008, Chapter 29, The Stationery Office Ltd, 2008.

Ref 6-12 National Policy Statement for National Networks, Department for Transport, 2014

Ref 6-13 IAN 174/13 Updated advice for evaluating significant local air quality effects for users of DMRB Volume 11, Section 3, Part 1 Air Quality (HA207/07), Highway Agency, 2013

Ref 6-14 The National Planning Policy Framework, Department for Communities and Local Government, 2012

Ref 6-15 The National Planning Practice Guidance – Air Quality, Department for Communities and Local Government, 2014

Ref 6-16 Clearing the Air: The Mayor’s Air Quality Strategy, Greater London Authority, Greater London Authority, 2010

Ref 6-17 Guidance on the assessment of dust from demolition and construction, Institute of Air Quality Management (IAQM), 2014

Ref 6-18 GLA 80371 Air Quality Neutral Planning Support, Air Quality Consultants Ltd, 2013

Ref 6-19 The London Plan Spatial Development Strategy for London, consolidated with alterations since 2011, Mayor of London, 2015.

Ref 6-20 The Control of Dust and Emissions during Construction and Demolition Supplementary Planning Guidance, Mayor of London, 2015

Ref 6-21 Sustainable Design and Construction SPG, Mayor of London, 2014

Ref 6-22 Air Pollution Information System, online at [http://www.apis.ac.uk]

Ref 6-23 Transport Analysis Guidance (TAG) Unit A3, Environmental Impact Appraisal, Department for Transport, 2014

Ref 6-24 London Atmospheric Emissions Inventory 2010, http://data.london.gov.uk/dataset/london-atmospheric-emissions-inventory-2010, 2015

Ref 6-25 IAN 170/12v3 Updated air quality advice on the assessment of future NO_x and NO_2 projections for users of DMRB Volume 11, Section 3, Part 1 'Air Quality, 2012

Ref 6-26 Local Air Quality Management Technical Guidance LAQM.TG(09), Department for the Environment, Food and Rural Affairs (Defra), 2009

Ref 6-27 Trend in NO_x and NO_2 emissions and ambient measurements in the UK, Department for the Environment, Food and Rural Affairs (Defra), 2011

Ref 6-28 Statement on the evidence for the effects of nitrogen dioxide on health, Committee of on the Medical Effects of Air Pollutants (Public Health England), 2015

Ref 6-29 The Mortality Effects of Long-Term Exposure to Particulate Air Pollution in the United Kingdom, Committee of on the Medical Effects of Air Pollutants (Public Health England), 2010

Ref 6-30 Google Maps, online at [https://maps.google.co.uk]

Ref 6-31 Multi-Agency Geographic Information for the Countryside, online at [www.magic.gov.uk]

Ref 6-32 Defra UK Air website, online at [http://uk-air.defra.gov.uk]

Ref 6-33 London Air Quality Network, online at [http://www.londonair.org.uk]

Ref 6-34 Greater London website, online at [http://data.london.gov.uk/datastore]

Ref 6-35 Kent Air website, online at [http://www.kentair.org.uk]

Ref 6-36 Essex Air website, online at [http://www.essexair.org.uk]

Ref 6-37 No to Silvertown Tunnel website, online at [http://www.silvertowntunnel.co.uk/our-study]

Ref 6-38 EU Directive 97/68/EC of the European Parliament and of the Council, 1997

Ref 7-1 National Road and Rail Networks National Policy Statement (NN NPS), December 2014

Ref 7-2 National Planning Policy Framework

Ref 7-3 Planning Practice guide, 2014

Ref 7-4 London Plan 2015

Ref 7-5 Economic Development Strategy, GLA, May 2010

Ref 7-6 Strategic Regeneration Framework, GLA 2011

Ref 7-7 Greenwich Core Strategy

Ref 7-8 Newham Core Strategy (adopted January 2012)

Ref 7-9 Tower Hamlets Core Strategy (adopted 2010)

Ref 7-10 Greenwich Peninsula West Masterplan Supplementary Planning Document, April 2012

Ref 7-11 Design Manual for Roads and Bridges (DMRB) Guidance (Volume 11, Section 3, Parts 3, 6, 8, 9 and 12)

Ref 7-12 Preliminary Outline Case for the Scheme, TfL, October 2015

Ref 7-13 Preliminary Regeneration Report, TfL, October 2015

Ref 7-14 Additionally Guide, Fourth edition, Homes and Communities Agency 2014

Ref 7-15 Navigational Risk Assessment, TfL, October 2015

Ref 7-16 Introductory Environmental Report, TfL 2014

Ref 7-17 Silvertown Tunnel Business Survey 2013-2015, WSP 2015

Ref 7-18 GLA Borough Level Population and Employment Growth Projections, 2011

Ref 7-19 Annual Population Survey 2014

Ref 7-20 Local Economic Assessment 2010-2027, London Borough of Newham, October 2010

Ref 7-21 Indices of Deprivation 2010, Department for Communities and Local Government

Ref 7-22 ONS Business Demography 2013

Ref 7-23 Distributional Impact Appraisal within the Preliminary Outline Case for the Scheme, TfL, October 2015

Ref 7-24 London Travel Demand Survey 2012/2013

Ref 7-25 Regeneration Report, Steer Davies Gleave 2010

Ref 7-26 Safeguarded Wharves Review, Mayor of London, March 2013

Ref 7-27 London's Economy Today, GLA, June 2015

Ref 7-28 Working Paper 53 'Tourism in London', 2012

Ref 7-29 GLA Borough Level Population Projections, December 2011

Ref 7-30 Preliminary Transport Assessment, TfL, October 2015

Ref 7-31 GLA Borough Level Employment Growth Projections, December 2011

Ref 7-32 Silvertown Tunnel Reference Design Settlement Report, Atkins. April 2014

Ref 7-33 Interface Issues with Greenwich Peninsula Developers, Atkins, 2015

Ref 7-34 Socio-Economic Technical Report, Crossrail

Ref 7-35 Eurest Lunchtime Report, 2008

Ref 7-36 Social Impacts Assessment, Jacobs 2015

Ref 8-1 National Planning Policy Framework, Department for Communities and Local Government, 2012

Ref 8-2 Royal Greenwich Local Plan: Core Strategy with Detailed Policies, Royal Borough of Greenwich, 2014

Ref 8-3 Newham 2027: Newham's Local Plan – The Core Strategy, Borough of Newham, 2012

Ref 8-4 Core Strategy 2025: Development Plan Document, Borough of Tower Hamlets, 2010

Ref 8-5 Design Manual for Roads and Bridges, Highways Agency, 2008

Ref 8-6 Standard and guidance for historic environment desk-based assessment, Chartered Institute for Archaeologists, 2014

Ref 8-7 Conservation Principles, English Heritage, 2008

Ref 8-8 The Setting of Heritage Assets, English Heritage, 2011

Ref 9-1 Eaton MA, Brown AF, Noble DG, Musgrove AJ, Hearn R, Aebischer NJ, Gibbons DW, Evans A and Gregory RD (2009) Birds of Conservation Concern 3: the population status of birds in the United Kingdom, Channel Islands and the Isle of Man. British Birds 102, pp296–341.

Ref 9-2 Shirt, D.B. (ed.), 1987, British Red Data Books: 2. Insects. NCC

Ref 9-3 Guidelines on Ecological Impact Assessment in the United Kingdom, CIEEM, 2006

Ref 9-4 Reptile Survey Methods, English Nature Science Series 27, 1996

Ref 9-5 Bat Conservation Trust (BCT) guidelines

Ref 9-6 DMRB Volume 11 Section 2, Part 5, Volume 11 Section 3 Part 4 (Highways Agency, 1993)

Ref 9-7 Interim Advice Note 130/10 (Highways Agency, 2010)

Ref 9-8 Ratcliffe, D.A. (Ed). 1977. A Nature Conservation Review. 2 vols. Cambridge University Press.

Ref 9-9 Birds of Conservation Concern, 2009

Ref 9-10 NCC Handbook for Phase 1 Survey

Ref 9-11 United Kingdom Climate Projections (UKCP09), Met Office [Online]. Available at: http://ukclimateprojections.metoffice.gov.uk/

Ref 9-12 British Standard 5837: 2012 Trees in relation to design, demolition and construction – Recommendations, BSI, 2012

Ref 10-1 Greater London Authority/London Biodiversity Partnership, 2007. London Biodiversity Action Plan - Priority Species.

Ref 10-2 Institute of Ecology and Environmental Management (IEEM), 2006. Guidelines for Ecological Impact Assessment in the UK.

Ref 10-3 Institute of Ecology and Environmental Management (IEEM), 2010. Guidelines for Ecological Impact Assessment in Britain and Ireland Marine and Coastal.

Ref 10-4 Marine Management Organisation, 2013. Marine conservation zones and marine licensing. Marine Management Organisation.

Ref 10-5 Wileman, T. and Davies, P.S., 2013. Review of Sites of Importance for Nature Conservation (SINCs) in the London Borough of Bexley. London Wildlife Trust. http://www.bexley.gov.uk/CHttpHandler.ashx?id=13118&p=0. Accessed: 19th August 2015.

Ref 10-6 ABPmer, 2013. Hub for London, Ecology Desk Study Part B: Marine and Coastal Baseline. Report No. Report R.2130. August 2013.

Ref 10-7 ABPmer, 2006. Environmental Baseline for TE2100.ABP Marine Environmental Research Ltd, Project File, September 2006.

Ref 10-8 ABPmer, 2007b. Greater Thames CHaMP Scoping Document. ABP Marine Environmental Research Ltd, Report No. R.1281. February 2007.

Ref 10-9 Mott MacDonald. 2006. Crossrail Instone Wharf Intertidal Studies.

Ref 10-10 Mott MacDonald. 2010. London Cable Car. Environmental Statement Volume 1: Main Report.

Ref 10-11 Marine Ecological Surveys Ltd., 2009. Enderby Wharf Benthic Biological Resource Assessment. Analysis of Survey Data for 2009. Prepared for West Properties UK Ltd.

Ref 10-12 Attrill, M.J., 2002. A testable linear model for diversity trends in estuaries. J Animal Ecol 71(2): 262-269.

Ref 10-13 Global Renewable Energy Partners (GREP), 2002. Kentish Flats Environmental Statement.

Ref 10-14 ABPmer, 2008a. Saltmarsh Characterisation in the Thames Estuary. ABP Marine Environmental Research Ltd, Report No. R.1436. August 2008.

Ref 10-15 ABPmer, 2008b. Intertidal Emergence in the Thames Estuary. ABP Marine Environmental Research Ltd, Report No. R.1443. November 2008.

Ref 10-16 Environment Agency, 2012. Benthic data collected as part of Environment Agency routine sampling.

Ref 10-17 Mott MacDonald. 2011. Thames River Crossings Marine Benthic Survey, November 2011, Transport for London.

Ref 10-18 Ballerstedt. 2006. Electra crustulenta. A sea mat. Marine Life Information Network: Biology and Sensitivity Key Information Sub-programme. Plymouth: Marine Biological Association of the United Kingdom. Available [Online] http://www.marlin.ac.uk/speciesinformation.php?speciesID=3245. Accessed 28/08/2015

Ref 10-19 ZSL, 2013. Invasive Species in the Thames. http://www.zsl.org/conservation/regions/uk-europe/thames-estuary/invasive-species-in-the-thames,933,AR.html. Accessed: 20th May 2013.

Ref 10-20 Gilbey, V., Attrill, M.J., and Coleman., R.A., 2008. Juvenile Chinese mitten crabs (Eriocheir sinensis) in the Thames estuary: distribution, movement and possible interactions with the native crab Carcinus maenas. Biological Invasions 10: 67-77.

Ref 10-21 Zieritz, A., 2011a. Zebra Mussel, Dreissena polymorpha. http://www.nonnativespecies.org/factsheet/downloadFactsheet.cfm?speciesId=1250 Accessed: 17th August 2015.

Ref 10-22 Pacific Northwest National Laboratory (PNNL). 2003. The Asiatic Clam, Corbicula fluminea . Richland, Washington: PNNL Ecology Group.

Ref 10-23 Zieritz, A., 2011b. Asiatic Clam, Corbicula fluminea. http://www.nonnativespecies.org/factsheet/downloadFactsheet.cfm?speciesId=897 Accessed: 17th August 2015.

Ref 10-24 Tyler-Walters, H., 2011. Slipper Limpet, Crepidula fornicata. http://www.nonnativespecies.org/factsheet/downloadFactsheet.cfm?speciesId=1028. Accessed: 17th August 2015.

Ref 10-25 Marine Life Information Network (MarLIN), 2008. Crepidula fornicata. Slipper limpet. Marine Life Information Network: Biology and Sensitivity Key Information Sub-programme [on-line]. Plymouth: Marine Biological Association of the United Kingdom. http://www.marlin.ac.uk/speciesinformation.php?speciesID=3086. Accessed: 17th August 2015.

Ref 10-26 Lengyel, N.L., Collie, J.S., and Valentine, P.C., 2009. The invasive colonial ascidian Didemnum vexillum on Georges Bank – Ecological effects and genetic identification. Aquatic Invasions 4: 143-152.

Ref 10-27 Bullard, S. G., Lambert, G., Carman, M. R. et. al., 2007. The colonial ascidian Didemnum sp. A: Current distribution, basic biology and potential threat to marine communities of the northeast and west coasts of North America. Journal of Experimental Marine Biology and Ecology 342: 99-108.

Ref 10-28 Centre for Environment, Fisheries and Aquaculture Science (Cefas), 2012. Modelling the risk of the introduction and spread of non-indigenous species in the UK and Ireland. Project report for E5405W. October 2012.

Ref 10-29 The European Network on Invasive Alien Species (NOBANIS), 2011. Invasive Alien Fact Sheet – Crassostrea gigas

Ref 10-30 Fofonoff, P.W., Ruiz, G.M., Steves, B., & Carlton, J.T. 2003. National Exotic Marine and Estuarine Species Information System. http://invasions.si.edu/nemesis/. Accessed: 11th August 2015.

Ref 10-31 Zieritz, A., 2012. Jenkins' Spire Snail, New Zealand Mudsnail, Potamopyrgus antipodarum. http://www.nonnativespecies.org/factsheet/downloadFactsheet.cfm?speciesId=2811 Accessed: 17th August 2015.

Ref 10-32 National Biodiversity Network. Interactive Map Tool. https://data.nbn.org.uk/imt/#4-0.235,51.385,0.314,51.614, Accessed: 17th August 2015.

Ref 10-33 FishBase, www.fishbase.org. Accessed: 17th August 2015.

Ref 10-34 Environmental Resources Management (ERM), 2010. Marine Aggregate Regional Environmental Assessment of the Outer Thames Estuary: A report to the Thames Estuary Dredging Association.

Ref 10-35 Coull, K.A., Johnstone, R., and Rogers, S.I., 1998. Fisheries Sensitivity Maps in British Waters. Published and distributed by UKOOA Ltd.

Ref 10-36 Ellis, J.R., Milligan, S.P., Readdy, L., Taylor, N. and Brown, M.J. 2012. Spawning and nursery grounds of selected fish species in UK waters. Sci. Ser. Tech. Rep., Cefas Lowestoft, 147: 56 pp.

Ref 10-37 ABPmer, 2007a. Benthic Ecology of the Thames Estuary. ABP Marine Environmental Research Ltd, Report No. R.1381. November 2007.

Ref 10-38 Vattenfall, 2011. Kentish Flats Offshore Wind Farm Extension Environmental Statement.

Ref 10-39 Environment Agency, 2015. Fish data collected as part of Environment Agency routine sampling.

Ref 10-40 Potts, G.W., and Swaby, S.E., 1993. Review of the status of Estuarine Fishes. No. 34 English Nature Research Reports. Peterborough.

Ref 10-41 Elliott, M., Whitfield, A.K., Potter, I.C., Blaber, S.J.M., Cyrus, D.P., Nordlie, F.G., and Harrison, T.D., 2007. The guild approach to categorizing estuarine fish assemblages: a global review. Fish and Fisheries 8 (3): 241.

Ref 10-42 Joint Nature Conservation Committee (JNCC), 2011. Conservation Designations for UK Taxa. http://www.jncc.gov.uk/page-3408. Accessed: 29th May 2013.

Ref 10-43 Crossrail, 2006. Limmo Peninsula Fish Surveys 2005/2006.

Ref 10-44 Department of Energy and Climate Change (DECC), 2009. UK Offshore Energy Strategic Environmental Assessment: Future Leasing for Offshore Wind Farms and Licensing for Offshore Oil and Gas and Gas Storage Environmental Report. DECC, London, 339p (excl. appendices).

Ref 10-45 Maitland, P.S. and Hatton-Ellis, T.W., 2003. Ecology of the Allis and Twaite Shad. Conserving Natura 2000 Rivers Ecology Series No. 3. English Nature, Peterborough.

Ref 10-46 Maitland, P.S., 2003. Ecology of the River, Brook and Sea Lamprey. Conserving Natura 2000 Rivers Ecology Series No. 5. English Nature, Peterborough.

Ref 10-47 Malcolm, I. A., Godfrey, J., and Youngson, A.F., 2010. Review of migratory routes and behaviour of Atlantic salmon, sea trout and European eel in Scotland’s coastal environment: implications for the development of marine renewables. Scottish Marine and Freshwater Science 1 (14).

Ref 10-48 Environment Agency. 2010. The European Eel Anguilla anguilla (L.) and Marine Conservation Zones. Environmental Agency.

Ref 10-49 SCANS-II, 2008 Small Cetacean Abundance in the European Atlantic and North Sea programmes (SCANS and SCANS-II):

Ref 10-50 Reid, J.B., Evans, P.G.H., and Northridge, S.P., 2003. Atlas of Cetacean distribution in north-west European waters. JNCC, Peterborough, 76p.

Ref 10-51 Special Committee On Seals (SCOS). 2015. Scientific advice on matters related to the management of seal populations: 2014. Special Committee on Seals.

Ref 10-52 Kowalik, R., Pryor, A., Causon, P., and Shaw, A., 2008. Thames Marine Mammal Sightings Survey July 2004 – June 2007. Zoological Society of London.

Ref 10-53 ZSL, 2015a. Thames Marine Mammal Survey: Public Sightings. http://sites.zsl.org/inthethames/#Public sightings. Accessed: 1st July 2015.

Ref 10-54 ZSL, 2015b. Greater Thames Estuary Seal Surveys Report.

Ref 10-55 ZSL, 2014. Thames harbour seal conservation project.

Ref 10-56 Sharples, R.J., Matthiopoulos, J., Hammond, P.S., 2008. Distribution and movements of Harbour seals around the coast of Britain. Report to the Department of Energy and Climate Change (DECC). Sea Mammal Research Unit, St Andrews, UK, 65pp.

Ref 10-57 Rural Planning Service (RPS) Energy, 2006. Underwater Noise Impact Assessment on Marine Mammals and Fish during Pile Driving of Proposed Round 2 Offshore Windfarms in the Thames Estuary. For CORE Limited, on behalf of London Array Limited, Greater Gabbard Offshore Winds Limited and Thanet OffshoreWinds Limited.

Ref 10-58 Jones, L.A., Coyle, M.D., Evans, D., Gilliland, P.M., Murray, A.R., 2004. Southern North Sea Marine Natural Area Profile: A contribution to regional planning and management of the seas around England. English Nature, Peterborough, 103p.

Ref 10-59 Sea Watch Foundation, 2006a. Cetaceans of Eastern England.

Ref 10-60 Sea Watch Foundation, 2006b. Marine mammals in the English Channel in relation to proposed dredging scheme.

Ref 10-61 Thompson, P.M., McConnell, B.J., Tollit, D.J., Mackay, A., Hunter, C., and Racey P.A.,1996. Comparative distribution, movements and diet of harbour and grey seals from the Moray Firth, NE Scotland. Journal of Applied Ecology 33: 1572-1584.

Ref 10-62 Pierpoint, C., 2008. Harbour porpoise (Phocoena phocoena) foraging strategy at a high energy, near-shore site in south-west Wales, UK. Journal of the Marine Biological Association of the United Kingdom 88 (6): 1167-1173.

Ref 10-63 Santos, M.B., Pierce, G.J., Learmonth, J.A., Reid, R.J., Ross, H.M., Patterson, I.A.P., Reid, D.G., and Beare, D., 2004. Variability in the diet of harbour porpoises (Phocoena phocoena) in Scottish waters 1992 – 2003. Marine Mammal Science, 20, 1-27.

Ref 10-64 Marubini, F., Gimona, A., Evans, P.G.H., Wright, P.J., and Pierce, G.J. 2009. Habitat preferences and interannual variability in occurrence of the harbour porpoise Phocoena phocoena in the north-west of Scotland. Marine Ecology Progress Series 381: 297-310.

Ref 10-65 MacLeod, C.D., Santos, M.B., Reid, R.J., Scott, B.E., and Pierce G.J., 2007. Linking sandeel consumption and the likelihood of starvation in harbour porpoises in the Scottish North Sea: could climate change mean more starving porpoises? Biology Letters 3: 185-188.

Ref 10-66 Parvin, S.J., Nedwell, J.R., Kynoch, J., Lovell, J., and Brooker, A.G., 2008. Assessment of underwater noise from dredging operations on the Hastings shingle bank. Report No. Subacoustech 758 R 0137.

Ref 10-67 Miller, D.C., Muir, C.L., and Hauser, O.A., 2002. Detrimental effects of sedimentation on marine benthos: what can be learned from natural processes and rates? Ecological Engineering 19: 211-232.

Ref 10-68 Chapman, A.S. and Fletcher, R.L., 2002. Differential effects of sediments on survival and growth of Fucus serratus embryos (Fucales, Phaeophyceae). Journal of Phycology 38: 894–903.

Ref 10-69 Elliott, M., Nedwell, S., Jones, N.V., Read, S.J., Cutts, N.D. and Hemingway, K.L. 1998. Intertidal sand and mudflats and subtidal mobile sandbank (Volume II). An overview of dynamics and sensitivity characteristics for conservation management of marine SACs. Scottish Association of Marine Science (UK Marine SACs Project) 151pp.

Ref 10-70 International Union for Conservation of Nature (IUCN). 2011. Invasive Species. http://www.iucn.org/about/union/secretariat/offices/iucnmed/iucn_med_programme/species/invasive_species. Accessed: 19th August 2015.

Ref 10-71 Carlton, J.T. and Geller, J.B., 1993. Ecological roulette: the global transport of nonindigenous marine organisms. Science 261: 78-82.

Ref 10-72 Hastings, M. C. and Popper, A. N., 2005. Effects of sound on fish. California Department of Transportation. Division of Research and Ination Office Materials and Infrastructure.

Ref 10-73 FHWG, 2008. Memorandum: Agreement in Principle for Interim Criteria for Injury to Fish from Pile Driving Activities.

Ref 10-74 Nedwell, J.R., Turnpenny, A.W.H., Lovell, J., Parvin, S.J., Workman, R., Spinks, J.A.L., and Howell, D., 2007. A validation of the dBht as a measure of the behavioural and auditory effects of underwater noise. Subacoustech Report No. 534R1231.

Ref 10-75 Britwell, I. K., 2000. Effects of sediment on fish and their habitat, DFO Pacific Region, Habitat status report 2000/01 E, Canada.

Ref 10-76 FARL, 1995. Possible impacts of dredging on salmonids. Research Note for ABP Research & Consultancy Ltd. Fawley Aquatic Research Laboratories Ltd.

Ref 10-77 Tillin, H.M., Houghton, A.J., Saunders, J.E., Drabble, R. and Hull, S.C., 2011. Direct and Indirect Impacts of Aggregate Dredging. Marine Aggregate Levy Sustainability Fund (MALSF). Science Monography Series: No.1.

Ref 10-78 Lees, P.G., Kenny, A., and Pearson, R., 1992. The condition of benthic fauna in suction dredger outwash: initial findings. Annex submitted to the report of the ICES working group on the effects of extraction of marine sediments on fisheries.

Ref 10-79 Brandt, M.J., Diederichs, A., Betke, K., and Nehls, G., 2011. Responses of harbour porpoises to pile driving at the Horns Rev II offshore wind farm in the Danish North Sea (2011). Marine Ecology Progress Series 421: 205–16.

Ref 10-80 Southall, B.L., Bowles, A.E., Ellison, W.T., Finneran, J.J., Gentry, R.L., Greene Jr, C.R., Kastak, D., Miller, J.H., Nachigall, P.E., Richardson, W.J., Thomas, J.A., and Tyack, P.L., 2007. Marine mammal noise exposure criteria: initial scientific recommendations. Aquatic Mammals 33:411–521.

Ref 10-81 Wyn, G, Brazier, D P and McMath, A J.,2000. CCW handbook for marine intertidal Phase 1 survey and mapping.CCW Marine Sciences Report: 00/06/01.

Ref 10-82 Wyn, G, Cooke, A, Sanderson, W G and Brazier, D P., 2000. The application of marine intertidal Phase 1 survey techniques to monitoring. In: Sanderson, W G, Holt, R H F, Kay, L, McMath, A J and Wyn, G (2000).The establishment of an appropriate programme of monitoring for the condition of SAC features on Pen Llyn a’r Sarnau: 1998–99 trials. CCW Report No. 03/80/99.

Ref 12-1 UK Government (1990) Environmental Protection Act.

Ref 12-2 Department for Transport: (2014), National Road and Rail Networks: National Policy Statement (NN NPS).

Ref 12-3 Communities and Local Government: (2012), National Planning Policy Framework.

Ref 12-4 Department for Communities Local Government (2014), Planning Practice Guidance.

Ref 12-5 UK Government (2011) The Waste Management (England and Wales) Regulations 2011.

Ref 12-6 UK Government (1991) Water Resources Act.

Ref 12-7 Environment Agency (2004) Model Procedures for the Management of Land Contamination (Contaminated Land Report 11) European Parliament (2003).

Ref 12-8 Environment Agency (2010), Guiding Principles for Land Contamination.

Ref 12-9 Environment Agency (2013), Groundwater Protection: Principles and Practice (GP3).

Ref 12-10 European Commission (2000), Water Framework Directive (WFD).

Ref 12-11 Welsh Government (2010), March 2013, The Environmental Permitting (England and Wales) Regulations.

Ref 12-12 CL:AIRE (2014) Definition of Waste Development Industry Code of Practice.

Ref 12-13 Environment Agency (2014) Pollution Prevention Guidance Notes.

Ref 12-14 Health and Safety Executive (2002), Control Substances Hazardous to Health.

Ref 12-15 Greater London Authority (2011), The London Plan.

Ref 12-16 Newham Council (2014), Local Plan.

Ref 12-17 Royal Borough of Greenwich (2014), Local Plan.

Ref 12-18 Royal Borough of Greenwich (2013), Greenwich Peninsula Environmental Method Statement (EMS).

Ref 12-19 UK Government (2003), Water Act.

Ref 12-20 Hyder Consulting Ltd (2014), Silvertown Tunnel, Environmental Impact Assessment Scoping Report.

Ref 12-21 Mott MacDonald (2013) TfL River Crossings – Ground Investigation Desk Study, Preliminary Sources Study Report.

Ref 12-22 Atkins (2015) Silvertown Tunnel Ground Investigation Report.

Ref 12-23 Mott MacDonald (2013) TfL River Crossings – Phase 1 Contamination Assessment, Silvertown to Greenwich Peninsula. (Envirocheck Report reproduced as Appendix 10A).

Ref 12-24 Landmark Information Group (2014) Historical Maps and Environmental Data Pack

Ref 12-25 Ove Arup and Partners Ltd: (2007), Greenwich Peninsula Remediation Strategy Framework Report, Ref AEC-SITEWIDE.

Ref 12-26 Landmark Information Group (2015) Environment Data Sheets.

Ref 12-27 British Geological Survey: (2014), Geological logs via GeoRecords web portal.

Ref 12-28 Environment Agency (2015) https://www.gov.uk/government/organisations/environment-agency.

Ref 12-29 British Geological Survey (1996) London and the Thames Valley

Ref 12-30 British Geological Survey (2004) “Geology of London: Special Memoir for 1:50,000 Geological Sheets 256 (North London), 257 (Romford), 270 (South London) and 271 (Dartford) (England and Wales).

Ref 12-31 British Geological Survey (1981) England and Wales Sheet 256 North of London Solid and Drift Geology. 1:50,000 scale map.

Ref 12-32 British Geological Survey (1981) England and Wales Sheet 270 South London Solid and Drift Geology, 1:50,000 scale map.

Ref 12-33 British Geological Survey (1998) England and Wales Sheet 271 Dartford Solid and Drift Geology. 1998. 1:50,000 scale map.

Ref 13-34 National Soil Resources Institute, Land Information System: (2014), Soilscapes website.

Ref 13-35 British Geological Survey: (BGS), website (2014) Lexicon Service.

Ref 13-36 British Geological Survey: (BGS), website (2014) Digital map viewer.

Ref 12-37 British Geology Survey: (2014), Aggregate Safeguarding Maps.

Ref 12-38 Mott MacDonald: (October 2010), London Cable Car Environmental Statement.

Ref 12-39 Atkins: (April 2014), Silvertown Tunnel Reference Design Settlement Report.

Ref 12-40 Highways Agency (2009) Design Manual for Roads and Bridges Volume 11

Ref 12-41 Town and Country Planning (Environmental Impact Assessment (EIA)) (England and Wales) Regulations 1999 (SI 1999 No 293) (as amended)).

Ref 12-42 The Environment Agency Website (2015) “What’s in my backyard”

Ref 12-43 CIRIA C681 (2009) Unexploded Ordnance A guide for the construction industry.

Ref 12-44 UK Government (1999) Country Planning (Environmental Impact Assessment) (England and Wales) Regulations (SI 1999 No 293).

Ref 12-45 MAFF (2000) Good practice guide for handling soils. Defra.

Ref 12-46 F.G Berry; Quarterly Journal of Engineering Geology and Hydrogeology; (1979) Late Quaternary scour hollows and related features in central London.

Ref 13-1 Design Manual for Roads and Bridges (‘DMRB’) Volume 11, Highways England, August 2009.

Ref 13-2 Interim Advice Note (‘IAN‘) 153/11 (Guidance on the Environmental Assessment of Materials Resources), Highways England, 2011.

Ref 13-3 EU Landfill Directive, Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste [1999] OJ L 182/1.

Ref 13-4 National Policy Statement for National Networks (NN NPS), Department for Transport, 2014.

Ref 13-5 Waste Framework Directive, Directive 2008/98/EC European Waste Framework Directive [2008] OJ L 312/3.

Ref 13-6 Clean Neighbourhoods and Environment Act 2005, c.16.

Ref 13-7 Environmental Permitting (England and Wales) Regulations 2007. SI 3538.

Ref 13-8 Environmental Permitting (England and Wales) Regulations 2010. SI 675.

Ref 13-9 Hazardous Waste (England and Wales) Regulations 2005, SI 894.

Ref 13-10 Hazardous Waste (England and Wales) (Amendment) Regulations 2009, SI 507.

Ref 13-11 Waste (England and Wales) Regulations 2011, SI 988.

Ref 13-12 Waste (England and Wales) (Amendment) Regulations 2012, SI 1889.

Ref 13-13 Waste Strategy for England 2011, Defra, 2011.

Ref 13-14 National Planning Policy for Waste, Department for Communities and Local Government, 2014.

Ref 13-15 Waste Management Plan for England, DEFRA, 2013.

Ref 13-16 National Planning Policy Framework, Department of Communities and Local Government, 2012.

Ref 13-17 National Planning Policy for Waste, Department of Communities and Local Government, 2014.

Ref 13-18 The Definition of Waste: Development Industry Code of Practice, Version 2, Contaminated Land: Applications in Real Environments, 2011.

Ref 13-19 The London Plan 2011: Spatial Strategy for Greater London, Mayor of London, 2011.

Ref 13-20 The Greater London Authority Sustainable Design and Construction, Supplementary Planning Guidance, Mayor of London, 2014.

Ref 13-21 Joint Waste Development Plan for the East London Waste Authority Boroughs, London Borough of Barking & Dagenham, London Borough of Havering, London Borough of Newham, London Borough of Redbridge, 2012.

Ref 13-22 Newham 2027: Newham's Local Plan – The Core Strategy, London Borough of Newham, 2012.

Ref 13-23 Royal Greenwich Local Plan: Core Strategy with Detailed Policies, Royal Borough of Greenwich, 2014.

Ref 13-24 Core Strategy Development Plan Document 2025, London Borough of Tower Hamlets, 2010

Ref 13-25 WRAP Netwaste tool dataset: http://nwtool.wrap.org.uk/QuickStart.aspx ,Waste and Resources Action Programme, accessed 08/01/2015.

Ref 13-26 EA waste conversion factors, https://www.gov.uk/government/publications/waste-returns- Ref 13-27spreadsheet-and-supporting-information.

Ref 13-27 UK Demand – Steel Industry Products and Import Share graph, http://www.issb.co.uk/uk.html, International Steel Statistics Bureau, accessed 24/04/2015.

Ref 13-28 Managing Japanese knotweed on Development Sites (version 3), Environment Agency, 2013.

Ref 13-29 Environment Agency EPR database: http://data.gov.uk/dataset/environmental-permitting-regulations--waste-sites-afa200, accessed 15/05/2015.

Ref 13-30 Survey of arisings and use of alternatives to primary aggregates in England: Construction, Demolition and Excavation Waste, Department for Communities and Local Government, 2005.

Ref 13-31 Waste management for England 2013 Statistics, https://www.gov.uk/government/statistics/waste-management-for-england-2013, accessed 15/05/2015.

Ref 13-32 'What's in your backyard', http://apps.environment-agency.gov.uk/wiyby/default.aspx, Environment Agency, accessed 15/05/2015.

Ref 13-33 Revised London Plan Waste Arisings Study Review for the Greater London Authority Model Guide and Task 4 Findings, SLR, 2014.

Ref 13-34 The mineral products industry at a glance – key facts, Mineral Products Association, 2014.

Ref 13-35 Carbon Calculation for Major Projects, Highways England, January 2013.

Ref 14-1 BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Noise, British Standards Instituition, 2014

Ref 14-2 BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Vibration, British Standards Instituition, 2014

Ref 14-3 TRL Report 328 Ground vibrations caused by road construction activities, Transport Research Laboratory, 1997

Ref 14-4 Calculation of Road Traffic Noise (CRTN), Department for Transport and Welsh Office, 1988

Ref 14-5 Traffic induced vibration in buildings, Transport and Road Research Laboratory, 1990

Ref 14-6 Converting the UK traffic noise index LA10,18-hour to EU noise indices for noise mapping, Transport Research Laboratory, 2002

Ref 14-7 BS 4142:2014 Methods for rating and assessing industrial and

commercial sound, British Standards Instituition, 2014

Ref 14-8 Standard ISO 9613, ‘Acoustics – Attenuation of Sound during Propagation Outdoors’ Part 2, 1996

Ref 14-9 Design Manual for Roads and Bridges, Volume 11 Section 3 Part 7 (HD213/11) ‘Noise and Vibration’, Highways England et al, 2011

Ref 14-10 Guidelines for Community Noise, World Health Organisation, 2000

Ref 14-11 Night Noise Guidelines for Europe, World Health Organisation, 2009

Ref 14-12 BS 8233:2014 Guidance on sound insulation and noise reduction for buildings, British Standards Instituition, 2014

Ref 14-13 BS6472-1:2008, Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting, British Standards Instituition, 2014

Ref 15-1 European Landscape Convention, Council of Europe, 2000

Ref 15-2 National Policy Statement (NPS) for National Networks, Department for Transport, 2014

Ref 15-3 National Planning Policy Framework (NPPF), Department for Communities and Local Government, 2012

Ref 15-4 Greater London Authority, The London Plan, 2015

Ref 15-5 Royal Greenwich Local Plan: Core Strategy with Detailed Policies, Royal Borough of Greenwich Council, 2014

Ref 15-6 Newham 2027, Newham’s Local Plan - The Core Strategy, London Borough of Newham Council, 2012

Ref 15-7 HA 205/08: DMRB Volume 11, Section 2, Part 5: Assessment and Management of Environmental Effects, Highways Agency, 2008

Ref 15-8 IAN 135/10: Landscape and Visual Effects Assessment, Highways Agency, 2010

Ref 15-9 Advice Note 01/11: Photography and Photomontage in Landscape and Visual Impact Assessment, Landscape Institute, 2011

Ref 15-10 Guidelines for Landscape and Visual Impact Assessment: Third Edition (GLVIA), Landscape Institute and Institute of Environmental Management and Assessment, 2013

Ref 15-11 Guidance Notes on the Reduction of Obtrusive Light, Institution of Lighting Engineers, 2005

Ref 15-12 National Character Area Profile: 81 Greater Thames Estuary, Natural England, 2013

Ref 15-13 Newham Character Study, London Borough of Newham Council, 2011

Ref 16-1 Department for Communities and Local Government (2012) National Planning Policy Framework

Ref 16-2 Department for Communities and Local Government (2014) National Policy Statement for National Networks (NN NPS)

Ref 16-3 The Environment Agency. Thames Estuary 2100: Managing Flood Risk through London and the Thames Estuary (TE2100), November 2012,

Ref 16-4 Greenwich Local Plan, Core Strategy, Adopted 2014

Ref 16-5 Newham's Local Plan, Core Strategy Adopted 2012

Ref 16-6 London borough of Newham Strategic Flood Risk Assessment SFRA - Final Report, 2011 Capita Symonds

Ref 16-7 London borough of Greenwich Strategic Flood Risk Assessment SFRA - Final Report, 2011 JBA.

Ref 16-8 Highways Agency (2009) Design Manual for Roads and Bridges Volume 11, Section 3, Part 10 (HD 45/09)

Ref 16-9 Hyder Consulting, Silvertown Tunnel Scoping Report, 2014

Ref 16-10 Hyder Consulting, Introductory Environmental Assessment Report, 2014

Ref 16-11 British Standards Institute (BSI). Code of Practice for Earthworks (BS6031), 2009.

Ref 16-12 CIRIA. C532 Control of Water Pollution from Construction Sites, 2001.

Ref 16-13 CIRIA. C650 Environmental Good Practice On-Site (Construction Industry Research and Information Association, 2005.

Ref 16-14 Department for Communities and Local Government. Planning Practice Guidance, 2015

Ref 16-15 EA (2014). Pollution Prevention Guidance. Various publication dates (accessed via https://www.gov.uk/government/collections/pollution-prevention-guidance-ppg

Ref 16-16 Water Framework Directive (Standards) 2000; Council Directive 2000/60/EC

Ref 16-17 Mustow et al. Practical Methodology for Determining the Significance of Impacts on the Water Environment, 2005

Ref 16-18 The Environment Agency. River Basin Management Plan, Thames River Basin District. Main Document, including Annex A and B, 2009.

Ref 16-19 What's In Your Backyard' Mapping, Environment Agency, http://maps.environment-agency.gov.uk/wiyby (linked accessed April 2015).

Ref 17-1 Design Manual for Roads and Bridges (DMRB) Volume 11, Section 2, Part 5

Ref 17-2 Planning Inspectorate (PINS), Advice note eight: How to get involved in the planning process, April 2012

1. INTRODUCTION

1.1 The Scheme

1.1.1 Transport for London (TfL) is proposing a new road tunnel linking the areas north and south of the River Thames between the Greenwich Peninsula and Silvertown, hereafter referred to as the Silvertown Tunnel (the Scheme). The location of the Scheme is shown in Figure 1-1 below.

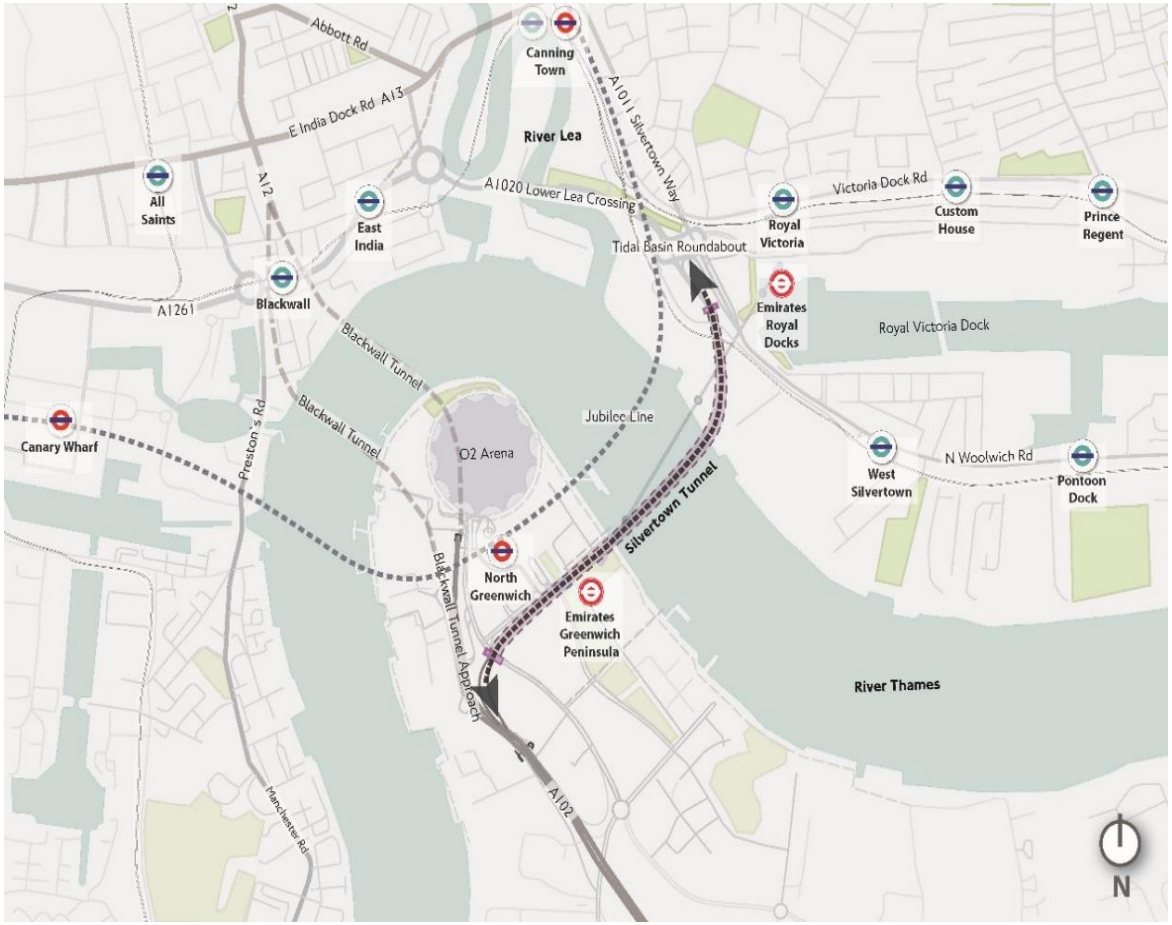
1.1.2 The scheme would comprise a new dual two-lane connection between the A102 Blackwall Tunnel Approach on Greenwich Peninsula (Royal Borough of Greenwich) and the Tidal Basin roundabout junction on the A1020 Lower Lea Crossing/Silvertown Way (London Borough of Newham) by means of a twin bore tunnel under the River Thames and associated approach roads. The Silvertown Tunnel would be approximately 1.4km long and would be able to accommodate large vehicles including double-deck buses. The design of the tunnel would include a dedicated bus/coach and Heavy Goods Vehicle (HGV) lane, which would provide opportunities for TfL to provide additional cross-river bus routes. The Boord Street footbridge over the A102 would be replaced with a pedestrian and cycle bridge.

1.1.3 New Portal buildings would be located close to each portal at the surface to house the plant and equipment necessary to operate the tunnel, including ventilation equipment.

1.1.4 The introduction of free-flow user charging on both the Blackwall and Silvertown Tunnels would serve to manage traffic demand and support the financing of the construction and operation of the Silvertown Tunnel.

1.1.5 Main construction works would likely commence in October 2018 and would last approximately four years with the new tunnel opening in 2022/23. The main site construction compound would be located at Silvertown to enable the utilisation, if reasonably practicable, of Thames Wharf to facilitate the removal of excavated material and delivery of materials by river. A secondary work site compound would be located adjacent to the alignment of the proposed cut and cover tunnel on the Greenwich peninsula.

Figure 1-1 Scheme location



1.2 Need for the Scheme

1.2.1 The Silvertown Tunnel Scheme is proposed in response to the three principal transport problems which exist at the Blackwall Tunnel: congestion, frequent closures and a lack of resilience (owing to the lack of proximate alternative crossings).

1.2.2 All of the road crossings of the River Thames between east and southeast London operate at, or close to, their practical capacity at peak times. The existing cross-river highway network in east London experiences high levels of congestion. Bus route 108, which uses the Blackwall Tunnel, is characterised by slow peak journey speed and poor reliability, and is frequently subject to disruption when the tunnel is closed. The route also has to operate with single deck vehicles due to the height restrictions on the northbound tunnel bore. Population and employment is expected to rise rapidly across London between 2011 and 2031, and the three Silvertown Tunnel host boroughs are expected to see higher forecast growth in particular. In the absence of new road crossings, there will be limited capacity for growth in road vehicle trips in the future, with average journey times and delays expected to increase significantly.

1.2.3 These problems have led to adverse effects on the economy and the local environment. In the context of forecast continued significant growth, these problems can only get worse, and in turn their consequential secondary adverse impacts on economic development and the environment will increase. Failing to address these problems could hamper the sustainable and optimal growth of London and the UK as described further in the Preliminary Case for the Scheme document.

1.2.4 The wider importance of a sustainable, effective, Silvertown Tunnel River Thames crossing at Blackwall in east London for national growth was recognised by the Secretary of State (SoS) for Transport in 2012. The SoS designated the Silvertown Tunnel Scheme be treated as a Nationally Significant Infrastructure Project (NSIP) for the purposes of the Planning Act 2008 (see section 1.4 for further discussion of the Planning Act 2008). The reasons given for the direction include that congestion at the Blackwall Tunnel is having an impact on the national road network which the Silvertown Tunnel Scheme could address. Critically, it highlights why the proposal has national significance:

'Given the position of London as an economic driver nationally, any decrease in efficiency in London's transport network may have a consequential detrimental impact nationally.'

1.2.5 The introduction of the Silvertown Tunnel and a user charge at both Blackwall Tunnel and Silvertown Tunnel would significantly reduce day-to-day journey time variability by road and deliver congestion-relief benefits during peak times on the main approach roads to the Tunnels; including the A102, the A12 and the A13. The user charge is critical in ensuring demand management and would also help to pay for the scheme.

1.2.6 The most important impact on public transport is the opportunities the Silvertown Tunnel Scheme would create for new cross-river bus services to improve public transport links between south-east and east London, notably the growing employment areas in the Royal Docks and Canary Wharf. The Silvertown Tunnel is designed to accommodate double-deck buses, thus providing operational flexibility in the bus routes that could be extended across the Thames, as well as greater capacity.

1.2.7 The need to act becomes more pressing as London continues to grow and land-uses in east London have changed and are changing in response to reflect a developing economy and growing population. Much of the land around the safeguarded area of the Scheme is now high-density residential, and continuing development is forthcoming both on the Peninsula and at Royal Docks. Although the safeguarding (see section 2.1 of this Preliminary Environmental Information Report (PEIR)) means that it is feasible to build a tunnel, competing demands for space will make this more difficult in the future.

1.3 The Applicant - Transport for London (TfL)

1.3.1 TfL is a statutory body created by the Greater London Authority (GLA) Act 1999. This Act gives the Mayor of London a general duty to develop and apply policies to promote and encourage safe, integrated, efficient and economic transport facilities and services to, from and within London. TfL's role is to implement the Mayor's Transport Strategy (MTS) and also manage those services across the Capital for which the Mayor is responsible. Income and funding comes from a variety of sources, including fares, the Congestion Charge, government grant and borrowing.

1.3.2 Responsibility for managing London's road network is shared between TfL, Highways England, and the 32 London boroughs:

- TfL manage the Transport for London Road Network (TLRN) and are responsible for the maintenance, management and operation of the Capital's 6,000+ sets of traffic signals;
- Highways England manages the national motorway network, including the M25 orbital motorway and the M1, M4 and M11; and
- The London boroughs are responsible for all the remaining roads within their boundaries.

1.4 Legislative context of NSIPs

1.4.1 TfL is applying for powers to construct and operate the Silvertown Tunnel scheme via a Development Consent Order (DCO). A DCO is the type of planning permission which must be sought for NSIPs. A DCO combines a variety of planning consents including, where appropriate, powers to compulsorily acquire land.

1.4.2 The Planning Act 2008 S22(2) states that:

> *'The construction of a highway is a NSIP if the SoS will be the highway authority for the highway, or if it is being constructed for a purpose connected with a highway for which the SoS is the highway authority.'*

1.4.3 The construction of the proposed Silvertown Tunnel does not directly fall within these criteria. However the Scheme was nevertheless designated as an NSIP by the SoS for Transport in June 2012, under section 35(10) of the Act which allows for schemes to qualify for NSIP project status in certain circumstances.

1.4.4 This designation was made in recognition of four characteristics of the Scheme, which were summarised in a letter from the SoS as follows:

- London as an engine for economic growth nationally;
- The projected growth of London;
- Current congestion at the Blackwall Tunnel is having a direct impact on the strategic road network; and
- The size and nature of the Silvertown Tunnel and comparison to other NSIPs.

1.4.5 The National Networks National Policy Statement (NN NPS) was first published in December 2014 and sets out the:

- need for development of road, rail and strategic rail freight interchange projects on the national networks; and
- the policy against which decisions on major road and rail projects will be made.

1.4.6 The Secretary of State will accordingly apply the NN NPS as the primary basis for his determination of the DCO application for the Scheme submitted by TfL. Appendix 1.A, National Networks National Policy Statement Compliance, in Volume 3 of this PEIR, sets out how the proposed Scheme complies with the environmental provisions of the NN NPS. A summary of how each PEIR topic complies with the NN NPS is also provided in Chapters 6 to 16 of this PEIR.

1.5 Need for Environmental Impact Assessment (EIA)

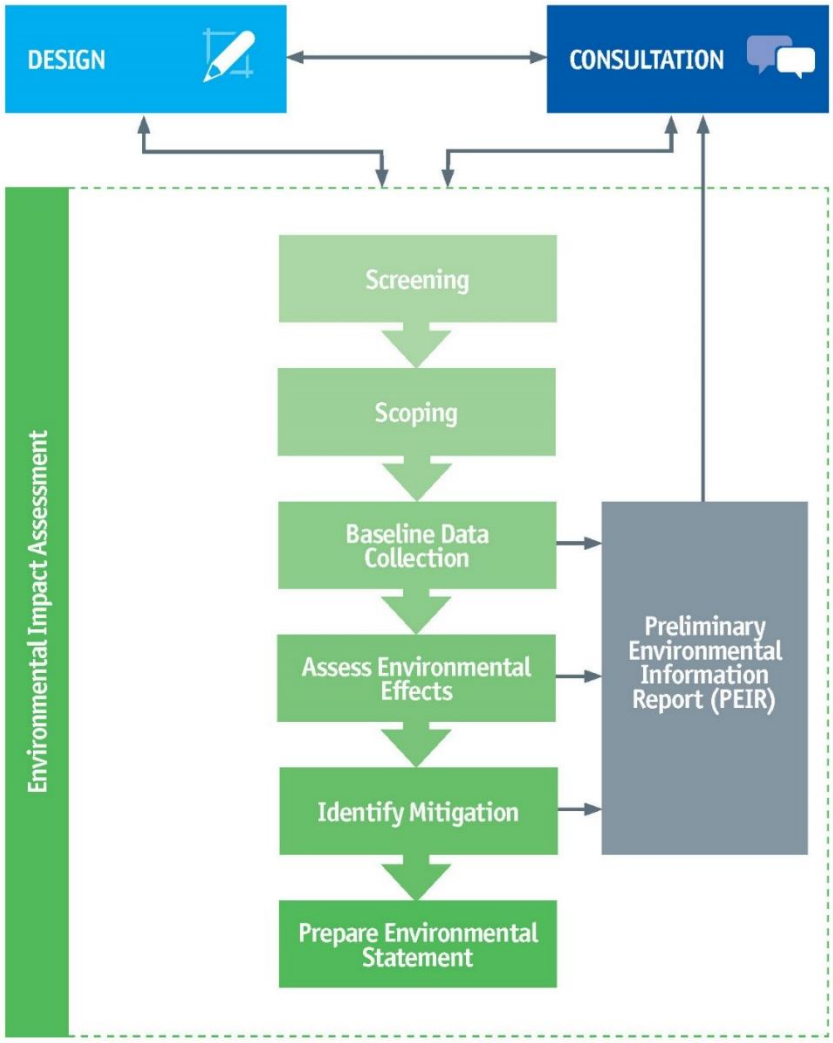
1.5.1 There are categories of development that are required by European and UK domestic legislation to be made subject of an assessment known as an Environmental Impact Assessment (EIA). The EIA regime in Europe is governed by Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of public and private projects on the environment. This directive is implemented for the purposes of NSIPs by the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009 (as amended) by the Infrastructure Planning (Environmental Impact Assessment) (Amendment) Regulations 2012 (the EIA Regulations).

1.5.2 It is considered that an EIA is required for the Scheme due to its scale and likelihood of significant environmental effects, and the applicant (TfL) wrote to the Planning Inspectorate (PINS) in May 2014, notifying the Secretary of State under regulation 6(1) (b) of the EIA Regulations, that it proposes to provide an Environmental Statement (ES) in respect of the Scheme. The ES submitted with the application will describe the findings of the EIA.

1.5.3 The EIA is being carried out in line with the EIA Regulations, guidance set out in the Design Manual of Roads and Bridges (DMRB) (Ref 1-1), NN NPS, and in accordance with current applicable good practice and guidance. An EIA Scoping Report was submitted to PINS in June 2014. PINS reviewed and consulted on the Scoping Report and issued a

Scoping Opinion on behalf of the Secretary of State in July 2014. The EIA process is set out in Figure 1-2 below.

Figure 1-2 The EIA process



1.5.4 The Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended) would also be relevant to the Scheme depending upon the extent that the works would require a marine licence.

1.5.5 Amendments to the EIA Directive 2011/92/EU have been made, and the Environmental Impact Assessment (EIA) Directive (2014/52/EU) entered into force on 15 May 2014. Although not yet transposed into UK legislation (planned for April 2017), the applicant will have regard to the changes in this latest EIA Directive during the assessment of the Scheme.

1.6 Purpose of this PEIR

1.6.1 The purpose of this PEIR is to provide consultees with the information compiled by TfL to date about the predicted environmental impacts of the Scheme and the proposed mitigation measures, to inform the pre-application consultation of the Scheme. The report:

- describes the Scheme, including construction details and timescales, and alternatives considered;
- describes the environmental baseline data collection work undertaken to date;
- describes the existing environment, based on the information collected;
- identifies further work to be undertaken to complete the EIA;
- provides an assessment of the likely significant environmental effects of the Scheme; and
- describes the range of mitigation measures that will be considered to avoid, reduce or offset environmental impacts.

1.6.2 This report constitutes the formal PEIR for the Scheme required by Regulation 10 of the Infrastructure Planning (EIA) Regulations 2009 (amended 2012).

1.6.3 The PEIR will be made available to the prescribed consultees, local authorities, and landowners and to members of the public and the wider community. This will enable the consultees, including the local community, to understand the main environmental effects and implications of the Scheme so as to inform their responses to consultation.

1.6.4 Following the end of the consultation, TfL will take account of all of the comments received, complete any further EIA work to be done and finalise the Environmental Statement (ES) which will for part of the application for the DCO. The application will also include a Consultation Report which will document the outcome of the consultation and how this has informed the final proposal.

1.7 Pre-application statutory consultation

1.7.1 Pre-application consultation is an important requirement for applications for DCOs. It provides an opportunity for interested parties to comment on the proposals while they are at a formative stage, and for potential issues

to be taken into account and, where necessary, addressed before the application is submitted for examination.

1.7.2 Under the Planning Act 2008, there are 3 key statutory requirements in respect of pre-application consultation and publicity:

- Section 42 consultation with prescribed consultees (e.g. Natural England, Environment Agency, Historic England), local authorities, landowners and others with interests in land;
- Section 47 consultation with the local community in accordance with the Statement of Community Consultation (SoCC); and
- Section 48 publicity of the proposed application.

1.7.3 For the purposes of this Scheme the section 42, section 47 and section 48 consultation and publicity stages will run in parallel. The consultation will run from 5 October to 29 November 2015. Throughout the statutory consultation, TfL will make a wide variety of information about the proposals available to the public and other stakeholders and provide relevant written information at specific locations open to the public. In addition, a series of roadshow events will be held at local venues, where the public will be able to view the proposals, talk to the Scheme team representatives and record their comments. Details of the community consultation process are set out in the SoCC.

1.7.4 Consultees are encouraged to respond to the information contained in this PEIR and other reports. A questionnaire will be provided at the road show events and on the TfL website tfl.gov.uk/silvertown-tunnel . This will ask for feedback in relation to: Connections to the existing road network, construction impacts, user charge, environmental effects, traffic impacts and cross-river bus service. The responses received will be taken into account in preparing the design of the Scheme submitted with the DCO Application, and in the ES. A Consultation Report (CR) will be produced to accompany the DCO Application which will detail the outcome of the statutory consultation process and, where relevant, how responses have been incorporated into the ES.

1.8 Pre-application non-statutory consultation

1.8.1 This statutory pre-application consultation follows previous non-statutroy consultations undertaken by TfL. In 2012 TfL undertook non statutory pre-application consultation on various river crossing options including a

tunnel at Silvertown and a new ferry at Gallions Reach, where 80% of responses to the consultation questionnaire supported the tunnel at Silvertown. In 2013 further non statutory River Thames crossing option consultation was undertaken on a tunnel at Silvertown, a new ferry at Woolwich, crossings at Gallions Reach and user charging.

1.8.2 The first non-statutory consultation on the Silvertown Tunnel Scheme was undertaken from 15 October to 19 December 2014. TfL published a Responses to Issues Raised Report (Ref 1-2) which committed to addressing issues and where appropriate these changes have been incorporated into the PEIR. At this initial phase of consultation 83% of respondents to the consultation questionnaire agreed that a new river crossing was needed at this location, just over half (55%) opposed the user charge and 37% supported it.

1.8.3 Further information on the options considered during these consultations are provided in Chapter 3, Alternatives, of this PEIR.

1.9 Structure and contents of this PEIR

1.9.1 A significant amount of survey work has been completed to date to inform the EIA, including ecological surveys, baseline landscape and visual surveys, and a ground investigation. At this stage not all of the detailed survey or assessment work required to complete the EIA and prepare an ES has been completed. This PEIR therefore presents the environmental information available at this time, and our current understanding of the likely environmental effects of the Scheme.

1.9.2 PINS Advice Note 7: Preliminary Environmental Information, Screening and Scoping (March 2015) provides guidance regarding the scope and contents of the PEIR:

> *'A good PEI document is one that enables consultees (both specialist and non-specialist) to understand the likely environmental effects of the proposed development and helps to inform their consultation responses on the proposed development.'*

1.9.3 The structure of the PEIR is outlined in Table 1-1.

Table 1-1 The structure of the PEIR

Volume	Chapter Number	Title
Volume 1	Chapter 1	Introduction

	Chapter 2	Scheme Context
	Chapter 3	Alternatives Considered
	Chapter 4	Description of the Scheme
	Chapter 5	Assessment Methodology
	Chapter 6	Air Quality
	Chapter 7	Community and Private Assets
	Chapter 8	Cultural Heritage
	Chapter 9	Terrestrial Ecology
	Chapter 10	Marine Ecology
	Chapter 11	Effect on all Travellers
	Chapter 12	Geology and Soils
	Chapter 13	Materials
	Chapter 14	Noise and Vibration
	Chapter 15	Townscape
	Chapter 16	Water Environment
	Chapter 17	Cumulative Effects
Volume 2	Drawings	N/A
Volume 3	Appendices	N/A
Other documents relating to the PEIR and available as part of the S.42, S.47 and S.48 consultation		
Preliminary Non-Technical Summary		
Preliminary Case for the Scheme		
Preliminary Charging Report		
Preliminary Transport Assessment		
Preliminary Design and Access Statement		
Preliminary Engineering Report		
Preliminary Maps, Plans and Drawings		
Preliminary Sustainability Statement		
Preliminary Equality Impact Assessment		
Preliminary Health Impact Assessment		
Preliminary Energy Statement		
Preliminary Outline Business Case		
Preliminary Distributional Impacts Appraisal		
Preliminary Social Impacts Appraisal		

1.9.4 The requirements of Part 1 of Schedule 4 of the Infrastructure Planning (EIA) Regulations 2009 (as amended), which describes the information required for inclusion in an ES submitted with a DCO application, are listed in Table 1-2. The Chapters of this PEIR where the information is presented are also identified.

Table 1-2 Requirements of Part 1 of Schedule 4 of the regulations and details of their location within this PEIR

Requirements (from Part 1 of Schedule 4 of the Regulations)	**Location within the PEIR**
Description of the development, including in particular: (a) a description of the physical characteristics of the whole development and the land-use requirements during the construction and operational phases; (b) a description of the main characteristics of the production processes, for instance, nature and quantity of the materials used; and (c) an estimate, by type and quantity, of expected residues and emissions (water, air and soil pollution, noise, vibration, light, heat, radiation, etc.) resulting from the operation of the proposed development.	Chapter 4
An outline of the main alternatives studied by the applicant and an indication of the main reasons for the applicant's choice, taking into account the environmental effects.	Chapter 3
A description of the aspects of the environment likely to be significantly affected by the development, including, in particular, population, fauna, flora, soil, water, air, climatic factors, material assets, including the architectural and archaeological heritage, landscape and the interrelationship between the above factors.	Chapter 6 to Chapter 17
A description of the likely significant effects of the development on the environment, which should cover the direct effects and any indirect, secondary, cumulative, short, medium and long term, permanent and temporary, positive and negative effects of the development, resulting from: (a) the existence of the development; (b) the use of natural resources; and (c) the emission of pollutants, the creation of nuisances and the elimination of waste, and the description by the applicant of the forecasting methods used to assess the effects on the environment.	Chapter 6 to Chapter 17

A description of the measures envisaged to prevent, reduce and where possible offset any significant adverse effects on the environment.	Chapter 6 to Chapter 17
A non-technical summary of the information provided.	Provided as a separate document
An indication of any difficulties (technical deficiencies or lack of know-how) encountered by the applicant in compiling the required information.	Limitations and Assumptions section of Chapter 5 to Chapter 17

1.10 Next steps

1.10.1 This PEIR is part of a suite of documents which have been made available for the statutory consultation on the Silvertown Tunnel scheme which runs from 5 October to 29 November 2015. As described in Section 1.2 and 1.7 TfL will carefully consider responses to consultation received from the public and stakeholders in continuing to assess the merits of the Scheme and where appropriate to improve and refine the scheme proposals. TfL aims to submit the DCO application to PINS in Spring 2016. This application will seek the consent of the SoS for Transport to build and operate the Scheme and all associated measures under the Planning Act 2008.

1.10.2 The information presented in this PEIR will be developed further through the EIA process, and the findings of the EIA will be presented in the ES, which will accompany the DCO Application.

1.10.3 If the application is accepted for examination, TfL will carry out further publicity, and interested parties will be able to register their interest in the application which will enable them to participate in the examination and be kept informed of opportunities to present their views.

1.10.4 PINS will examine the application on behalf of the Secretary of State. Interested parties will be able to submit written comments on the proposals and participate in the public open floor, issue specific and compulsory acquisition hearings.

1.10.5 The examination must be completed within 6 months. Following the examination, the Planning Inspectorate will make a recommendation to the Secretary of State for Transport who will then have three months to make a decision.

1.11 PEIR team and contact details

1.11.1 To comment on the proposals, please visit tfl.gov.uk/silvertown-tunnel, which contains a link our consultation questionnaire. Our questionnaire seeks your views on specific issues, however please feel free to express your thoughts more generally if you would prefer. Please use our email address rivercrossings@tfl.gov.uk or our freepost address. Simply mark your envelope 'TfL Freepost Consultations'.

1.11.2 The closing date for comments is 29 November 2015.

2. SCHEME CONTEXT

2.1 Safeguarded land

2.1.1 Safeguarding of land is an established part of the planning process, designed to ensure that land which has been identified for major infrastructure projects is protected from conflicting developments.

2.1.2 The Scheme would pass under the River Thames, in land that has been safeguarded for this purpose since 1997 (Government Office for London: Safeguarding direction under articles 10 and 27 of the Town and Country Planning Act 1990 relating to potential corridors for east Thames river crossings, transferred to the Mayor of London in 2001).

2.2 Silvertown north side

2.2.1 The northern tunnel portal and associated highway tie-in is situated in Silvertown to the south of Canning Town in the London Borough of Newham. Transport infrastructure is a dominant feature of the area with the elevated A1020 Silvertown Way/Lower Lea Crossing and the elevated Docklands Light Railway (DLR) Woolwich extension running north-west to south-east and the Jubilee Line and Emirates Air Line (EAL) cable car running north-east to south-west across the River Thames. To the north of Silvertown Way the area predominantly consists of mixed residential and recreational land uses around the perimeter of the Royal Victoria Docks. This contrasts with light industrial and commercial uses to the south of Silvertown Way, which is bounded by a safeguarded wharf known as Thames Wharf. In this area Dock Rd/North Woolwich Road provide local access to a number of businesses including steel and metal suppliers, scrap metal dealers, concrete batching plants, waste recycling and management businesses and an aggregates supplier. There are emerging plans to redevelop the area for high density residential and mixed uses in the future but no formal proposals exist.

2.3 Greenwich Peninsula south side

2.3.1 The southern tunnel portal and associated highway tie-in lies on the Greenwich Peninsula in the Royal Borough of Greenwich. The main transport infrastructure on the peninsula are: the A102 Blackwall Tunnel Approach leading to the north and southbound tunnels; Millennium Way providing access to the North Greenwich London Underground (LU) and bus station; Jubilee Line linking to Canning Town and Canary Wharf; and

EAL south station. The majority of the area to the north and east of the A102 is undergoing re-development as part of the consented Greenwich Peninsula Masterplan, which is a major high-density residential-led (ca. 12,000 homes), mixed-use development. Currently the masterplan is part implemented with offices, hotel and college buildings to the north set around the established The O2 and new residential blocks to the south. The central portion is predominantly laid out as surface car parks and access roads associated with The O2 and the station. There is a redundant gas holder (approximately 75m in diameter), former lorry park, nightclub and office/commercial uses between Millennium Way and the A102 immediately south of the proposed southern tunnel portal. This area is bisected west to east by Boord Street which provides access to a footbridge crossing of the A102 and links to Tunnel Avenue on the west side. Tunnel Avenue provides access to a variety of existing and former light industrial and commercial uses on the west side of the peninsula including aggregates supplier/wharf and chemical distribution company.

2.4 River Thames

2.4.1 In addition to the EAL, Jubilee Line and Blackwall Tunnel infrastructure there is a pier serving the Thames Clipper river bus on the east side of the Greenwich Peninsula. South of this there are moorings for leisure craft and on the north side there are moorings for barges, tugs and marine engineering vessels adjacent to Thames Wharf. The main navigation channel serves a variety of traffic from large sea-going vessels and to small leisure craft. The River Lea (known as Bow Creek) joins the main river at the northern end of Thames Wharf.

Figure 2-1 Location plan

2.5 Planned infrastructure and planned developments

2.5.1 There are plans for significant regeneration either side of the River Thames along the route of the Scheme. These plans act as constraints to some aspects of the Scheme.

2.5.2 A consented masterplan for the development of the Greenwich Peninsula has been in place since 2004 and has been partly implemented (Ref 2-1). A revised masterplan application for the undeveloped areas was submitted in spring 2015 and has recently been approved by the Royal Borough of Greenwich. This revised application introduces further building and associated infrastructure constraints on the Scheme proposals. TfL and the developers for the Greenwich Peninsula are working closely to resolve structural interfaces and coordinate construction phasing.

2.5.3 There are as yet no consented developments in the Silvertown area within the immediate vicinity of the Scheme. Details of developments within the wider area are provided within the Preliminary Design and Access

Statement. Nevertheless, in line with the objectives for the Scheme, the design ensures that the area around the Scheme could be developed at some stage in the future, in line with the aspirations of the Greater London Authority (GLA) and the London Borough of Newham.

3. ALTERNATIVES CONSIDERED

3.1 Introduction

3.1.1 This section provides an outline of the main alternatives to the Scheme that have been considered by TfL in developing the Scheme, including alternatives to a tunnel solution, alternative tunnel designs and detailed refinement of the Scheme. It provides an outline of the main reasons for the selection of the proposed Scheme and explains how environmental and other factors have influenced the decisions taken in respect of the proposed development. Consideration is given to the requirements of the Infrastructure Planning 2009 EIA Regulations (amended 2012) and the relevant policy guidance contained in the National Road and Rail Networks: National Policy Statement (NN NPS).

3.1.2 The Infrastructure Planning (Environmental Impact Assessment) Regulations 2009 (as amended), state at Schedule 4, Part 1 (18) that the ES needs to provide:

> *'An outline of the main alternatives studied by the Applicant and an indication of the main reasons for the Applicant's choice, taking into account the environmental effects.'*

3.1.3 Under the EIA Regulations there is no requirement to assess all potential alternatives, only a requirement to provide a review of those main alternatives that have actually been considered.

3.2 Strategic options development

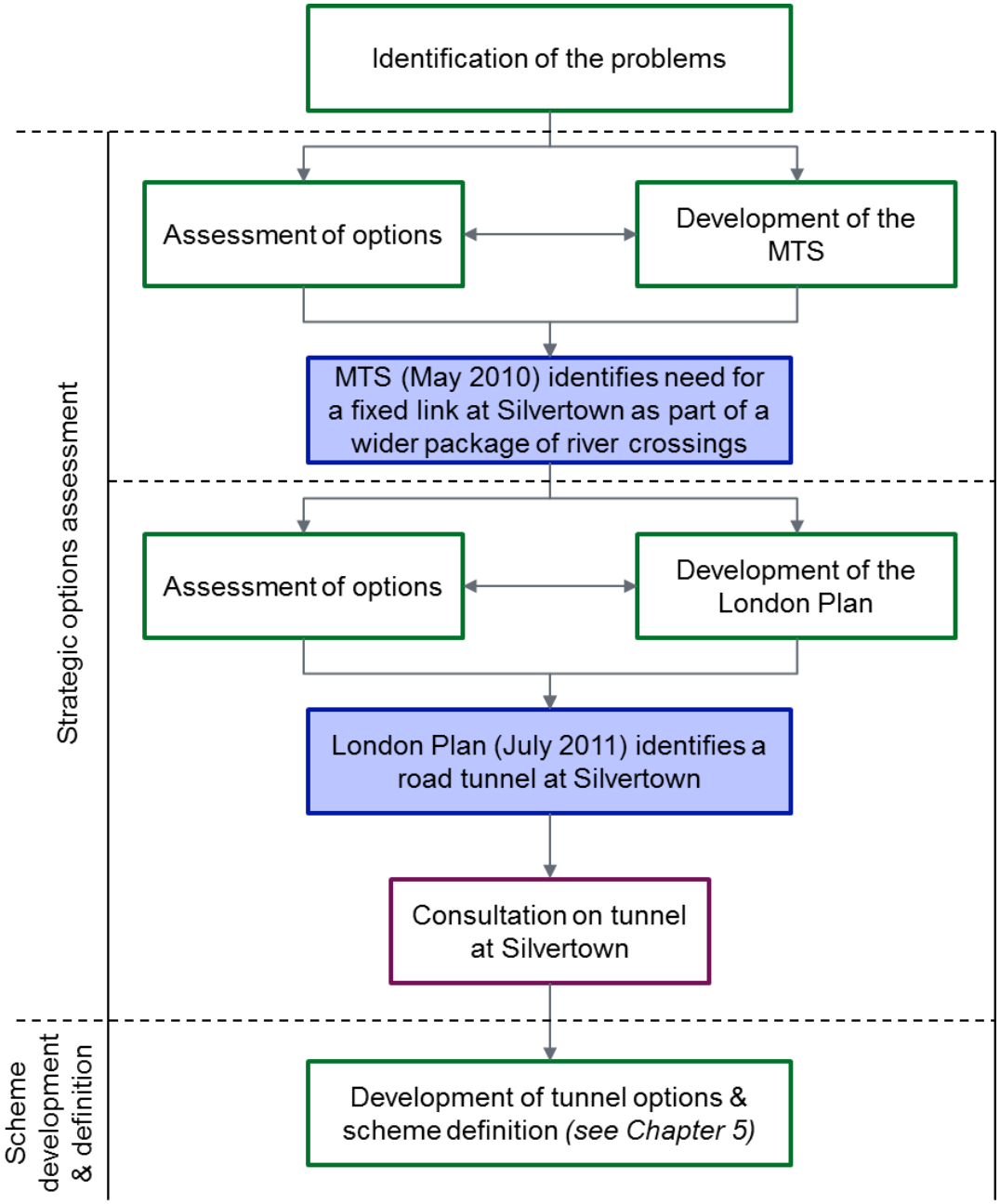
3.2.1 Figure 3-1 summarises the process that was followed in developing the Silvertown Tunnel Scheme. Initially, the problems were identified (as described in Section 1.2 of this PEIR), and a wide range of potential options were assessed that might be capable of addressing the particular problems that had been identified. As a result of this, policies were adopted in the Mayor’s Transport Strategy (MTS) and the London Plan which support a Silvertown crossing within a wider package of River Crossings package. The need to consider user charges to support additional river crossings was also identified in the MTS and the London Plan in order to manage demand and to help pay for the schemes. Both the MTS and London Plan were subject to statutory consultation. The policies were refined as a consequence in response to consultation responses.

3.2.2 The NN NPS paragraph 4.27 states that:

> *'Where projects have been subject to full options appraisal in achieving their status within Road or Rail Investment Strategies or other appropriate policies or investment plans, option testing need not be considered by the examining authority or the decision maker. For national road and rail schemes, proportionate option consideration of alternatives will have been undertaken as part of the investment decision making process. It is not necessary for the Examining Authority and the decision maker to reconsider this process, but they should be satisfied that this assessment has been undertaken.'*

3.2.3 This chapter does not, therefore, provide a detailed description of the strategic options assessment, but focusses on the alternatives considered by TfL once the principle of a tunnel crossing at Silvertown had been established in policy. A full account of the option selection process is provided in the Preliminary Case for the Scheme document (Ref 3-1).

Figure 3-1 Summary of the options development and assessment process



3.3 Scheme development and definition

Options assessments

3.3.1 Following the inclusion of the option of a river crossing at the Silvertown Tunnel scheme in the London Plan, different Scheme options and variants have been assessed against environmental, land-use and cost criteria.

3.3.2 A 2012 tunnel engineering study (Ref 3-2) refined the bored tunnel solution, looking particularly at the issue of cross passages and fire life safety. It also looked at an immersed tunnel option for the crossing to determine if this was technically feasible and to identify the potential environmental impacts and implications for navigation that might determine whether such an option was viable. The study concluded that while both a bored or an immersed tube tunnel option were technically feasible, the immersed tube tunnel would have greater adverse impacts on the environment and local land uses.

3.3.3 In addition to this assessment, the fixed road-based options (including a wide range of options for comparative back-check assessment purposes) were appraised using TfL's Strategic Assessment Framework (SAF), which enables comparative assessment of projects and programmes using a set of strategic planning criteria (Ref 3-3). SAF enabled the river crossing options to be tested against all MTS outcomes and was consistent with the Department for Transport's WebTAG process. This assessment recommended the following for further development:

- a bored tunnel at Silvertown; and
- user charging at the Blackwall Tunnel (in conjunction with the new Silvertown infrastructure)

3.3.4 In order to verify these recommendations, TfL undertook a comparison of eight tunnel options in 2013 on the basis that these options were feasible in engineering terms but presented contrasting impacts in relation to relevant criteria (Ref 3-4). The eight options broke down into two groups – bored and immersed tube (four each) and included 'full length' and 'short' length variants. In the short length variants, the tunnel portal is located closer to the river, and the exit road runs above ground rather than in a cut-and-cover tunnel. This has implications for matters such as project cost and the amount of land required.

3.3.5 As indicated in Section 3.3.2, the assessment showed that the immersed tube option posed higher environmental risks resulting from the additional land take and excavation works required for the construction phase, the construction methods which would need to be used and the vertical alignment of the immersed tube tunnel. Higher comparative environmental risks were identified with regards to:

- land take;

- loss of archaeological assets;
- temporary loss of habitats;
- deterioration of water quality, elevated suspended sediments in the river and the loss of intertidal mudflats;
- contamination of controlled waters;
- large volumes of waste and fewer opportunities to re-use key waste materials; and
- changes to water level, flow paths and dynamics and the movement of sediment within the River Thames.

3.3.6 The assessment also concluded that the environmental risks associated with the shortened options were higher than the long options due to the reduced cut and cover sections on the south side of the River Thames, the close proximity of sensitive receptors to the open cut road, and construction design changes of Millennium Way. Higher environmental risks were identified with regards to:

- permanent land take;
- severance;
- noise; and
- deterioration in townscape character.

3.3.7 Further details of the comparative environmental risks of the options assessed are provided in Appendix 3.A, in Volume 3 of this PEIR.

3.3.8 The assessment, against cost, risk, land-use and environmental criteria therefore, concluded that the ‘full length’ bored tunnel option be progressed to concept design stage with a focus on mitigating and minimising environmental, safety and construction risks.

3.4 Public consultation feedback

3.4.1 Following the inclusion of the option of a river crossing at Silvertown in the London Plan, and as a result of the options assessments described above, the bored tunnel option has been developed in greater detail with regard to alignment, capacity, design, junction tie-ins, construction method and sites and associated topics. Details of this exercise were presented in

the non-statutory consultation on the Silvertown Tunnel in October to December 2014.

3.4.2 This was the first consultation which focused solely on the Silvertown Tunnel scheme (each previous consultation having considered a Silvertown crossing in the context of the wider TfL River Crossings programme). For the purposes of this consultation, TfL took into account the responses to consultation on the previous river crossings programme consultation (Ref 3-5) and published detailed information on the proposal. The consultation materials included information about changes to road layout at the approaches to the scheme, the likely impacts of the scheme (on traffic and the environment), potential public transport improvements; and an indicative user charge. TfL also published extensive background and development information including:

- the River Crossings business survey;
- the methodology for the EIA;
- options assessment and tunnel development studies;and
- an independent peer review group report into the Scheme.

3.4.3 The consultation questionnaire sought views on the principle of the Silvertown Tunnel as part of the river crossings programme, the imposition of a user charge and account system and preferences with regard to about new cross-river bus services. It also asked if the proposed junction tie-ins at the north and south side were appropriate and invited comments on the technical reports and any other issues of concern. There was a good level of interest in the consultation, with some 4,655 responses.

3.4.4 83% of respondents to consultation agreed that a new river crossing was needed at this location. Just over half (55%) opposed the user charge, with 37% supporting it. In general there was support for the junction changes (48% at north side and 54% at south side), with a substantial proportion responding ‘don’t know’. There were many suggestions about new bus connections and services.

3.4.5 Respondents raised a number of issues, including concerns about how the traffic impacts of the scheme might be managed; suggestions for discounts to the user charge; suggestions for new public transport links in addition to or instead of the new tunnel; comments about the decision not

to permit pedestrians and cyclists to use the tunnel; and a range of comments about the materials published to support the proposals.

3.4.6 Following the consultation TfL published a Responses to Issues Raised report (Ref 3-5) which committed to addressing the issues raised by consultees in the statutory consultation on the scheme. As a consequence, in the materials included for the statutory consultation (Autumn 2015) there have been a number of changes made to the Scheme in response to points made by consultees as a result of a the comments received during the previous consultation, for example in respect of work sites and the size and layout of tunnel buildings. The statutory consultation materials also contain further information on potential new bus services and extensions to existing services and intentions to explore changes to EAL fare structure. The Preliminary Charging Report provides more detail about the proposed scope of the charge and the mechanism for setting and varying it. It also outlines the proposed discounts and exemptions and explains the indicative user charges which have been used to date for the purposes of the assessment.

3.4.7 Also as a result of consultation responses, TfL re-considered the potential to allow pedestrians and cyclists to use the tunnel. Current design and safety standards indicate that only a segregated solution – either a separate tunnel bore or a deck underneath the road tunnel – would be acceptable in terms of avoiding potential conflicts with other users. However, both of these options would be very expensive and, given the length of the crossing and the need to provide lifts and ramps, would provide a poor ambience, and would be unsuitable in terms of safety and security. The Scheme cost increase to provide these facilities could bring greater benefits for pedestrians and cyclists if invested in infrastructure elsewhere along the eastern Thames including access to the EAL and where schemes have in some cases already been identified and are being given serious consideration. For these reasons the Scheme does not include facilities to allow pedestrians and cyclists to use the tunnel, but does include improvements for these users in the area around the northern portal to enable better connections through to the Emirates Air Line, which is the primary cross-river connection for pedestrians and cyclists.

3.5 Detailed Scheme development

3.5.1 Since the selection of the preferred tunnel option in early 2014, the Scheme proposals have undergone development and improvement, most notably through detailed public consultation and engagement with key stakeholders including:- host boroughs and other local authorities; statutory bodies and undertakers (e.g. Port of London Authority, Environment Agency, Utilities), Emergency Services; and affected land interests (e.g. owners, developers and tenants). A number of design and construction related changes have been adopted as a direct result of this engagement activity, which are described in Table 3-1 below.

Table 3-1 Detailed Scheme development

Design development	Reason for development	Impacts and benefits
Modification of the proposed construction methodology and sequence to include a temporary diversion of Millennium Way during construction of the tunnel.	The change has been implemented in response to requests from existing service providers, operators and businesses.	This development will maintain full access along Millennium Way for the full duration of the construction period which will improve access during the works for existing service providers, operators and businesses. The development also reduces the proposed footprint of the works adjacent to existing operations.
Modification of the construction methodology and sequence to co-ordinate with the consented Greenwich Master Plan	Alignment with the construction planning for the consented Master Plan	The revised construction strategy will minimise the disruption to existing service providers and venues arising from the combined impacts of the Silvertown Tunnel

Design development	Reason for development	Impacts and benefits
		Works and the construction works associated with the consented development plans for the Greenwich peninsula.
Development of the design for the proposed Boord Street cycle and pedestrian crossing to create a more compact structure	Feedback from stakeholders which identified that the previous proposals impacted on accesses to existing services and businesses	In comparison to the earlier proposals this development improves the proposed accesses for existing businesses and services. It retains existing planting along highway boundary and reduces the footprint of the land required for this element of the scheme.
Development of the layout of the Tidal Basin Roundabout	Feedback from stakeholders and existing service providers relating to the extent of land occupied by the junction and the constraints that the junction layout placed on current land use and future land use opportunities. Feedback from the Stage 1 Road Safety Audit team.	The design developments achieve a simpler arrangement through creating a more open layout and through removing one dedicated entry lane onto the roundabout. The changes reduce the overall area of carriageway at the junction and address a number of operational concerns raised in the Stage 1 Road Safety Audit. These changes contribute to a

Design development	Reason for development	Impacts and benefits
		reduction in the number of constraints to current and future land use around the area that were inherent in the previous arrangement.
Introduction of low noise road surfacing on Tidal Basin Road between Tidal Basin Roundabout and Silvertown Way	Reduction in impact arising from changed traffic levels on traffic noise levels	The proposal to provide low noise surfacing to the link between Tidal Basin Roundabout and Silvertown Way mitigates the impact of changed traffic levels on this link arising from the new Silvertown tunnel.
Modifications to the siting and layout of the Ventilation Building and Tunnel Service Buildings at the Service Compound adjacent to the North Portal	Feedback from stakeholders which proposed that the tunnel service compound could be located on land more suitable for this type of land use.	These changes contribute to a reduction in the constraints to current and future land use around the area that were inherent in the previous arrangement. The new arrangement also creates a more open aspect on the land adjacent to the realigned Dock Road.
Rationalisation of the proposals for the construction and operation of temporary loading	Feedback from stakeholders relating to encouraging greater use of the river for construction logistics	The design has developed to focus on a single option of using the existing wharves directly onto the River

Design development	Reason for development	Impacts and benefits
facilities in the River Thames at the Silvertown Works Compound.	and to mitigation of environmental impacts. Requests from existing businesses and service providers to minimise impacts to their operations during the construction period.	Thames. This reduces the potential impact on existing operators. The option progressed would allow a greater range of vessels to operate from the work site, improving the reliability and flexibility of the marine logistics.
Development of proposals for the location and extent of the construction compound in Silvertown	Responds to feedback from existing businesses and service providers local to the Silvertown compound, to minimise impacts to their operations during the construction period.	The current proposals provide sufficient construction area for the contractors to operate safely and efficiently. The proposals seek to minimise the impact on existing businesses operating from the area through the construction period.
Removal of the requirement for niches in the tunnel	Simplification of the tunnel construction methods which will reduce Health & Safety risks for workers during construction and maintenance	TfL have formed a Tunnel Design & Safety Consultation Group (TDSCG) in accordance with best practice to provide expert advice and opinion on the management and mitigation of risk during the tunnel design, construction and operation periods. This development has been promoted by the

Design development	Reason for development	Impacts and benefits
		TDSCG to reduce risk to the work force during the construction phase, and to simplify maintenance procedures.
Increase in the spacing of the cross passages formed between the twin tunnel bores	Simplification of the tunnel construction methods which will reduce Health & Safety risks for workers during construction and maintenance	TfL have formed a Tunnel Design & Safety Consultation Group (TDSCG) in accordance with best practice to provide expert advice and opinion on the management and mitigation of risk during the tunnel design, construction and operation periods. Through consultation with the TDSCG, TfL have implemented this change in order to reduce the number of instances requiring workers to form openings in the precast tunnel lining. This has the benefit of reducing risk to the work force during the construction of the cross passages.
Potential enhancements to cycle provision around Silvertown end of the scheme	Responds to proposals from local stakeholders	A number of enhancements to the cycle network local to the Silvertown portal are being considered by

Design development	Reason for development	Impacts and benefits
		local stakeholders. The degree to which the scheme supports or facilitates these enhancements remains part of the ongoing development of the scheme proposals.

4. DESCRIPTION OF THE SCHEME

4.1 Introduction

4.1.1 This Chapter outlines the Scheme Description and is based on the Preliminary Engineering Report (PER), part of the suite of documents available for the s.42, s.47 and s.48 statutory consultation. The PER defines the Scheme in sufficient detail to allow stakeholders to understand the scope and extent of the Scheme, inform the PEIR and enable a DCO application to be submitted. The Scheme design, associated construction methodology and programme have established:

- that construction of the Scheme is feasible in the timescale indicated;
- a possible construction sequence allowing traffic movements and services (utilities) supplies to be maintained during construction;
- the land required for the permanent works;
- land required temporarily for the safe construction of the works; and
- a level of detail to allow assessment of the likely costs, impacts, effects and benefits of the scheme.

4.2 Scheme overview

4.2.1 The Scheme would comprise a new dual two-lane connection between the A102 Blackwall Tunnel Approach on Greenwich Peninsula (London Borough of Greenwich) and the Tidal Basin roundabout junction on the A1020 Lower Lea Crossing/Silvertown Way (London Borough of Newham) by means of twin tunnel bores under the River Thames and associated approach roads. The Silvertown Tunnel would be approximately 1.4km long and would be able to accommodate large vehicles including double-deck buses.

4.2.2 On the north side, the tunnel approach road connects to the Tidal Basin Roundabout, which would be altered to create a new signal-controlled roundabout linking the Silvertown Way, Dock Road and the Lower Lea Crossing. Dock Road would be realigned to accommodate the new tunnel and approach road. On the south side, the A102 would be widened to create new slip-road links to the Silvertown Tunnel. A new overbridge would be built to take southbound traffic exiting the Blackwall Tunnel over the northbound approach to the Silvertown Tunnel. The Boord Street

footbridge over the A102 would be replaced with a pedestrian and cycle bridge.

4.2.3 New portal buildings would be located close to each portal to house the plant and equipment necessary to operate the tunnel, including ventilation equipment.

4.2.4 The introduction of free-flow road user charging (RUC) on both the Blackwall and Silvertown Tunnels would play a fundamental part in managing traffic demand and support the financing of the construction and operation of the Silvertown Tunnel. The design of the tunnel, which also includes a dedicated bus/coach and HGV lane, which provides opportunities for TfL to introduce additional cross-river bus routes.

4.2.5 Main construction works would likely commence in October 2018 and would last approximately four years with the new tunnel opening in 2022/23. A Tunnel Boring Machine (TBM) would be used to bore the main tunnel sections under the river with shorter sections of cut and cover tunnel at either end linking to the portals. The proposal is to erect and launch the TBM from a specially constructed chambers at Silvertown and Greenwich Peninsula where the bored and cut and cover sections connect. The main site construction compound would be located at Silvertown to utilise Thames Wharf to facilitate the removal of excavated material and delivery of materials by river. A secondary site compound would be located adjacent to the alignment of the proposed cut and cover tunnel on the Greenwich peninsula.

4.3 Future design and build development

4.3.1 As noted in the Preliminary Outline Business Case, TfL propose to deliver the Silvertown Tunnel Scheme through a private finance initiative and has established that a Design Build Finance and Maintain (DBFM) structure would best meet the project objectives and constraints, and achieve an appropriate risk balance. A DBFM contract would be competitively tendered in accordance with EU procurement procedures.

4.3.2 The DBFM contractor would complete the detailed design, construct the tunnel and supporting infrastructure and be responsible for maintenance during a likely 30 year concession period. TfL would control the day to day operation (traffic management) of the Silvertown Tunnel while Blackwall Tunnel would continue to be managed by TfL under the existing operations and maintenance arrangements.

4.3.3 Once out to tender, bidders for the DBFM service would submit proposals to meet TfL's specification and requirements which would be reflected in the requirements of the DCO. Bidders' proposals would be subject to a robust technical and environmental evaluation.

4.3.4 Subject to gaining DCO consent a DBFM contractor would be appointed and they would be responsible for completing the Detailed Design. TfL's specifications and requirements and commitments made under the DCO examination would be incorporated in the contract documents. The contractor's detailed proposals would be subject to further detailed review prior to construction to ensure that the final design and construction methodology have no greater adverse effects than those assessed in the ES and the DCO.

4.4 Limits of deviation & Limits of Land to be Acquired or Used

4.4.1 The limits of deviation (LoD) for the Scheme are described in the Preliminary Engineering Report (PER), representing an 'envelope' within which the tunnel works would be constructed. The LoD define the maximum extent to which the main elements of the Scheme can be deviate both horizontally (in plan) and vertically (in elevation).

4.4.2 The design set out in the PER is a preliminary design only and therefore the LoD provide the necessary flexibility to allow for small adjustments once the Detailed Design has been prepared. It is standard practice for such limits to be included in DCO applications and these will be shown on the works plans which accompany the DCO application..

4.4.3 Taking the LoD into consideration in combination with the assumed construction methodology has enabled the Limits of Land to be Acquired or Used (LLAU) to be determined for the Scheme. This ensures that the application for the DCO has identified sufficient permanent and temporary land requirements for the safe construction, operation and maintenance activities involved in the Scheme.

4.4.4 In addition, the DCO will provide a power to carry out other works known as ancillary works, such as the provision of environmental mitigation. These ancillary works must be carried out within the limits of land to be acquired or used.

4.4.5 The LLAU are shown on Drawing 4.1, Proposed LLAU located in Volume 2 of the PEIR. The detailed preliminary Scheme layout and general arrangement plans are included in Volume 3 of the PEIR, Appendix 4.C of

the PEIR, Preliminary Engineering Report (PER) Maps Plans and Drawings.

4.4.6 LLAU are taken into account in the environmental and other assessments to ensure that the likely significant effects in relation to each topic assessed would not be greater if these elements of the proposed development were configured elsewhere within the defined LoD for the Scheme. This is in line with Planning Inspectorate advice with regard to the use of the 'Rochdale envelope' (Ref 4-1). If the DCO is granted, the detailed design of the Scheme, would need to be reviewed to ensure that the environmental effects of the Scheme are no "worse than" those assessed in the EIA process.

4.5 Scheme design

4.5.1 The preliminary Scheme design is described in detail below and is accompanied by a detailed set of Preliminary Maps, Plans and Drawings in Volume 3, Appendic 4.C of the PEIR. These include: the master plan layout, preliminary Scheme layout, general arrangement plans, proposed and existing junction arrangements and highway tie-ins and typical cross sections and profiles.

Tunnel design

4.5.2 The 'tunnel' comprises a central twin-bored tunnel section approximately 1km in length, with cut and cover sections approximately 200m in length at each end. These elements are described further below.

Bored tunnels

4.5.3 The tunnel would comprise two broadly parallel bores, each of approximately 1.0km in length. The bores will be of circular cross section, with a proposed diameter of approximately 12m, and would be constructed using a Tunnel Boring Machine (TBM). A bored tunnel cross section through a typical cross passage and longitudinal section are included in Volume 3, Appendix 4.C of the PEIR.

4.5.4 The bores would be separated by approximately one tunnel diameter. Connecting cross-passages would be provided between the tunnel bores at maximum spacing of 150m.

4.5.5 The vertical tunnel alignment descends to a maximum depth of 30m, Tunnel Plan & Profile Drawings are provided in Appendix A of the Preliminary Engineering Report.

4.5.6 The entire tunnel would be constructed below the groundwater level, and the tunnel lining would be designed to resist water ingress.

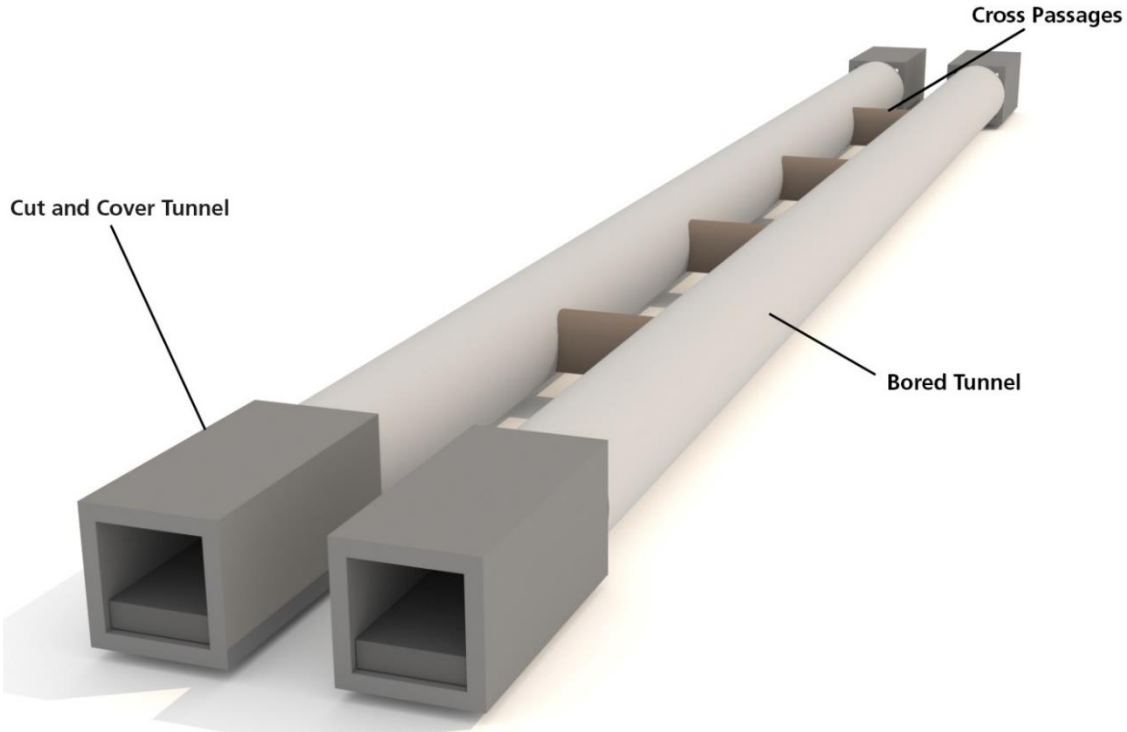
4.5.7 Each bored tunnel will include a TBM chamber at its interface with the cut and cover tunnel in order to facilitate its construction.

Cut and cover tunnel

4.5.8 The Greenwich (south) and the Silvertown (north) cut and cover tunnel sections, 0.2km in length at each end of the tunnel, would each comprise two separate two-lane carriageways continuing from the bored sections of the tunnel.

4.5.9 The cut and cover tunnel sections would be rectangular in cross-section, and are likely to be constructed using secant pile walls, and cast in-situ reinforced concrete inner lining walls, bases and the roof slab. A cut and cover tunnel typical cross section is included in Volume 3 of the PEIR, Appendix 4.C.

Figure 4-1 Tunnel schematic arrangement



Tunnel portals

4.5.10 The tunnel portals form an integral part of the cut and cover sections and are also, therefore, similarly likely to be constructed using secant pile

walls, and cast in-situ reinforced concrete inner lining walls, bases and the roof slabs. Northern and south portal cross sections are included in Volume 3 of the PEIR, Appendix 4.C.

Tunnel ventilation

4.5.11 The tunnel ventilation system (TVS) proposed for the Scheme comprises two separate functional elements:

- Longitudinal TVS (LTVS) for the control of air quality inside the tunnel during non-emergency operation and for the protection of evacuees during an emergency. During normal operations, the 'piston' action of moving vehicles would provide a degree of forced ventilation without the need for jet fans. The tunnel would therefore effectively be self-ventilating during periods of continuous traffic at speeds greater than 20 km/hr. In the event of congestion occurring within the tunnel, jet fans mounted in the crown of the tunnel will be activated.

- Portal Extract Ventilation System (PEVS) would be provided for vehicle emissions to be exhausted during normal operations via the tunnel exit portals. Based upon the design criteria established by the air quality modelling, the PEVS is required to divert a minimum of 50% of the tunnel emissions to a high level discharge at the portals to limit the extent of road level portal emissions. The operation of the PEVS will vary with the prevailing traffic and wind characteristics and the operating principles are to be developed at detailed design stage to optimise the operation for energy consumption and performance.

4.5.12 The extractor fans for the PEVS would be housed within ventilation buildings located with the service buildings at each portal, the design of which is referred to in further detail below. The design proposals currently include the provision of high level ventilation outlets at both portals. The ventilation shaft is at present envisaged to discharge the exhaust air vertically at +25m above surrounding ground level.

Tunnel service buildings and plant rooms

4.5.13 Tunnel services buildings would be provided close to the tunnel portals, within a secure compound that provides parking facilities for maintenance vehicles. The tunnel service buildings would contain the electrical and mechanical systems required to operate the tunnel. They would also contain limited welfare facilities to allow their use as a base of operations

for tunnel maintenance staff. The tunnel services buildings would also make provision for local control of the tunnel facilities.

4.5.14 The majority of the operational plant and equipment for the tunnel would be housed within a service building structure of approximately 1,500m^2 plan area at each portal. Buildings would be a maximum of two storeys high. Electrical transformers would be located within a fenced bay within each compound. Hardstandings and vehicle access roads would be provided around the compound to facilitate the safe movement of service vehicles and personnel undertaking maintenance tasks.

4.5.15 The form, scale and massing of the service buildings would be designed to be visually discreet and fit in with the surrounding context.

4.5.16 The northern service buildings are located above ground. The buildings would be designed so that the visual appearance breaks down their scale and massing at the same time as creating a landmark structures of high design quality. The buildings would be urban in style but may also incorporate green walls and roofs to help improve air quality, support sustainable urban drainage, provide habitats and breakdown the visual size of the buildings.

4.5.17 The ancillary service building is single storey with level direct access to all areas via the new access road. To enhance their appearance the tunnel side façade can incorporate a “green wall” planting.

4.5.18 The southern service compound is located to the south east of the portal with the ventilation building adjacent to Millennium Way and the ancillary service buildings behind hidden from view.

4.5.19 The buildings would be designed to create landmark structures with distinctly different design principles on the vehicular (west) and pedestrian (east) sides of the buildings. To the west the style would recognise the transport infrastructure function of the buildings while to the east a more urban, human scale approach would be taken that breaks down the bulk of the buildings.

4.5.20 The internal layouts of the service buildings would be arranged to maximise direct access to areas at ground level and provision for welfare facilities for personnel would be incorporated into the building layouts. The ventilation buildings would be located directly above the emerging traffic lane at each portal. The proposd location of service and ventilation

buildings are shown on the general arrangement plans in Volume 3 of the PEIR, Appendix 4.C.

4.5.21 Applications for temporary and permanent energy supplies for the construction and operational phases respectively have been made to the appropriate utility provider. These are the subject of ongoing discussion to ensure that the Scheme demands can be met along with that of other developments in the area and utility network improvements.

Highway

Design speeds and stopping sight distance

4.5.22 The speed limit in and around the Blackwall Tunnel is 30mph, rising to 50mph south of Blackwall Lane junction. The Silvertown Tunnel would also be designed for 30mph speed limit, to provide continuity on the highway network and improve driver safety in the urban environment.

Highway alignment and junctions

4.5.23 At each end of the tunnel, the carriageways would tie-in to the existing road network at grade, transitioning to the tunnel portals in short lengths of retained cutting increasing in depth from around 0.5m to 9.0m.

Highway alignment and junctions – northbound carriageway

4.5.24 The A102 Blackwall Tunnel Approach Northbound alignment would widen from three lanes to four, north of the entry-slip from Blackwall Lane junction. The two left-hand lanes would lead to the Blackwall Tunnel. The two right-hand lanes would form the new approach to the Silvertown Tunnel. They would diverge away from A102 Blackwall Tunnel Approach Northbound, pass underneath the realigned A102 Blackwall Tunnel Approach Southbound carriageway before entering the Silvertown Tunnel southern portal.

4.5.25 The northbound carriageway of the Silvertown Tunnel would then emerge at the northern portal, north of the existing DLR viaduct, where the alignment returns to existing ground level by the modified Tidal Basin roundabout. The Silvertown northern tie-in existing and proposed junction arrangements are included in Volume 3 of the PEIR, Appendix 4.C.

Highway alignment and junctions – southbound carriageway

4.5.26 Southbound traffic approaching the Silvertown Tunnel would use the modified Tidal Basin roundabout, which would be elongated and signalised to enable the new link to tie-in. The roundabout layout would include a 'hamburger' link for traffic approaching from A1020 Lower Lea Crossing improving capacity and journey time. Figure 4-2 below shows the hamburger arrangement of the modified Tidal Basin roundabout.

Figure 4-2 Modified Tidal Basin roundabout

4.5.27 Upon exiting the southern tunnel portal, the alignment would rise to existing ground level alongside the A102 Blackwall Tunnel Approach to access either the A102 (becoming the A2) or the exit-slip to Blackwall Lane Junction towards Greenwich Peninsula, including the O2. The Greenwich Peninsula southern tie-in existing and proposed junction arrangments are shown on detailed drawings in Volume 3 of the PEIR, Appendix 4.C.

Highway alignment and junctions – side roads

4.5.28 At the northern end of the Scheme, Dock Road would be realigned to follow the embankment of the DLR and tie into the new Tidal Basin Roundabout.

4.5.29 On Greenwich Peninsula, Dreadnought Street would be extinguished to accommodate the widened A102 Blackwall Tunnel Approach carriageway whilst Boord Street would be stopped up at the A102 Blackwall Tunnel Approach, with access provided from Millennium Way only. West of the A102 Blackwall Tunnel Approach, Tunnel Avenue is currently severed close to the location of the existing Boord Street footbridge. Under the Scheme, Tunnel Avenue would be reconnected to provide a 2-way local access road along its full length from Blackwall Lane to Ordnance Way.

4.5.30 On the Greenwich Peninsula, a proposed bus-only link on Tunnel Avenue would provide access for buses to join the A102 Blackwall Tunnel Approach northbound into the Blackwall Tunnel. For buses heading southbound along the A102 Blackwall Tunnel Approach from the Blackwall Tunnel, a dedicated bus only exit-slip is proposed to allow buses to access North Greenwich bus station via Millennium Way. This would replace the existing facility that utilises Dreadnought Street and Boord Street that would be stopped-up. A further link would also provide access for buses and emergency service vehicles from Millennium Way into Silvertown Tunnel, via an access road near the southern portal.

4.5.31 Carriageway lane widths will be in accordance with the appropriate design standards. Non-motorised users (i.e. cyclists and pedestrians) would be prohibited from the tunnel so no allowance would be made for them in this part of the carriageway design.

Traffic signals

4.5.32 The modified Tidal Basin roundabout incorporates a ‘hamburger’ design enabling southbound traffic travelling southbound towards the tunnel to pass directly through the roundabout. This design relies on the roundabout being signalised. The traffic signals are designed to enable safe use of the junction for all road users and to maximise capacity at the junction. The key features of the signalisation provision would include the provision of Toucan crossings at all signalised arms to provide shared facilities for both pedestrian and cyclists. With the Dock Road arm not being signalised, a separate Toucan crossing would be located further south along Dock Road.

4.5.33 Junction and crossing controllers would be controlled via TfL's Urban Traffic Control (UTC) system allowing adoption of a

Non-tunnel structures

Blackwall Tunnel approach southbound overbridge

4.5.34 The proposed northbound approach to the Silvertown Tunnel would pass beneath a realigned A102 Blackwall Tunnel Approach Southbound carriageway. The existing Blackwall Tunnel Approach southbound would be raised onto a new bridge spanning across the new Silvertown Tunnel northbound approach as shown in Figure 4-3 below.

Figure 4-3 Blackwall Tunnel approach southbound overbridge

4.5.35 The bridge deck would be supported on abutments at either end which would also serve to retain the earth behind the abutments. The bridge deck would be formed from reinforced concrete or steel girders supporting an insitu concrete deck.

Boord Street pedestrian and cycle bridge

4.5.36 A safe crossing for non-motorised users would be maintained near Boord Street on the Greenwich Peninsula, to allow pedestrians and cyclists to cross the widened A102 Blackwall Tunnel Approach. The current footbridge would be demolished to accommodate the realignment of the road and replaced with a wider, shared-use structure.

4.5.37 The location of the replacement pedestrian and Cycle Bridge will take into consideration outline masterplans for the regeneration of the Greenwich Peninsula. Under the Scheme the replacement footbridge would be relocated south east of the existing footbridge, to make it more visible to users approaching along Boord Street as shown in Figure 4-4 below.

4.5.38 It is desirable to make this new bridge a single span. Approach ramps and stair access would be provided at each end of the footbridge making the bridge accessible to all in compliance with the Equality Act 2010.

4.5.39 The proposed bridge would have sufficient width to allow safe, un-segregated use by all Non Motorised Users's (NMUs) and the parapets would be high enough to provide combined cycle and pedestrian containment.

Figure 4-4 Illustrative Boord Street pedestrian and cycle bridge

Drainage Strategy

4.5.40 A drainage strategy has been developed adopting Sustainable Urban Drainage System (SuDS) principles using the appropriate design standards, which requires:

- no increase in the current discharge rate from the proposed Scheme to the existing drainage system owned by Thames Water;
- where proposed drainage connects into the existing watercourse, the discharge rates would be limited to greenfield run-off rate and subject to agreement with the owner of the watercourse ;
- a 20% capacity allowance is applied for climate change;
- additional paved areas deemed to be new development do not cause flooding in critical 1 in 5 year event, attenuation to be provided for the critical duration 1 in 100 year storm event; and
- routine spillage collection and emergency major spillage containment is provided.

Tunnel drainage

4.5.41 A linear kerb entry drainage system is proposed for tunnel drainage between portals to collect water carried in by vehicles, wash down water from cleaning operations, and liquid spillages in the event of incidents within the tunnels. Run-off collected by the verge drains would be conveyed via a system of collector drains and main carrier drains located within the tunnel invert to one of three sumps located within the tunnel. The effluent from the TBM chamber sumps would be pumped to the receptor drainage system adjacent to the tunnel service building at each portal. The water from the low point sump would be pumped to the receptor drainage system adjacent to the tunnel service building at the northern portal.

4.5.42 The low-point sump would be sized to accommodate spillage from a large tanker.

4.5.43 Any water which might collect over time in the tunnel invert (e.g. due to leakage of the carrier drain, fire main, tunnel lining etc.) would drain by gravity through the granular infill via the slotted carrier drain located in the invert of each bore to the low point sump.

4.5.44 It is proposed that the cross passage tunnels will drain into the carriageway kerb drainage system. The in-tunnel surface water drainage system will be a completely separate system from that used to collect surface water run-off from the tunnel approaches. Cross carriageway drains are not proposed at the portals, as the area of the approach roads external to the tunnel will drain into the external surface water drainage system.

Highway drainage

4.5.45 Cut-off drainage will be provided along the tunnel portal to intercept surface run-off. This will be designed for 1 in 5 year storms, with anything in excess of this being picked up by the combined drainage and kerb units within the tunnel.

4.5.46 Pumps will be installed at the portals to discharge water into the Thames Water drainage network at the southern end and into the River Thames open watercourse owned by the GLA at the northern end. All discharge up to a rainfall rate of 6.5mm/hour will be treated using petrol interceptors. Flows exceeding this rates will be allowed to bypass the interceptor. Manually operated penstocks provide a shutoff facility in the event of major spillage, with emergency impoundment facilities provided to contain contaminants and run-off during fire-fighting operations.

Lighting

4.5.47 A preliminary lighting design has been undertaken to establish the required lighting levels, the type of equipment to be used and the maintenance periods and regimes. All luminaires would use LEDs mounted on steel lighting columns.

4.5.48 All highway lighting, including within the tunnel would be in accordance with the appropriate design standards and guidance and use energy efficient illumination throughout. As set out in the Preliminary Design and Access Statement, lighting would also be used for personal security and to illuminate cycleways and footways.

4.5.49 The tunnel lighting system would be designed to give a level of illumination that would provide tunnel users with adequate visibility throughout and would be designed in three zones to take account of the light level changes experienced by the driver.

4.5.50 In the main body of the tunnel, is the interior zone where a standard level of illumination would be provided. At the entry and exit portals, are the entry and exit transitions zones respectively, where additional lights would be installed to allow the tunnel control system to 'match' the outside illumination levels.

4.5.51 Outside of the tunnels, at the Greenwich end, it is proposed that both the A102 and Tunnel Avenue are illuminated, which is consistent with the existing situation. Twin luminaire lighting columns (10m high) are proposed in the strip between the northbound A102 and Tunnel Avenue. The bus link from Millennium Way to the Silvertown Tunnel portal will also be lit. At the Silvertown end, all new carriageway, including the modified Tidal Basin roundabout, will be lit and will tie-in to existing street lighting along on the A1020 (Lower Lea Crossing) and Dock Road.

Road pavement and road surfacing

4.5.52 The design of road pavements would be carried out in accordance with the appropriate design standards and good practice. The road surface would be formed using a suitable material that meets with operational and maintenance requirements whilst also providing noise reduction benefits (as described in Chapter 14 of this PEIR).

4.5.53 High friction surfacing (HFS) would also be considered where high braking forces would be expected such as on approaches to junctions. Risk assessments would be carried out and the locations where HFS material would be used would be defined during the detailed design stage for each junction approach.

Signing

4.5.54 The proposed tunnel and the new highway would necessitate the need for substantial new signing in the area. Much of this signing would need to be supported on sign gantries, to provide the greatest visibility to road users as well as making optimum use of the available space.

4.5.55 As part of the Scheme, six sign gantries would be installed at the southern end of the tunnel and one gantry would be installed at the northern end to provide directional signing for strategic and local destinations. The gantry signs would be lit and elevated above the carriageways, an example is included in Figure 4-5.

4.5.56 Where possible, existing sign gantries would be used to support the new signing subject to confirmation of their design capacity. A number of new gantries are required however, and certain existing gantries would need modification to support additional signing.

4.5.57 Depending on their location, the proposed new gantries would either be portal steel truss gantries or cantilever tubular steel gantries.

Figure 4-5 Typical gantry and Variable Message Signs (VMS) signs

Landscape and urban design

4.5.58 The illustrative design for the Silvertown portal and vicinity is focussed around enhancements to the Tidal Basin Roundabout, which would be significantly reconfigured by the Scheme, with new arms to provide access to and from the tunnel, and a realigned Dock Road. This would create additional pockets of land which have the future potential to become development sites.

4.5.59 An overarching aim of the public realm design is to play down the presence of the roads so that the pedestrian spaces, planting and future buildings would define the character, not the roads.

4.5.60 Enhanced pedestrian and cycle routes alongside the new access roads are also a primary feature, in particular an extension of the existing off-road cycleway that runs on the southern side of the Lower Lea Crossing along Dock Road to tie into the routes that run around the Royal Docks themselves.

4.5.61 The illustrative design combines hard surfaces and landscape in the form of trees and low wildflower planting, and provides seating for pedestrians. The majority of the surfaces would be paved in a resin bound gravel material, which is suitable for both walking and cycling on, and which provides a low key surfacing that is not visually dominant, and which would minimise the visual impact of the macadam surface of the roads.

4.5.62 Unlike the Silvertown portal the illustrative scheme for the Greenwich portal vicinity is designed to optimise function and place making for vehicle drivers because it is not a pedestrian space.

4.5.63 There would be a number of grass verge areas created as part of the junction reconfiguration, and these will continue onto the embankments for the new flyover. The area between the flyover and the existing A102 Blackwall Tunnel Southern Approach road provides a greater opportunity for some additional tree planting, and a more extensive grass area beneath.

4.5.64 Appropriate landscape and planting would be included on the Millennium Way edge of the portal buildings to ensure that an appropriate edge is presented to future development.

4.5.65 The illustrative planting scheme is predominantly birch trees clustered on the island formed by the new flyover. These would be a mixture of Birch trees to match the scheme on the north side of tunnel. There would be no wildflower mixes used on the south, with grass instead being a low maintenance standard mix which is more suited to the verges that would typify the design on the southern side.

4.5.66 The area around the Greenwich portal is designed for vehicles only rather than pedestrian and cyclists and the landscape proposals reflect this. There are no paved surfaces for pedestrians or cyclists, so the hard surfaces will all be in macadam or concrete to the highways specification. Likewise, no street furniture is proposed within this area is designed to optimise function and place making for vehicle drivers because it is not a pedestrian space.

4.5.67 The two exceptions to this is the landscape the landscape on Millennium Way by the portal buildings and the landscape around Boord Street footbridge. Both would be laid to fit in with the existing landscape to an equal or enhanced level of quality.

Pedestrian and cyclist facilities

4.5.68 Pedestrians and cyclists would not be able to use the Silvertown Tunnel for reasons of safety, security and poor amenity. They would, however, continue to be able to make use of the nearby EAL, which was constructed as part of the package of river crossings in east London, expressly to facilitate pedestrian and cyclist crossings.

4.5.69 At the northern end of the Scheme, a new footway/cycleway provision would be provided adjacent to the carriageway with signal controlled Toucan crossing facilities proposed at the modified Tidal Basin roundabout. Non-motorised user (NMU) routes have been designed to achieve the anticipated desire lines through the centre of the modified Tidal Basin roundabout. The footway/cycleway space has been laid-out such that a high quality, open feel is achieved, especially around the roundabout area. A controlled crossing would also be provided on the realigned Dock Road.

4.5.70 At Greenwich Peninsula, a new footway/cycleway would be provided adjacent to the reconnected Tunnel Avenue. In addition, the existing Boord Street Footbridge would be replaced with a new structure for pedestrians and cyclists with both step and ramp provision on both sides. This new bridge would be positioned at a location to better serve the pedestrian and cyclist desire lines to and from Boord Street. No on-carriageway cycle facilities would be provided on the A102 Blackwall Tunnel Approach, which leads principally into the Blackwall Tunnel or the proposed Silvertown Tunnel, where NMUs are prohibited. Under the Mayor of London's Transport Strategy (MTS), the EAL has been constructed to improve the opportunities for pedestrians and cyclists to cross the River Thames in east London.

4.5.71 To keep the street scene open with minimum street furniture the proposal is that pedestrian guard railing would only be deployed where a clear need exists.

4.5.72 Wayfinding signs would be incorporated into the Scheme alongside other pedestrian and cyclist enhancements to improve the movement and accessibility in the Silvertown and Greenwich Peninsula areas.

Utilities diversions

4.5.73 The approximate location of existing utility services and potential diversions have been assessed. The recorded positions of the apparatus

are indicative only due to the accuracy of records kept by asset owners. It would be necessary to confirm the location of all apparatus on site at the detailed design stage, prior to finalising detailed proposals for diversions.

4.5.74 Utility diversion corridors have been proposed to relocate any services that conflict with the construction of the Scheme. The principle of the utility corridor is to have all utilities diverted along the same route in the same trench with the appropriate spacing to the meet with National Joint Utilities Group (NJUG) guidelines (Ref 4-2).

4.5.75 Disruption of existing services would be minimised through careful planning and liaison with the utility providers and construction works programme. This would enable the efficient diversion of utilities and prevent excessive outage periods to those fed by the same supply.

4.6 Construction processes and methods

Construction management

4.6.1 The construction methodology set out here, and in more detail in the relevant PEIR chapters, has been developed to inform the assessment of the environmental impacts of the Scheme. It presents a practical and achievable approach to the construction of the Scheme, however the methodology ultimately employed for would be determined and is dependent upon the detailed design and the methodology developed by the appointed contractor in accordance with the parameters of the DCO.

4.6.2 A Code of Construction Practice (CoCP) (a preliminary version of which is located in Volume 3, Appendix 4.A of this PEIR) will be included with the DCO application for development consent, and will set out the principles for the preparation of a Construction Environmental Management Plan (CEMP). The CEMP will ensure that any construction methodologies employed are consistent with the assessments and mitigation measures set out in the ES. The CEMP will be completed and approved by relevant stakeholders prior to the start of construction.

4.6.3 During the construction phase all activities undertaken would be subject to a health and safety and environmental risk assessment. Where works require the consent or approval of any external body or authority this approval would be obtained prior to construction works proceeding.

4.6.4 The works necessary to complete the Scheme are complex but can be sub-divided into a number of elements which when planned holistically

could be constructed in a logical and safe manner. The main elements of the Scheme include:

- construction compounds;
- surface works – Silvertown;
- surface works – Greenwich;
- bored tunnel works;
- cut and cover tunnel works;
- testing and commissioning; and
- demobilisation.

Scheme construction timescales/construction phasing

4.6.5 Subject to the Scheme receiving DCO consent and based on the current programme, main construction works could commence as early as October 2018 and would last approximately four years as shown in Figure 4-6, below. The programme derived is considered realistic at this stage of the design with future opportunity available under the detailed design and construction stages to reduce this.

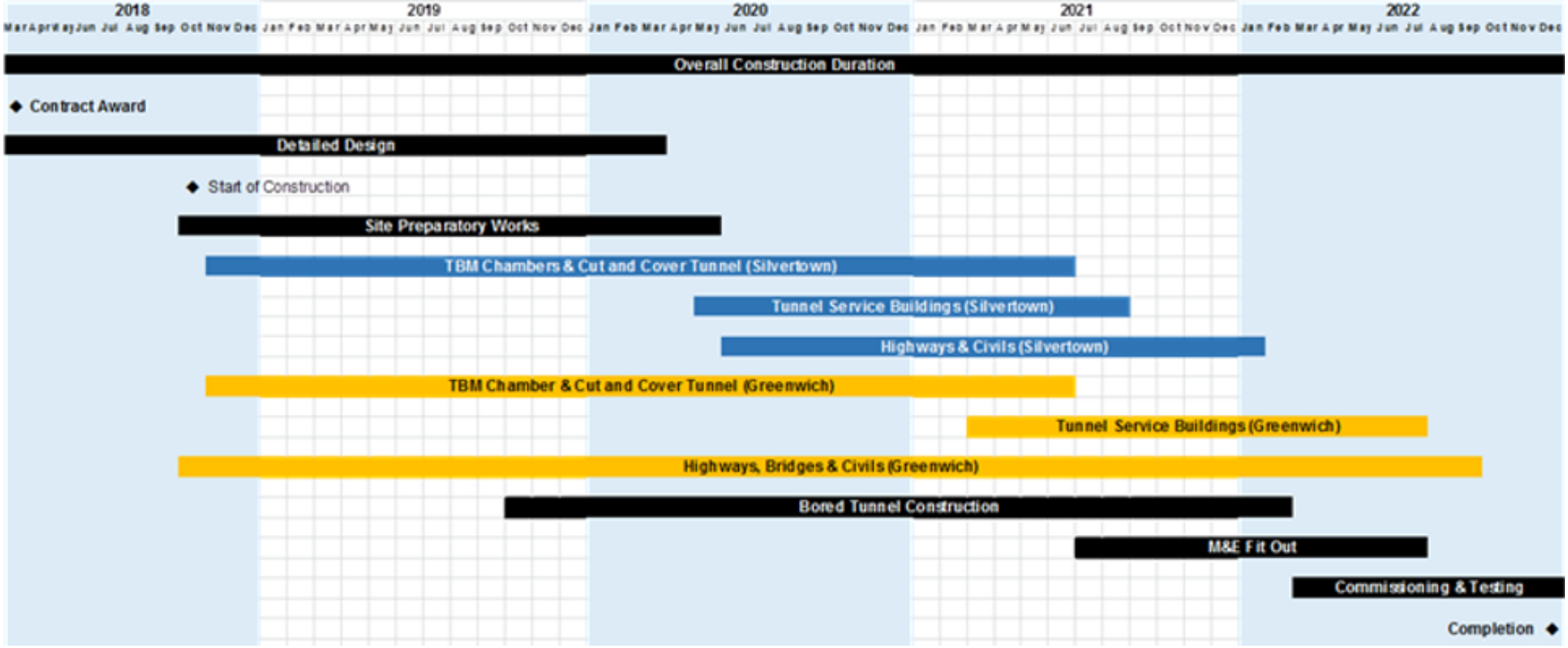
4.6.6 The construction of the TBM chambers would be the critical item to permit the bored tunnelling works to progress. Piling activities for cut and cover structure formation would follow. Once the TBM chambers are completed the TBM could be prepared for launch and the tunnelling activities could commence.

4.6.7 The necessary reconfiguration of the existing highway networks at Silvertown and Greenwich would progress in parallel with tunnelling activities. These works would be phased in order to limit any adverse impact on traffic movements in the surrounding areas.

4.6.8 Highway construction through the tunnels and installation of M&E equipment would commence on completion of the tunnelling activities.

4.6.9 The works would culminate in a period for commissioning and testing of the new tunnel safety systems prior to bringing the tunnels into full operation.

Figure 4-6 Construction overview programme



Advance works and site preparation

4.6.10 Advance works would be undertaken prior to main works starting on site at both Silvertown and Greenwich worksites. This would significantly aid in the efficient delivery of the scheme. These works may include but not be limited to:

- advance (pre-construction) surveys;
- site clearance (to be completed during the ecological dormant season);
- fencing and footway diversions;
- contaminated land remediation if required;
- archaeological evaluation (if required); and
- utilities diversions.

Construction compounds

4.6.11 Site compounds would be established at the commencement of the works and would remain throughout the construction phase. The layout of construction compounds needs careful consideration to ensure a safe, secure and efficient base for operation and associated construction activities. A preliminary Scheme construction works area drawing is included in Volume 3 of the PEIR, Appendix 4.C.

4.6.12 The main site compound or work site would be located at Silvertown as shown in Figure 4-7, and would typically contain offices, stores, plant maintenance facilities, materials testing laboratory, recycling facilities, medical and welfare facilities, blacktop and potential concrete batching plants, materials stockpiles and a wheel wash. This site has been selected as the best location for the option of utilising Thames Wharf for marine logistics. This would, if available, enable the efficient management of excavated material removal and material deliveries by river and thereby reduce the increased demand on the local highway network.

Figure 4-7 Silvertown works area

4.6.13 The satellite compound at Greenwich, as shown on Figure 4-8 would contain sufficient offices and welfare facilities to support the surface works to be undertaken on the peninsula.

Figure 4-8 Greenwich worksite

4.6.14 All of the tunnelling activities would be supported from the Silvertown Site. The only potential exception to this may be a tunnel segmental lining storage area established at this compound to provide segments to the second drive.

4.6.15 Suitable excavated material (known as arisings) from the tunnel and other earthworks would be stockpiled in the site compounds and then used to restore the land to its original condition when the area is reinstated or to prepare it for landscaping, if they are not found to be contaminated.

4.6.16 The area of compound to be occupied at each of the locations would provide sufficient space to undertake the works without taking space that is non-essential to the construction. The shape of the site compound adopted to support the construction of the works would also take into consideration the proximity of surrounding development.

Surface works – Silvertown

4.6.17 This section describes the works required to construct the approach ramps, retaining walls, highway connections and service compounds at

Silvertown. Figure 4-9 below demonstrates the elements of work to be undertaken within the three phases of the surface works at Silvertown as identified in the outline construction programme.

Phase 1

4.6.18 Tunnelling related earthworks would commence during this stage including piling for the retaining walls on the tunnel approaches, for the cut and cover section of the tunnel and for the TBM launch chamber.

4.6.19 The elongated circulatory carriageway extension to the Tidal Basin Roundabout would be constructed along with the realignment of the A1020 Lower Lea Crossing and the link to Dock Road. This would cause minimal disruption to the existing traffic flow with localised temporary traffic management required to facilitate the tie-in to the new construction.

4.6.20 Access from North Woolwich Road would be stopped up at the site boundary and Dock Road would be closed during the works. A turning facility would be constructed at the severed end of North Woolwich Road so that access is maintained.

4.6.21 Tunnel service building construction would commence following the completion of the tunnel launch process and Royal Victoria Dock Drainage diversion.

Phase 2

4.6.22 Traffic would be diverted around the modified Tidal Basin Roundabout which would enable the redundant sections of carriageway to be removed. The southbound link from the A1020 Lower Lea Crossing would be constructed to connect with the hamburger link through the modified Tidal Basin Roundabout.

4.6.23 Drainage attenuation tanks would be constructed and traffic signals would be installed at this stage but these would not be operational until later.

4.6.24 Tunnel ventilation building would be with other service building construction ongoing during this phase.

Phase 3

4.6.25 All tunnelling related earthworks would be completed during this stage including the piled retaining walls for the tunnel approaches and the reinforced concrete ground slab beneath the carriageway. These works

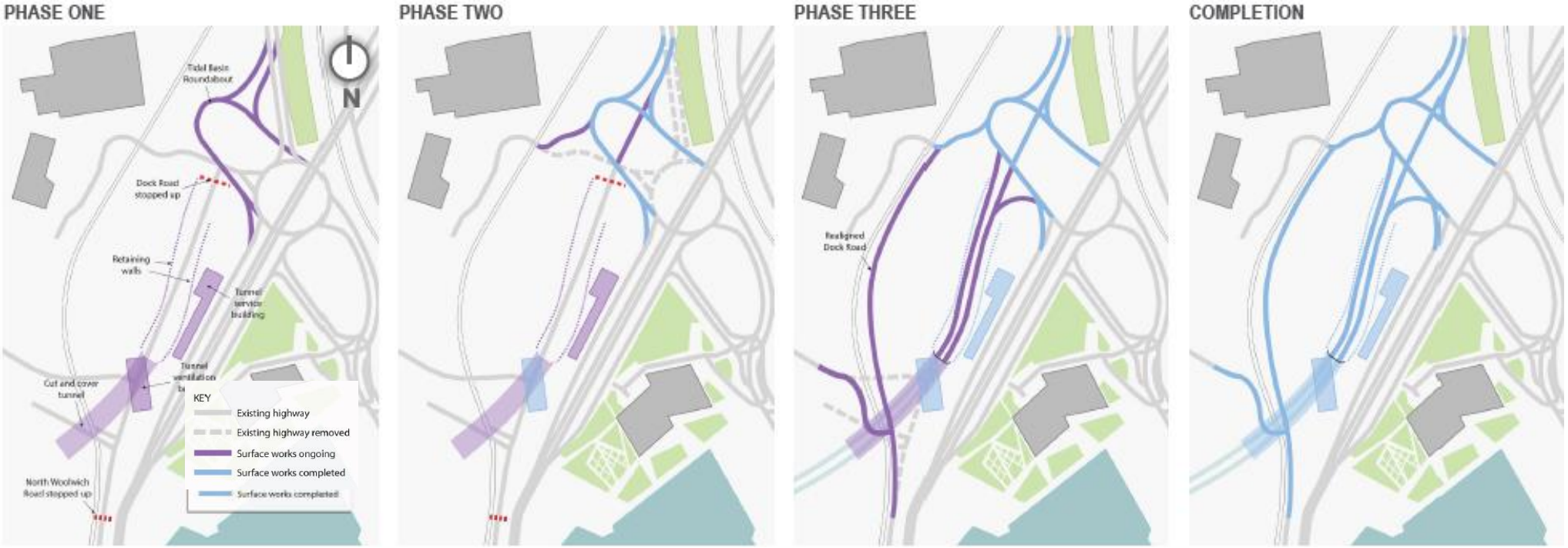
would enable the construction of the northbound and southbound carriageways from the modified Tidal Basin Roundabout along the tunnel approach ramps down to the tunnel portal.

4.6.26 A gantry would be erected over the carriageway on the tunnel approach and fittedout with signage, CCTV and RUC equipment.

4.6.27 The realigned Dock Road would be constructed across the cut-and-cover structure of the tunnel to tie-in at the modified Tidal Basin Roundabout. The final areas of redundant carriageway would be broken out and all remaining works including drainage, street lighting, and landscaping works would be completed. The traffic signals would become operational once these works were complete and the tunnel had been opened.

4.6.28 Tunnel service buildings including associated compound access roads and landscaping would be completed.

Figure 4-9 Phase one to four and completed - Silvertown



Surface works – Greenwich

4.6.29 This section describes the works required to construct the approach ramps, highway connections and service compounds at Greenwich, A102 Blackwall Tunnel Approach overbridge and Boord Street footbridge. Figure 4-10 and Figure 4-11 (below) demonstrates the elements of work to be undertaken within the four phases of the surface works at Greenwich as identified in the outline construction programme.

Phase 1

4.6.30 Retaining walls for the tunnel approach ramps would be constructed. The A102 Blackwall Tunnel Approach overbridge abutments and bridge deck would also be constructed in this phase to enable the A102 Blackwall Tunnel Approach Southbound diversion in Phase 2. The bulk excavation between the retaining walls would begin at this stage to create the tunnel approach ramps.

4.6.31 Construction of the replacement Boord Street foot and cycle bridge would be completed followed by demolition of the existing footbridge. This would need to be done during night time working with short term road closures with the works over an live carriageway. Disruption to pedestrians and cyclists using the footbridge crossing would be minimised by delaying the demolition of the existing bridge until the new bridge and stepped access had been opened. The ramps for the existing footbridge could then be demolished to allow construction of the new access ramps.

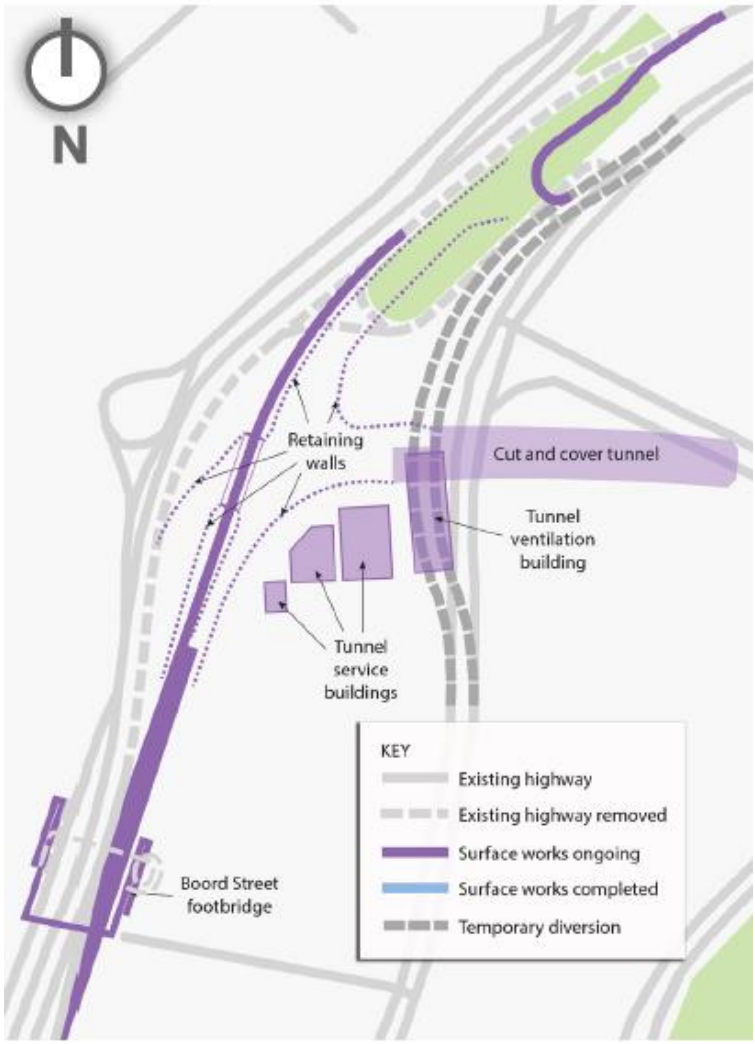
4.6.32 During Phase 1 the new alignment of the southbound A102 could be constructed offline with minimal disruption to the existing A102 Blackwall Tunnel Approach. The tie-in to the existing carriageway may need to be completed during night time working and with temporary lane closures. Partial construction of the Bus Link to Millennium Way using similar techniques would also occur in this phase.

4.6.33 The methodology foresees a temporary diversion of Millennium Way during this phase to allow the construction of the southern tunnel portal. The piling works would be stopped short of the road and the structure completed. Millennium Way would then be diverted over the completed section of the cut and cover structure as the piling works resume. Traffic would be moved back to the original alignment once the cut and cover structure is complete.

4.6.34 Edmund Halley Way would still require temporary closure to permit the construction of the cut and cover tunnel but Millennium Way access would be maintained throughout construction removing the need for a temporary diversion across the area where the multi-story car-park construction is proposed.

4.6.35 Tunnel service buildings construction would commence following the completion of reception/launch chamber. The ventilation building would be completed during this phase with the other service building construction ongoing.

Figure 4-10 Phase One - Greenwich



Phase 2

4.6.36 During Phase 2 the southbound traffic on the A102 Blackwall Tunnel Approach would be diverted over the newly constructed Bridge. This

enables the removal of the existing central reserve and construction of the full depth carriageway and temporary safety barrier. An access to this area of works would be necessary from the live carriageway or from beneath the bridge.

4.6.37 Construction of the other tunnel service buildings would be ongoing.

Phase 3

4.6.38 On removal of the central reserve, traffic on the northbound A102 Blackwall tunnel approach would be diverted to the original southbound carriageway and would re-join its original alignment at the Gatehouse structure. This allows construction of the new northbound alignment along with widening of Tunnel Avenue.

4.6.39 The remaining tunnel service buildings including associated compound access roads and landscaping would be completed.

Phase 4

4.6.40 During Phase 4 the northbound and southbound traffic would be running in the permanent configuration. A piling rig would be remobilised to complete the retaining walls. The bulk earthworks could be completed for all new alignments. Following completion of the earthworks a reinforced concrete slab could be cast at the base of the secant pile wall

4.6.41 All finishing works remaining including drainage, street lighting and landscaping works would be completed.

Figure 4-11 Phase one to four and completed - Greenwich

Tunnelling works

4.6.42 The bored tunnel section could be excavated through the use of a TBM.The type of TBM selected could be one of two options, using either a slurry shield or earth pressure balance machine.

4.6.43 Final TBM selection would be determined by the contractor based on their assessment of the construction risk with consideration given to the tunnel alignment, depth and associated ground pressure, ground cover, anticipated geology and depth of the water table.

4.6.44 These two machines are similar in many ways. However, the condition of the excavated material produced by these different methods is very different. The condition of the material excavated by the slurry shield TBM requires treatment at the surface in order to separate the slurry used in the excavation from the excavated material.

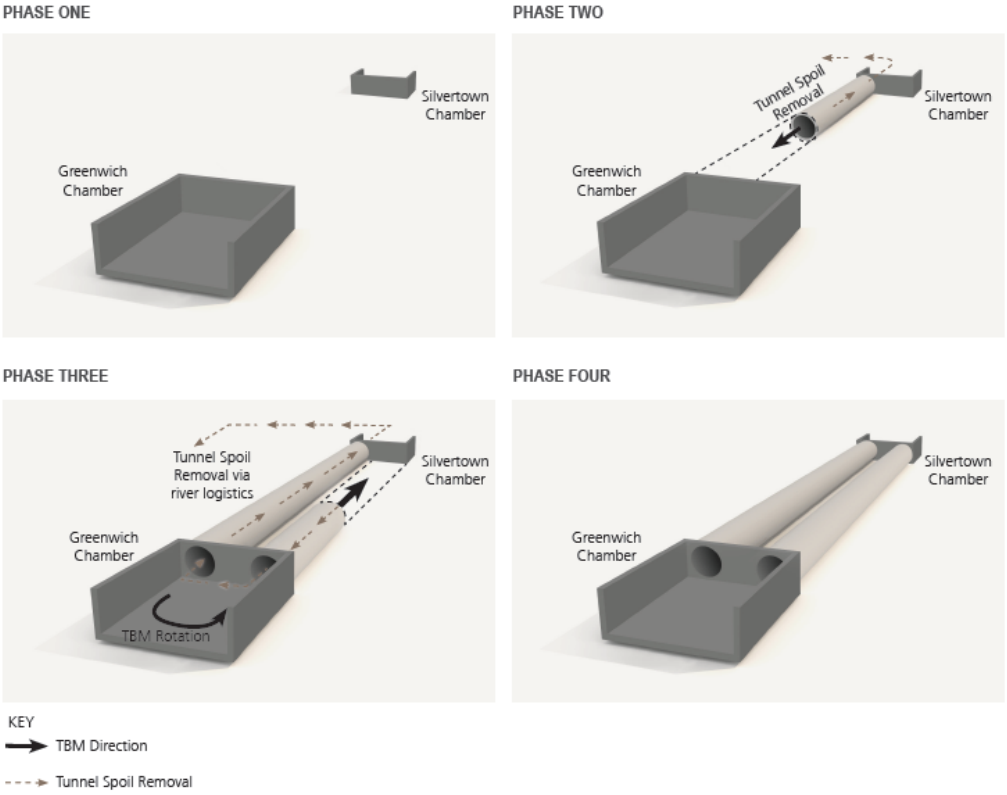
4.6.45 The Scheme design has therefore ensured that sufficient temporary land is available for slurry separation plant if this option is adopted.

4.6.46 In each case, the excavated tunnel would be lined with a segmental concrete lining formed of precast concrete elements. The Scheme Design has assumed that the concrete segments would be cast off site and delivered to site via either river or road.

4.6.47 Large deep chambers – TBM launch chambers – would be required at each end of the tunnel for the launch, reception, and rotation of the TBM. The chambers would be constructed using secant piling or similar techniques as for the retaining walls for the cut and cover tunnel sections. Construction of these chambers is a critical element of the Scheme which must be completed to enable the tunnel works to begin.

4.6.48 This construction methodology has assumed that the TBM would commence from the launch chamber at Silvertown and head southbound beneath the River Thames emerging into the reception chamber at Greenwich Peninsula. Once the TBM has reached the reception chamber it would be rotated before undergoing a period of maintenance to prepare for the next tunnel drive. The launch preparation would then be repeated from the first drive and the TBM would begin tunnelling the second drive northbound beneath the River Thames to create the second bore, finishing up at the Silvertown launch chamber as shown in Figure 4-12.

Figure 4-12 Tunnel construction phasing

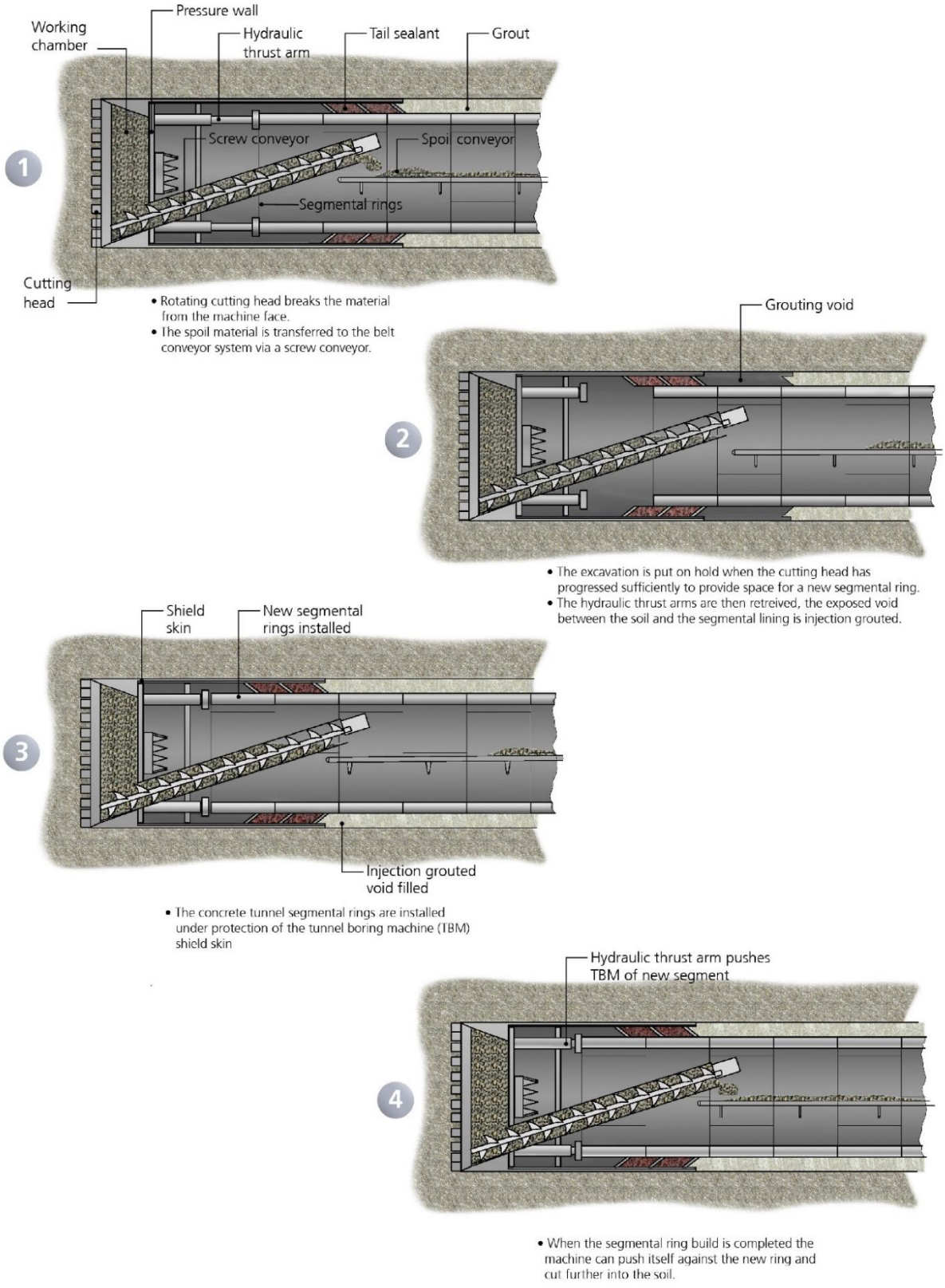


4.6.49 As the excavation progresses, the TBM advances forward propelled by pistons located to the rear of the TBM structure. Once an excavation advance has been completed the pistons would be sequentially retracted to permit the installation of the segmental lining whilst permitting the face pressure to be maintained. The TBM construction process is detailed further in Figure 4-13 below.

4.6.50 Once the TBM has reached the reception chamber it would be rotated and have the required maintenance completed. The launch preparation would then be repeated from the first drive and the TBM would begin tunnelling the second drive as per the first.

4.6.51 Noise and vibration monitoring would be undertaken at existing sensitive assets along the tunnel alignment. Initial noise and vibration monitoring would be undertaken following commencement of excavation, and prior to the TBM passing under any existing sensitive assets in order to adjust excavation methods if required, to achieve specified noise and vibration criteria.

Figure 4-13 TBM construction process



Cut and cover tunnel construction

4.6.52 The approaches to the bored section of tunnel at either end would adopt cut and cover techniques to form the sections of the tunnel that are too shallow to be completed using the TBM and are too deep to remain in open cut. This methodology adopts a basic method of forming a wide trench in which the tunnel structures are constructed. The ground above the structure would subsequently be reinstated to permit use in the surrounding area for public spaces, roads or small buildings. If larger structures are required to span the cut and cover tunnel, their foundations must be designed accordingly to allow for the tunnel.

4.6.53 The Scheme proposes that the walls of the cut and cover structures would be formed using secant piling techniques although other methods exist. Secant piling adopts an overlapping pile configuration to create a continuous wall to support the opening as the cut and cover structure is formed. The piles would form an integral part of the structure.

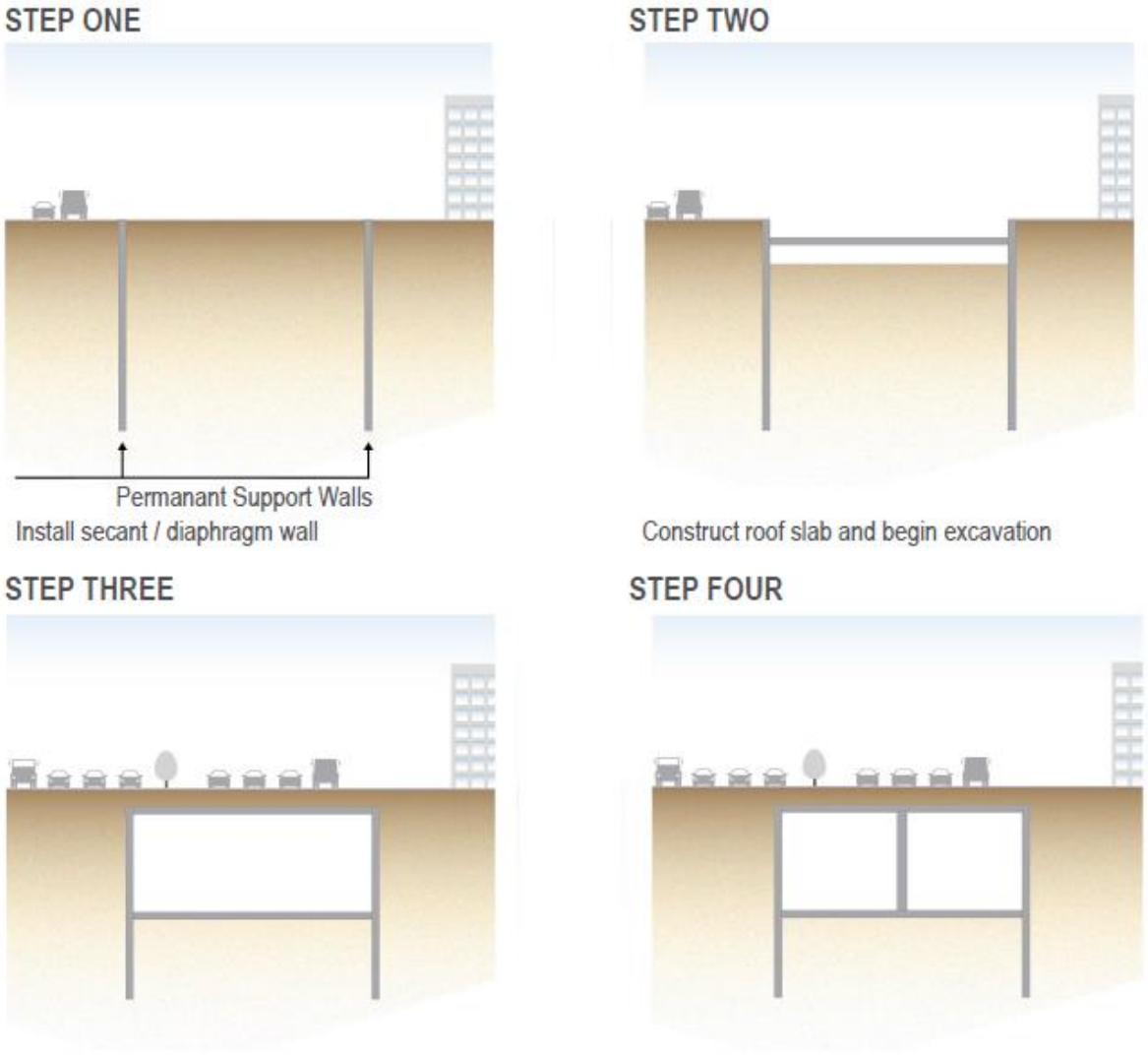
Top down construction

4.6.54 This method is proposed for the majority of the cut and cover areas except for those areas of restricted headroom or known underground obstruction. This method entails excavating down between the piles over where the section of tunnel is to be constructed. When the level for the roof slab is reached the roof would be constructed as shown in Figure 4-14.

4.6.55 Once the roof slab has been formed the overlying ground could be reinstated to permit other activities to progress at the location or free up space for other construction works which is the main benefit of this technique since the roof slab replaces the need for temporary propping.

4.6.56 The works to construct the structure would progress from one of the end faces where there is a means of access. Both ends could be used to gain access for the remainder of the construction process.

Figure 4-14 Top down construction method



Bottom up construction

4.6.57 As the name suggests, this method forms the permanent structure from the bottom upwards by conventional civil engineering techniques. The trench between the rows of piles is excavated with temporary propping installed as the excavated face progresses down to prevent destabilisation as shown in Figure 4-15.

4.6.58 This method of construction has the benefit of increasing the accessibility of the works without restricting working headroom enabling such activities as excavating through the dock structure to be undertaken with the necessary equipment and not be restricted by working beneath the roof slab.

Figure 4-15 Bottom up construction method

Non-tunnelling construction works

4.6.59 Works to be undertaken at the surface include:

- Approach Highways - The new sections of carriageway and ancillary works would be constructed in accordance with the Specification for Highways Works. The method of construction would be dictated by the exiting highway alignment, traffic management phasing and ground conditions;
- Retaining Walls - Secant piled retaining walls would be installed beyond the cut and cover structures at each portal to allow construction of the new carriageways below the ground level. Tension piles would be installed below a concrete slab to prevent floatation of the structure due to groundwater pressure;

- Blackwall Tunnel Approach Southbound Overbridge - The abutments to the Blackwall Tunnel Approach Southbound Overbridge would be formed by extending and cladding the secant piled retaining walls. A steel and concrete composite deck would span the abutments providing a minimum headroom clearance of 5.3m to the northbound alignment below;

- Boord Street Pedestrian and Cycle Bridge - The existing deck of the Boord Street footbridge would be demolished following the installation of the new pedestrian and cycle bridge and stepped access. These works would need to be carried out during night shifts with road closures as the works are over the live carriageway. Disruption to users of the footbridge would be minimised by delaying the demolition of the existing footbridge until the new footbridge and stepped access has been opened. The ramps for the existing footbridge could then be demolished to allow construction of the new access ramps; and

- Tunnel service buildings - The Tunnel services buildings and ventilation structures would be constructed using traditional construction methods and materials to ensure that their presence integrates into the surrounding environment. They would be constructed within a compact compound that would provide suitable access and accommodation for operational and maintenance requirements.

Construction waste

4.6.60 Details on management of waste are provided in the Preliminary CoCP, Volume 3, Appendix 4.A and Chapter 13 on Materials of the PEIR and the Preliminary Site Waste Management Plan.

4.6.61 All waste arisings from the Scheme, including from tunnel excavation and cut and cover works would be disposed of to a suitably licensed site.

4.6.62 As with other similar construction projects, and where possible, excavated materials would be sent for beneficial reuse to a site such as Wallasea Island on the Essex coastline. Wallasea Island is part of the Royal Society for the Protection of Birds (RSPB) project to transform the whole island into a wetland habitat. The volume of excavated material that could be transported will depend on the suitability and condition of the material for transport by river and for the intended end use.

4.6.63 The historical use of the relevant areas on the Greenwich Peninsula and Silvertown has left a legacy of contamination of the made ground and river

terrace gravels. Where possible, materials would be remediated to make them suitable for re-use. This remediation can be undertaken either on-site, permitting disposal with all inert materials, or removed from site for treatment off-site at a licenced treatment centre.

4.6.64 Where remediation of materials is not possible, these would be disposed of at a suitably licensed site.

Construction traffic

4.6.65 Details of construction traffic forecasts are provided in the Preliminary Transport Assessment.

4.6.66 In line with current TfL policy, it is proposed that, where reasonably practicable, materials and waste associated with the Scheme would be transported to and from the Silvertown site by river. However, the volumes or materials and waste that could be transported by river would be highly dependent on ground conditions and detailed construction methodologies. Therefore, for the purposes of the EIA, the worst case has been assumed, where all construction traffic, including excavated material removal, would be undertaken by road.

4.6.67 The approximate number of lorry movements by works element and site are presented below in Table 4-1, indicating a scenario allowing for river transport of excavated spoil alongside a worst case scenario where all construction traffic would be undertaken by road. The table indicates that excavated material removal by river barge could reduce road-based construction traffic by over 89,300 two-way lorry movements over the duration of the works (the difference between the worst case of 155,200 trips and the forecast of 65,900 including use of the River Thames).

Table 4-1 Estimated two-way lorry movements over four year construction period (with river transport and worst case – inbound and outbound trips)

Works element	Silvertown site (with river transport)	Silvertown site (worst case)	Greenwich site
Site buildings	2,600	2,600	2,000
Cut and cover tunnel	18,100	41,100	38,600

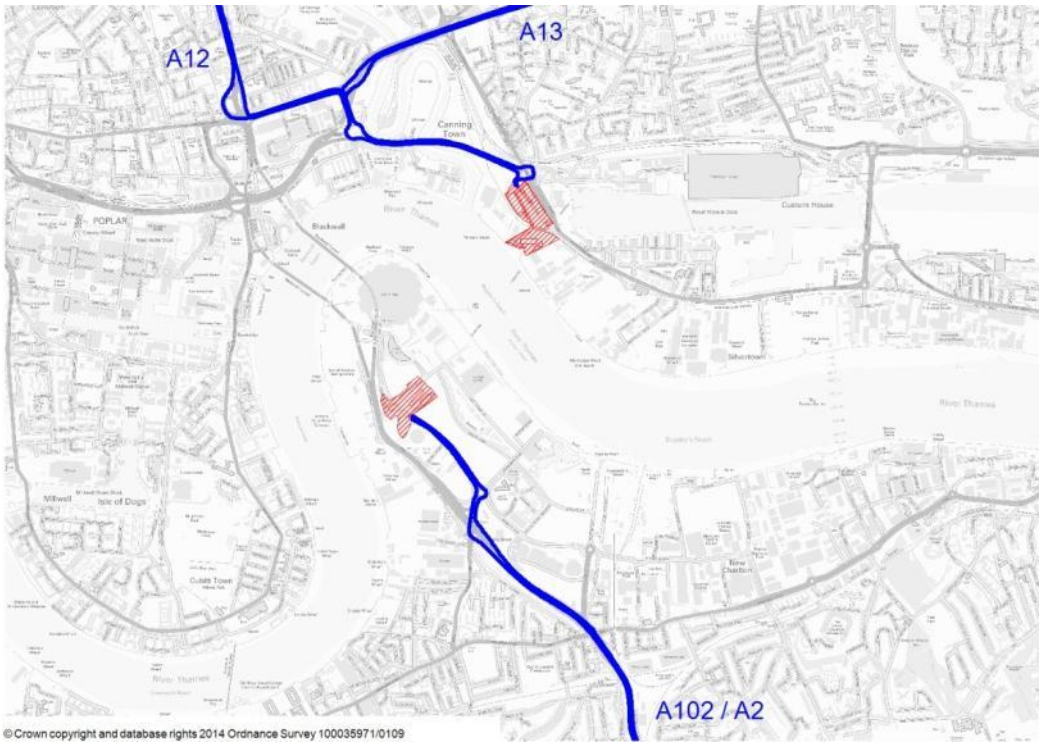
Works element	Silvertown site (with river transport)	Silvertown site (worst case)	Greenwich site
Bored tunnel	29,000	86,500	-
Highways	4,400	13,200	24,100
Mechanical and electrical	2,500	2,500	2,500
Landscaping	1,000	1,000	1,000
Site establishment	7,300	7,300	3,400
TBM delivery/removal	1,000	1,000	-
Total	**65,900**	**155,200**	**71,600**

4.6.68 Construction Traffic Management Plans (TMPs) will be prepared for both working sites and these will include further details of the expected number of lorry movements per day during the construction phases.

4.6.69 The Silvertown works site would require a larger number of lorry movements due to the larger working areas. The vehicular access point to this site would be via the current alignment of Dock Road from the Tidal Basin roundabout. The CMP would include HGV routes from the strategic road network to the site. The principal HGV route from the A13 and A12 to the site would be via Leamouth Road and the Lower Lea Crossing(Figure 4-16)). HGV drivers would be required to avoid Canning Town to minimise the impact on residential areas and to avoid Silvertown Way, which does not offer a direct route into the Tidal Basin roundabout.

4.6.70 The TMP would also confirm arrangements for a lorry holding facility near to the site entrance, which could be located on part of the current Crossrail site accessed from the Lower Lea Crossing.

Figure 4-16 Proposed HGV works site access routes



4.6.71 The Greenwich site would require a smaller number of lorry movements, and the vehicular access point to the site would be from Millennium Way. HGVs could access the site from the A102 Blackwall Tunnel Approach via Blackwall Lane and there is space for a small lorry holding facility near to the site entrance if required.

Marine transportation

4.6.72 In line with TfL policy, and subject to detailed construction methodologies and ground conditions, the Scheme would seek to maximise marine transportation for construction materials and waste. Although the EIA assumes a worst case in terms of construction traffic by road, the implications of river transport (including construction and operation of the jetty) are also considered in the assessments.

4.6.73 The Silvertown works site includes a safeguarded wharf facility known as Thames Wharf, from which the majority of excavated material from both tunnel bores and some from the highways works could be transported. There is an existing Not always Afloat but Safely Aground (NABSA) facility along Thames Wharf believed to be in the order of 120m in length. A NABSA berth facility consists of a levelled section of river bed, which is cleared of debris and can be capped with a chalk layer. Provided the berth

is levelled, cleared of debris, possibly capped with a chalk layer, the integrity of the wall confirmed and fenders, ladders and other Life Saving Appliances (LSA) provided, the berth would be acceptable for use under the Scheme proposals.

4.6.74 In addition, the Scheme includes the potential for construction of a temporary jetty, respecting the requirement to maintain the navigable channel. The jetty would be approximately 75m in length and 5m wide, and would be constructed using hollow tubular steel piles embedded into the river bed. The jetty superstructure would probably consist of cross beam steel members with a pre-cast concrete deck, and would be equipped with a conveyor system. Temporary scour protection may be required around piles at the head of the structure and berth pocket which may consist of rock mattresses, rip-rap or concrete mattresses. Dredging would be required around the temporary jetty to allow for barge movements.

4.6.75 Following completion of Scheme construction, the jettywould be dismantled by first removing the concrete and steel superstructure first, followed by the removal of steel piles. The piles would be cut at bed level. The NABSA berth will remain in-situ and no further construction works are anticipated.

4.6.76 A Navigational Risk Assessment (NRA), included in Volume 3 of the PEIR, Appendix 4.B is being undertaken to determine whether the proposed construction works within the river can be carried out without significantly increasing the risk of conflicts with marine traffic within the navigable river channel.

4.6.77 The Principal Contractor would also be responsible for producing a full passage plan which would establish cycle times for loading, unloading and both journeys for ships in relation to tides.

4.6.78 Unlike at Silvertown, there is little or no opportunity to provide marine access to or from the Greenwich site for spoil removal or material delivery directly to the site at North Greenwich, leaving the only option for transportation to be via road. There would be an effort to ensure that once the TBM has started on the second drive and the conveyor system is operational in the chamber at the North Greenwich site, this would be utilised to transfer materials from Greenwich through to Silvertown for disposal using the river.

Hours of working

4.6.79 Hours of work would be in line with standard good practice for major construction works. Normal working hours for non-tunnel construction works are planned to be from 07:00 to 19:00 on weekdays (Mon-Sat excluding Bank Holidays), with the first and last hour restricted to start up and shut down activities such as maintenance, site briefings, meetings and training.

4.6.80 Where feasible, operations likely to cause disturbance and/or disruption would be limited to within these hours. However, some non-tunnel activities may be required outside these hours. These activities would include works that can only be undertaken during periods of road or rail closure, such as bridge span removal or placement over existing transport corridors. Works outside these hours would be subject to agreement with the local Environmental Health Officers (EHO).

4.6.81 Some minor activities, such as changes in traffic management operations, may be required out of hours on a more frequent basis, but this would not be expected to have a significant impact in the context of the existing movements of traffic.

4.6.82 Tunnel boring works, including operation of the materials conveyor, tunnel lining segment storage yard and the jetty (if used), will be undertaken on a 24 hour, seven days per week basis following commencement of the TBM launch for both tunnel drives. A 12 hour shift pattern has been adopted due to the relatively short nature of the tunnels to be constructed and minimal travelling time for access. Production has been assumed to occur for 6.5 days each week and the remaining half day is set aside for maintenance to ensure the on-going performance of the TBM and all associated equipment to prevent damage or breakdowns which would prove costly to the scheme.

Testing and commissioning

4.6.83 Upon completion of the main construction and safety systems fit out, the Silvertown tunnel would be subject to a testing and commissioning phase prior to opening. Initially, the individual tunnel safety systems as described in would be installed and tested in isolation. These systems would then be progressively connected and their combined functionality verified through integration testing.

4.6.84 Once all elements of the tunnel safety systems have been installed and integrated, acceptance testing would commence. Acceptance testing would be carried out in a series of increasingly comprehensive tests. This testing and commissioning methodology ensures that the testing is complete and thorough.

4.6.85 The successful completion of the acceptance testing marks the point at which the tunnel safety systems are commissioned and the tunnel could be opened to traffic. It should be noted that the thoroughness of the testing and commissioning phase is vital to the ongoing safety of the tunnel.

Demobilisation

4.6.86 Following the completion of the construction, testing and commissioning activities the temporary land used to construct the Scheme would be returned to existing land owners. This could be undertaken in a staged process to make land used on a temporary basis available to landowners in order to facilitate original operations or planned future developments. This would be of particular interest on Greenwich Peninsula and the masterplan proposals.

4.6.87 All construction facilities (offices, workshops, stores, material stockpiling areas waste facilities etc.) would be removed and the land would be reinstated to its previous condition.

Scheme operation

User charging

4.6.88 As part of the Scheme, TfL proposes to charge for the use of the Silvertown and Blackwall Tunnels for three principal reasons:

- to manage demand and ensure that the local road network can accommodate future traffic levels;
- reducing the environmental impacts of traffic congestion; and
- to help raise revenue money to pay for the construction and operation of the new tunnel.

4.6.89 For the purposes of this consultation, an indicative charge has been identified based on the conditions predicted to exist at the time the tunnel opens in 2022/23. These indicative charging levels have been used to

assess the likely traffic and environmental impacts of the scheme. Further information about the user charge is available in our Preliminary Charging Report.

4.6.90 The level of the charge would be set closer to the time that the Silvertown Tunnel opens, taking account of the conditions that exist at that time. This approach would maximise the effectiveness of the scheme in helping to resolve the challenges at the Blackwall Tunnel.

4.6.91 The charge would apply from 6am until 10pm every day, including Bank Holidays. The charge would apply each time a motorist entered the Blackwall or Silvertown Tunnels. Outside of these times, the tunnels would be free to use. The charge would be automatically collected by TfL, using systems similar to those we use to collect the Congestion Charge: there would be no toll booths at the Blackwall or Silvertown Tunnels. There are no proposals to introduce user charging at other east London crossings such as the Rotherhithe Tunnel or Woolwich Ferry as part of this scheme.

4.6.92 In common with many other charging schemes, larger vehicles would pay more to use the tunnels, reflecting the greater impact they have on maintenance costs, traffic and the environment. TfL would set up an account system, to make it easier to pay the charge. Users who set up an account would register their details with us, and we would collect the charge automatically for every journey they make through the tunnels.

4.6.93 Users who set up an account would pay a discounted amount that would vary by time of day and direction of travel. We would charge a higher ‘peak’ rate for those times and direction of travel when demand is greatest, as shown in Table 4-2 below.

Table 4-2 Indicative charging structure

Time of Travel	Travelling northbound	Travelling southbound
0600 - 1000	Peak Rate	Off-peak rate
1001 -1600	Off-peak rate	
1601 - 1900	Off-peak rate	Peak Rate
1901 - 2200	Off-peak rate	
2201 - 0559	Free	

4.6.94 Table 4-3 indicates how the charge might vary between peak and off-peak times. The charges are expressed at today's prices.

Table 4-3 Indicative charges for account holders

Time of Travel	Indicative off-peak charge for account holders	Indicative peak charge for account holders
Motorbike	£1	£2
Car & small vans	£1	£3
Large van (less than 3.5 tonnes)	£1.65	£5
HGV (more than 3.5 tonnes)	£4	£7.50

4.6.95 Users who do not register for an account would pay a set amount per journey. The level of the charge would not be set until nearer to the

opening date of the tunnel. However, for the purposes of this consultation, we have assumed the charges would be as shown in Table 4-4:

Table 4-4 Indicative charges for non-account holders

Time of Travel	Indicative off-peak charge for account holders
Motorbike	£3
Car & small vans	£4
Large van (less than 3.5 tonnes)	£6
HGV (more than 3.5 tonnes)	£8.50

Setting and varying the level of the charge

4.6.96 The likely traffic and environmental impacts of the Scheme are based on the charging levels indicated in Table 4-4 and 4-5. These effects would differ if the charge were set at a higher or lower level.

4.6.97 If the charge were set at a higher rate, it would have a greater effect on reducing demand for the Blackwall and Silvertown Tunnels. It could however lead to increased demand at other crossing points, as motorists seek alternative routes. If the charge were set at a lower rate, it could be less effective in managing demand for the Blackwall and Silvertown Tunnels. This could mean that the local road network becomes congested in future.

4.6.98 To ensure the Scheme remains effective over time, we would keep the level of the charge under review. There would be a number of circumstances that could lead us to amend the level of the charge in future. For example, if London's population or employment grew at a faster rate than is currently predicted, there could be need to set the charge at a higher rate than that indicated in this booklet. The charge might be set at a lower level than indicated in this booklet if London's

population grew at a slower rate than is expected and demand for the crossings were not as great.

Further discounts & exemptions

4.6.99 By setting up an account, motorists could pay the charge more easily and at a discounted rate. Further discounts or exemptions have been considered and might be possible, including those suggested by respondents to our last consultation.

4.6.100 A key objective of the user charge is to manage demand for the tunnels, to ensure the benefits of the Scheme are fully realised. Introducing extensive further discounts, or those which might apply to large numbers of people such as a residents discount, could increase demand to use the tunnels, potentially to a level beyond the capacity of the local road network. TfL do however believe that some exemptions and discounts from the charge might be possible. Largely the same discounts and exemptions as are available for the London Congestion Charging zone are proposed to apply to the Silvertown and Blackwall Tunnels. These discounts and exemptions are currently:

- Emergency services vehicles;
- NHS vehicles exempt from vehicle tax;
- Vehicles which are exempt from paying road tax as they are used by disabled people Military vehicles; and
- ‘Non-road mobile machinery’, such as industrial equipment not intended to carry passengers or goods.

4.6.101 Subject a 100 per cent discount:

- Recovery and accredited breakdown vehicles;
- Buses and coaches;
- Blue Badge holders;
- Low emission vehicles;
- Taxis and Private Hire Vehicles; and
- Vehicles used in the provision of particular public services, for example refuse lorries.

The charge in future

4.6.102 There will likely always be a need to manage demand for the Blackwall and Silvertown Tunnels through user charging. For this reason, it is expected that some level of user charging would continue to apply at the crossings even once the costs of implementing the Silvertown Tunnel scheme had been recouped. Future revenue would be used to help fund further enhancements to transport in London.

Maintenance

4.6.103 During operation of the Scheme, it is expected that regular maintenance activities would include:

- inspections of Scheme elements such as tunnel lining and drainage systems;
- maintenance – such as periodic washing of tunnel lining, verges, cross passages and niches; highways cleaning; vegetation management; maintenance of equipment; and
- programmed repairs and renewals – such as repainting tunnel side-walls; repair or renewal of road surfaces, equipment and furniture.

4.6.104 It is expected that in order to safely carry out inspection and certain specified maintenance activities in the tunnel a full closure of the relevant bore may be required periodically. These would be planned to minimise disruption.

4.6.105 Additional maintenance activities may be required at short notice in response to emergency situations, such as repair of damage for safety reasons.

Monitoring

4.6.106 The DCO will include a commitment to undertake a programme of monitoring impacts (e.g. traffic, noise and air quality) impacts in the long term, to ensure demonstrate that the effects of the scheme are as reported in EIA and associated mitigation is effective. An overview of these measures is outlined within the the Draft Monitoring and Mitigation Strategy within the Preliminary Case for the Scheme document. Details of the measures will be confirmed in the ES and will include a procedure to report findings and revise mitigation as required.

Zone of influence

4.6.107 The DCO would include apower to impose restrictive covenants on a specified area of land adjacent to and above the tunnel (referred to as the 'zone of influence'). The restrictive convenants would prevent development which could damage the tunnel from taking place within the zone of infuence. The zone of influence is included within the Limits of the Land to be Acquired or Used (LLAU), shown on the plans.

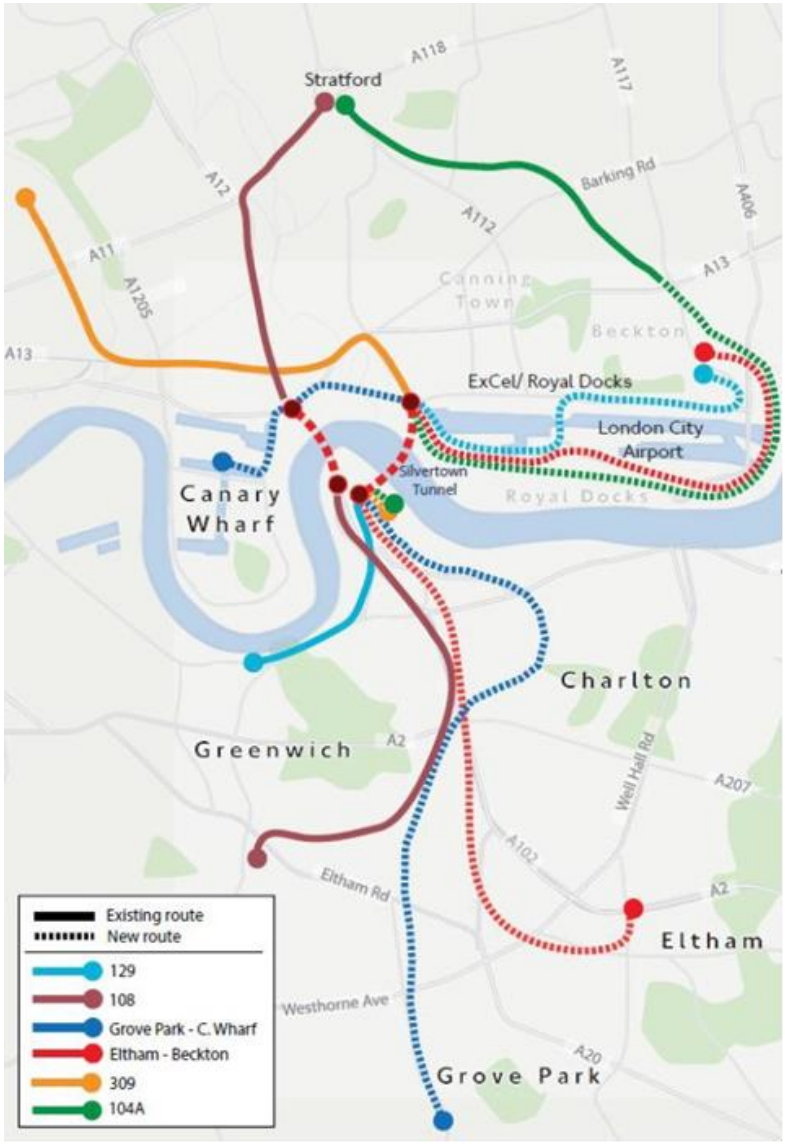
Bus corridors

4.6.108 The Silvertown Tunnel Scheme would create opportunities for new cross-river bus services to improve public transport links between south-east and east London, notably the growing employment areas in the Royal Docks and Canary Wharf (Figure 4-17). The Silvertown Tunnel is designed to accommodate double-deck buses, thus providing operational flexibility in the bus routes that could be extended across the Thames, as well as greater capacity.

4.6.109 It is currently proposed that one lane in each direction would be reserved by buses and HGVs through the tunnel bores which would further enhance reliability and reduce bus journey times. This configuration has the potential, over time, to deliver in excess of 60 buses per hour in each direction

4.6.110 However, since the Silvertown Tunnel has an assumed opening date of 2022/3, any plans for the bus network at this time can only be indicative and for the purpose of assessing operational feasibility. Services would be finalised until about two years before opening, but TfL has identified two potential new services and enhancements to four existing services (predominantly though cross-river extensions).

Figure 4-17 Potential bus corridors



Source: TfL

Decommissioning

4.6.111 The Scheme has been, and will continue to be, designed to maximise the scope for materials re-use in the event of decommissioning of its components, as well as considering the design life and maintenance requirements of the Scheme. The Scheme design-life is 120 years, and it is not intended that the Scheme would be decommissioned in the foreseeable future.

5. ASSESSMENT METHODOLOGY

5.1 EIA process

5.1.1 The main aims of the Environmental Impact Assessment (EIA) are to inform decision-makers of the likely significant environmental effects of the Scheme on people and the environment, and to demonstrate how the adverse effects of the Scheme may be minimised, within practical engineering and other constraints.

5.1.2 EIA is an iterative process, which continues and develops in conjunction with the design of the Scheme.

5.1.3 In general terms, the main stages in the EIA prior to an application for a DCO are as follows:

- (i) Data Review - draw together and review available data;
- (ii) Screening - determine the need for EIA;
- (iii) Scoping - identify significant issues, determine the subject matter of the assessment and the methodologies for undertaking the assessment;
- (iv) Baseline Surveys - undertake surveys and monitoring to identify existing environmental conditions;
- (v) Consultation - provide information to consultees and the public about the Scheme so that parties can make informed contributions to the development of the Scheme and EIA process, and take account of issues raised by consultees;
- (vi) Assessment and Iteration - assess the likely significant effects of the Scheme (including alternatives) on people, communities and the environment; identify the need for mitigation, if any, through improved design and environmental management during construction and operation; and re-assess the residual effects of the mitigated development; and
- (vii) Preparation of an ES and the Non-Technical Summary.

5.1.4 Stages (iv) to vi) are currently in progress, and this PEIR presents the findings of these stages to date.

Assessment guidance

5.1.5 The development and design of major road projects is addressed by guidance and standards set out in the DMRB and the NN NPS. Volume 11 of DMRB provides guidance on the EIA methodologies for highway projects, while environmental design guidance is provided in Volume 10 (Ref 5-1). Where DMRB does not provide topic specific guidance, alternative sources of guidance have been used in the assessments undertaken for the Scheme. DMRB is supplemented by a number of Interim Advice Notes (IANs) that provide up-to-date and detailed guidance in relation to certain environmental topic assessments. DMRB and IANs are published by the Department for Transport (DfT) and the Highways Agency (HA) (now Highways England) respectively.

5.1.6 DMRB Volume 11, Section 2, Part 1, 'General Principles and Guidance on Environmental Impact Assessment' outlines the approach to assessment that may be relevant, depending upon the potential environmental effects and the stage of the project.

Scope of the EIA

5.1.7 An EIA Scoping Report was prepared in July 2014, which provided an outline approach for the identification of potentially adverse and beneficial effects for each of the identified topics.

5.1.8 The EIA Scoping Report was issued to the PINS in June 2014 along with a request for an EIA Scoping Opinion in accordance with Regulation 8(3) of the Regulations. The following environmental topics were proposed to be considered in the scope of assessment:

- Air Quality (Chapter 6 of this PEIR);
- Community and Private Assets (Chapter 7);
- Cultural Heritage (Chapter 8);
- Ecology and Nature Conservation (Chapter 9 and 10);
- Effects on All Travellers (Chapter 11);
- Geology and Soils (Chapter 12);
- Materials (Chapter 13);
- Noise and Vibration (Chapter 14);

- Townscape and Visual Amenity (Chapter 15);
- Water Environment and Flood Risk Assessment (FRA) (Chapter 16);
- Cumulative Impacts including interrelationships i.e. synergistic effects (Chapter 17); and
- Health and Equality Impact Assessments.

5.1.9 A Scoping Opinion was received from PINS in July 2014, and the comments in the Opinion have been taken into account, as set out in Appendix 5A. Where possible the PEIR covers the required scope, or indicates where further work will be necessary or is being carried out. Further consultations to agree the detail of the scope of the environmental topics based on the Reference Design of the Scheme have been undertaken with relevant stakeholders, and are ongoing.

5.1.10 A separate climatic factors topic will not be included within the ES. Instead, climatic factors will be considered in the Air Quality (carbon) (Chapter 6), Materials (selection of materials in the design process) (Chapter 13) and the Water Environment (flood risk mitigation and adaptation) (Chapter 16) assessments. Climate adaptation is considered as part of the Scheme description, for example, as addressed in drainage design, which allows a 20% capacity for climate change.

5.1.11 Whilst none of the topics identified will be scoped out of the EIA there are elements of certain broader environmental topics that are not relevant to the assessment of the Scheme that are listed below:

- Air quality – odour will be scoped out of the assessment as this is not relevant to a highways scheme and any potential odour impacts generated through the movement of contaminated materials during construction would be managed through the use of a Preliminary Code of Construction Practice (CoCP), Volume 3 of the PEIR, Appendix 4.A and adherence to task specific method statements. This was agreed by the SoS for Transport in the Scoping Opinion provided in July 2014.
- Community and Private Assets – effects on agricultural land will be scoped out of the assessment at the tunnel location only as there is no agricultural land within the vicinity of the Scheme and therefore no impacts are expected in terms of land-take, husbandry, severance or accommodation works to agricultural land. This was agreed by the Secretary of State, except where agricultural land may be affected by

sites identified for the disposal of excavated material. The Scheme is also unlikely to give rise to any impacts on Waterway Restoration Projects. This was agreed by the Secretary of State.

- Effects on All Travellers - previous assessment of the Scheme has confirmed that there are no bridleways in the study area. Therefore, given the urban nature of the Scheme and the lack of evidence of equestrian use, this sub topic will not be assessed. This was agreed by the Secretary of State.

- Geology and Soils – effects on agricultural land and agricultural soils at the tunnel location will be scoped out of the assessment in view of the entirely urban environment of the Scheme's location. Effects on geological designated sites will also be scoped out of the assessment as the scoping exercise confirmed the absence of local geological sites in the study area. This was agreed by the Secretary of State.

- Materials – the potential environmental effects associated with the extraction and transport of primary raw materials, and the manufacture of products will be scoped out of the assessment. This is consistent with the guidance in Interim Advice Note 153/11. The environmental impacts associated with extraction of raw materials and manufacture of products is outside the scope of this assessment as they are already likely to have been subject to environmental assessment as part of the consent/permitting process. This was agreed by the Secretary of State, however, the transport of materials and manufactured products both to and from the proposed site will be assessed in the Effects on all Travellers Chapter (Chapter 11), as well as the resulting effects on noise (Chapter 14) and air quality (Chapter 6).

5.1.12 The above scope has been confirmed through a review of the Scoping Opinion provided by PINS.

5.1.13 Subsequent to the scoping exercise, the Scheme now includes the possibility of a jetty being provided to facilitate the movement of construction materials by river. The effects of this are therefore being considered in all relevant topics, but particularly Marine Ecology (Chapter 10), Cultural Heritage (Chapter 8), and the Water Environment (Chapter 16). The scope of these assessments is being agreed in consultation with PINS and the relevant stakeholders including Natural England (NE), the Environment Agency (EA), Port of London Authority (PLA) and Marine Management Organisation (MMO).

Study area

5.1.14 There is no single study area which is applicable to all topic areas in this PEIR. Instead, the study areas for each topic vary according to the environmental resource potentially affected. The individual study areas for each environmental topic are defined in chapters 6 to 16. These are based on the geographical scope of the potential effects relevant to the topic, and the information required to assess the effects, as well as topic specific guidance provided in DMRB and other good practice guidance and consultation with stakeholders.

Baseline data

5.1.15 Establishing the baseline environmental conditions (i.e. the environment without the Scheme) is a necessary starting point for any assessment of potential change as a result of the Scheme. The existing conditions for the study area have been identified by desk-based study and/or survey, or calculated by modelling to allow the assessment of changes that would be caused by the Scheme.

5.1.16 For the assessment of environmental effects, the baseline needs to reflect the conditions that would exist in the absence of the Scheme, at key stages of the Scheme's implementation and operation (see paragraph 5.1.22-5.1.24 for a definition of the assessment years).

5.1.17 Therefore, it is necessary to estimate the changes that would occur over time, in the absence of the Scheme. This includes the consideration of trends including traffic growth, and the identification of developments that are likely to be implemented (i.e. committed developments) before the Scheme is constructed. In this assessment, this is referred to as the 'future baseline'.

5.1.18 The description of the baseline and future baseline conditions has identified receptors that may be affected by the Scheme and also their 'value' and/or 'sensitivity' to potential change. Receptors may be a physical resource (e.g. a water body or a habitat type), flora/fauna, or a user group (e.g. local residents or recreational users of an area). Some receptors will be more sensitive to particular environmental impacts than others, or be considered more valuable.

Design and mitigation

5.1.19 Mitigation measures have been incorporated in the design of the Scheme (embedded mitigation). In addition, where potentially significant adverse environmental effects have been identified during the assessment process, developing appropriate mitigation has been an iterative part of the Scheme development following the hierarchy below:

- Avoidance – incorporate measures to avoid the effect, for example, alternative design options or modifying the Scheme programme to avoid environmentally sensitive periods;
- Reduction – incorporate measures to lessen the effect, for example, road user charging to control traffic generation; fencing off sensitive areas during construction; and implementing a Preliminary CoCP, (Volume 3 of the PEIR, Appendix 4.A) to reduce the potential impacts from construction activities;
- Remediation – as a form of mitigation, for example the re-provision of habitat to replace that lost to Scheme construction, or remediation such as the clean-up of contaminated soils; and
- Compensation – to be considered in the circumstances where mitigation at the affected location is not possible to avoid or reduce a significant effect, in which case the undertaking of offsetting measures should be considered at other locations.

5.1.20 The term ’enhancement’ refers to providing measures over and above those needed to mitigate the adverse effect, and/or maximising the opportunity for beneficial effects from the Scheme.

5.1.21 Environmental effects of the Scheme that remain after mitigation are referred to as ’residual effects’. Therefore, the key outcome of the EIA assessment is the significance of the residual effects after mitigation or enhancement.

Assessment of effects

Limits of deviation

5.1.22 The limits of deviation (LoD) for the Scheme are discussed in Chapter 4. The DCO will provide a power of deviation which will allow the Scheme to be varied within these LoD. For instance, it will allow a change in height of structures up to maxima which are specified in the DCO or on the

planning drawings, for each type of work which may be subject to the power to deviate.

5.1.23 LoD are taken into account in the assessments to ensure that environmental effects recorded under EIA topic effects would not be greater if these elements of the proposed development were configured elsewhere within the defined LoD for the Scheme. This is in line with Planning Inspectorate advice with regard to the use of the 'Rochdale envelope' (Ref 4-1). During the detailed design of the Scheme, the design would be reviewed to ensure that the environmental effects are no "worse than" those assessed in the EIA process.

Defining assessment years and scenarios

5.1.24 The assessment of effects compares a scenario with the Scheme against one without the Scheme over time. The absence and presence of the Scheme are referred to as the 'Do Minimum' and 'Do Something' scenarios respectively. The 'Do Minimum' scenario represents the future baseline with minimal interventions and without new infrastructure, particularly the Scheme or alternatives. The 'Do Something' scenario represents the situation if the Scheme is progressed.

5.1.25 Depending on the topic, the effects are assessed for the 'Do Minimum' and 'Do Something' scenarios, during construction, in the opening year and in a future assessment year. For example, assessments might be undertaken 15 years after opening, or the worst year in the first 15 years of operation.

5.1.26 The current proposals are that main construction works would likely commence in October 2018 and would last approximately four years with the new tunnel opening in 2022/23. However, the traffic model is based on an opening year of 2021, and therefore all assessments that are dependent on traffic modelling use 2021 as an opening year, and 2036 as the future assessment year i.e. 15 years after the opening date, as required by the DMRB guidelines (Ref 1-1). Implications of this approach on the assessment outcomes are different for each topic that this applies to, and is therefore discussed in the relevant topic chapter.

5.1.27 Chapters 6 to 17 of this PEIR set out the environmental assessments of the construction and operation effects of the Scheme. In view of the long design-life of the Scheme (120 years), and the fact that the Scheme is not planned to be decommissioned, it is not considered appropriate for decommissioning of the Scheme itself to form part of each environmental

topic assessment. Decommissioning of temporary construction elements of the Scheme (such as the temporary jetty) is considered as part of the assessment of construction effects. Decommissioning of individual elements of the Scheme as part of a regular programme of maintenance and renewal, is considered as part of the assessment of operational effects.

Identifying potential effects

5.1.28 Schedule 4 Part 1 Regulation 20, of the Infrastructure Planning EIA Regulations requires:

> *'A description of the likely significant effects of the development on the environment, which should cover the direct effects and any indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative effects of the development, resulting from:*
>
> *The existence of the development;*
>
> *The use of natural resources;*
>
> *The emission of pollutants, the creation of nuisances and the elimination of waste; and*
>
> *The description by the applicant of the forecasting methods used to assess the effects on the environment'.*

5.1.29 A range of environmental topics may be affected by the Scheme. Effects may be negative or positive, temporary or permanent. They may also be described as:

- Direct or Primary Impacts: caused by activities which are an integral part of the Scheme resulting in a change in environmental conditions, such as construction works causing an increase in dust concentrations in the air;
- Indirect or Secondary Impacts: due to activities that affect an environmental condition or receptor, which in turn affects other aspects of the environment or receptors, for example, drainage from the construction site increases sediment in the receiving water, which in turn affects aquatic organisms;

- Cumulative: comprising multiple effects from different sources within the Scheme (synergistic or interrelationships), or cumulatively with other developments (additive), on the same receptors.
- Residual: effects that remain after the positive influence of mitigation measures are taken into account;
- Short term: effects that would last for a limited duration, for example, dust generated during construction; and
- Long term: permanent effects from the operation of the Scheme.

Assessing significance

5.1.30 The significance of an environmental effect is typically a function of the 'value' or 'sensitivity' of the receptor and the 'magnitude' or 'scale' of the impact. Combining the environmental value of the resource or receptor with the magnitude of change produces a significance of effect category.

5.1.31 DMRB Volume 11, Section 2, Part 5 HA 205/08 'Assessment and Management of Environmental Effects'(Ref 5-1) provides advice on typical descriptors of environmental value, magnitude of impact and significance of effects.

5.1.32 DMRB recognises that:

> *'the approach to assigning significance of effect relies on reasoned argument, professional judgement and taking on board the advice and views of appropriate organisations. For some disciplines, predicted effects may be compared with quantitative thresholds and scales in determining significance. Assigning each effect to one of the five significance categories enables different topic issues to be placed upon the same scale, in order to assist the decision-making process at whatever stage the project is at within that process'.*

5.1.33 In arriving at the significance of effect, the assessor also considers whether the effect is direct, indirect, secondary, cumulative, short, medium or long-term, permanent or temporary, positive or negative.

5.1.34 Not all of the environmental topic assessments will use the approach described above in measuring effects. For example, some topic assessments do not use a matrix based approach, but instead use numerical values to identify effects (e.g. Noise and Vibration). Some topic assessments do not have agreed or standard methods of assessment or

scales of measurement for either value or sensitivity (e.g. CH 12 – Geology and Soils or CH 13 - Materials). Therefore, each environmental topic specialist will have used the information provided above, alongside their topic-specific guidance and their professional judgement to assess the significance of effects. Where alternative bases of assessment apply, this is explained in the appropriate chapter.

5.1.35 Further details of the topic specific significance criteria used in this PEIR are discussed in Chapters 6 to 16.

Difficulties and limitations

5.1.36 Access to land both within and outside the Limits of Land to be Acquired or Used (LLAU) has been gained wherever possible through liaison with land-owners, in order to undertake the necessary environmental surveys. However, access was not afforded to all areas. Such areas, are for example, the embankments of the railway line (compartments D shown in Volume 3 of the PEIR, Appendix 9.B Invertebrate Survey Report). In areas where access was not available, the baseline has been defined through desk-top study using aerial photographs, or by surveying from the boundary of the land where publically accessible. Professional judgement has been used, and relevant assessments have been based on a worst case scenario. This has been described in the relevant topic chapters.

Cumulative (including interrelationships or synergistic effects) impacts

5.1.37 Schedule 4, Part 1, Regulation 20, of the 2009 Infrastructure Planning EIA Regulations requires an ES to include the assessment of the cumulative effects. Schedule 3 Regulation 14(b) of the 2009 EIA Regulations refers to:

‘. .the cumulation with other development (additive)’.

5.1.38 ‘Cumulative’ is not defined in the EIA Directive or Regulations and there is no standard approach to the assessment of cumulative effects, with different projects adopting different approaches.

5.1.39 The potential cumulative impacts with other major developments will need to be identified, as required by the Directive. The significance of such impacts are assessed against the baseline position which would include built and operational development. In assessing cumulative impacts PINS advised in the Scoping Opinion, other major development were identified

through consultation with the local planning authorities on the basis of those that are:

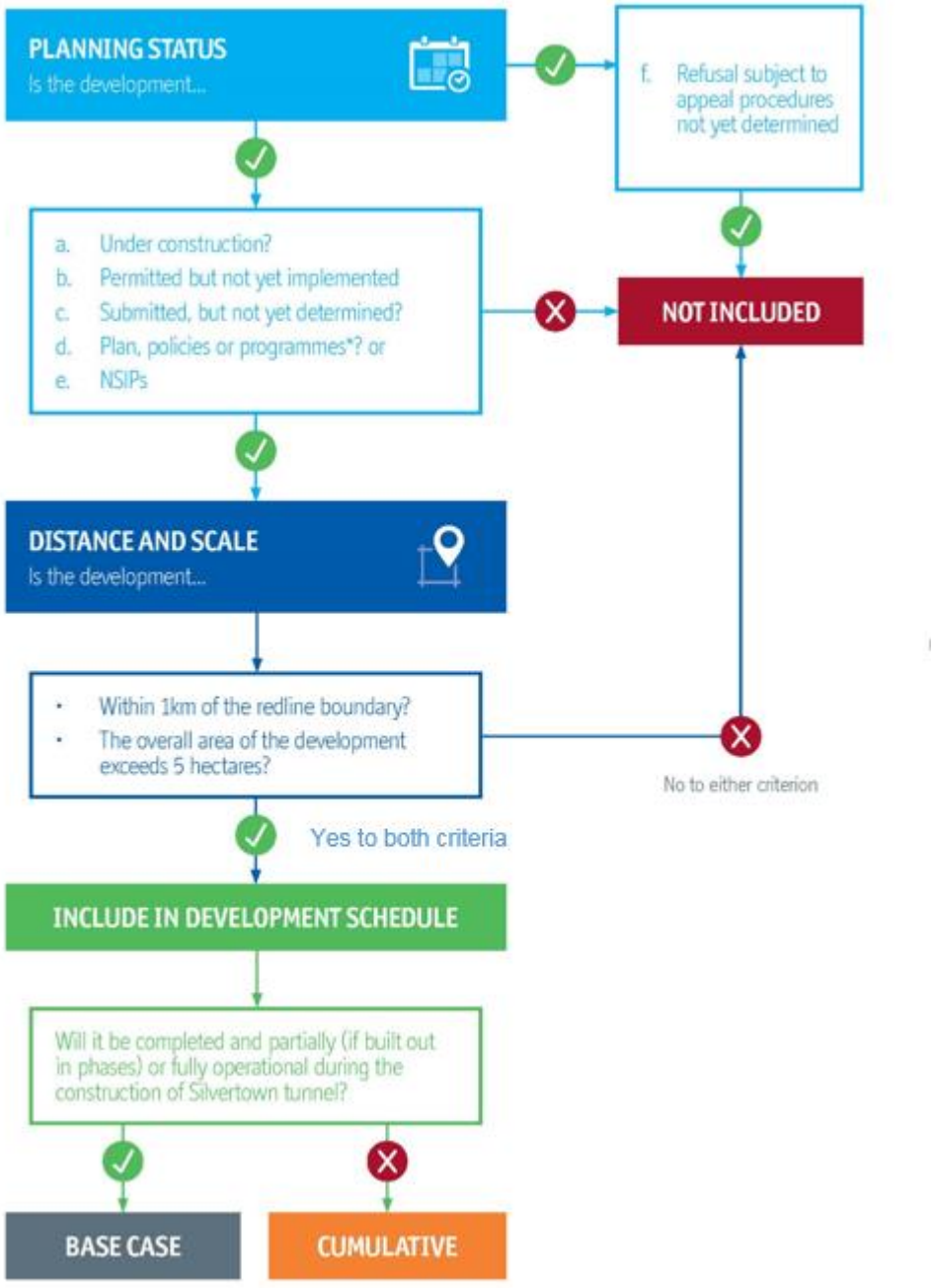
- projects that are under construction;
- permitted application(s) not yet implemented;
- submitted application(s) not yet determined;
- all refusals subject to appeal procedures not yet determined. (Rejected planning applications that are not subject to appeal have not been considered, as their implementation is not considered to be reasonably foreseeable);
- projects on the Planning Inspectorate's Programme of NSIPs;
- projects identified in the relevant development plan (and emerging development plans - with appropriate weight being given as they move closer to adoption) recognising that much information on any relevant proposals will be limited; and
- projects identified in other plans and programmes (as appropriate) which set the framework for future development consents/approvals, where such development is reasonably likely to come forward.

5.1.40 The types of developments and location are presented in Volume 2, Drawing 17.1 and Drawing 17.2.

5.1.41 The developments for assessment have been differentiated into those to be assessed as part of the 'base case' (i.e., future baseline year 'without the Scheme' scenario) and those assessed as part of the cumulative effects assessment.

5.1.42 Figure 5-1 below shows the approach to identifying base case and cumulative schemes.

Figure 5-1 Base case criteria



5.1.43 The Base Case includes developments that are programmed to be completed and partially (if built out in phases) or fully operational during construction of the Silvertown Tunnel project. This is proposed on the basis that these developments will be in place when Scheme construction is taking place and therefore it is appropriate to assume their presence in the base case (i.e., 'without Silvertown Tunnel project' scenario).

5.1.44 The assessment of cumulative effects meanwhile considers those developments that are programmed to be under construction or operational at the same time as the Silvertown Tunnel project.

5.1.45 For the Scheme, cumulative effects are defined as those that arise from the Silvertown Tunnel with other non-Silvertown Tunnel projects.

5.1.46 The inter-relationship between aspects (in-combination or synergistic of the environments likely to be significantly affected is a requirement of the EIA Regulations (see Schedule 4 Part 1 of the EIA Regulations). These occur where a number of separate impacts, e.g. noise and air quality, affect a single receptor such as fauna. This assessment will be included in the ES rather than the PEIR.

5.1.47 The in-combination effects will be assessed in order to address the environmental impacts of the Scheme proposal as a whole. This will help to ensure that the final ES is not a series of separate reports collated into one document, but rather a comprehensive assessment drawing together the environmental assessment as a whole.

5.2 Next steps in the EIA process

5.2.1 This PEIR is part of a suite of preliminary documents which have been made available for the statutory consultation on the Silvertown Tunnel scheme which runs from 5 October to 29 November 2015. Following the conclusion of the statutory consultation, the PEIR will be developed into a full ES which will accompany the DCO application. The ES will reflect any further changes to the Scheme and present the full results of the ongoing EIA together with any additional information and TfL's response to comments received to statutory any relevant consultation where considered appropriate.

5.2.2 Details of all relevant statutory consultation responses and how these have informed the environmental assessment will be presented in the ES.

5.2.3 Subject to the Scheme receiving DCO consent, the ES (and associated CoCP) will form part of the contractors' tender documentation, describing TfL's requirements for bidders to comply with in submitting their proposals. Final design and construction methodologies received from the appointed contractor will be assessed by TfL for compliance with the ES and DCO Requirements.

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