

# **Lower Thames Crossing**

Pre-Consultation Scheme Assessment Report
Volume 7: Appraisal Conclusions and Recommendations
Section 12: Appendices

Lower Thames Crossing Route Consultation 2016

## **Contents**

	Title
Appendix 7.1	Appraisal Summary Table Route 2 WSL (BT) *
Appendix 7.2	Appraisal Summary Table Route 3 WSL (BT) *
Appendix 7.3	Appraisal Summary Table Route 4 WSL (BT) *
Appendix 7.4	Appraisal Summary Table Route 2 ESL (BT) *
Appendix 7.5	Appraisal Summary Table Route 3 ESL (BT) *
Appendix 7.6	Appraisal Summary Table Route 4 ESL (BT) *

- \* For each Appraisal Summary Table (AST) the following AST tables and worksheets are included:
- TEE table
- PA table
- AMCB table
- Biodiversity worksheet
- Historic environment worksheet
- Landscape/ townscape worksheet
- Water worksheet
- Noise worksheet

### **Explanation of abbreviations used in the Appraisal Summary Tables**

Abbreviation	Full Description
SSSI	Site of Special Scientific Interest
AONB	Area of Outstanding Natural Beauty
AQSO	Air Quality Strategic Objective
SPA	Special Protection Area
BAP	Biodiversity Action Plan
LWS	Local Wildlife Site

# **Appendix 7.1 Appraisal Summary Table Route 2 WSL (BT)**

Appraisal Summary Table Route 2 WSL (BT)

Annex 1: TEE table

Annex 2: PA table

Annex 3: AMCB table

Annex 4: Biodiversity worksheet

Annex 5: Historic environment worksheet

Annex 6: Landscape/ townscape worksheet

Annex 7: Water worksheet

Annex 8: Noise worksheet

Appra	isal Summary Table	Route 2, Western Southern Link, Bored Tunnel	Date produced: 22 Jan 2016	]	C	ontact:
	Name of scheme:	Route 2 Bored Tunnel with Western Southern Link - Core Growth, Central Case costs			Name	Chris Taylor
De	escription of scheme:	New Dual 2 lane trunk road (70mph) from M25 between J29 and J30, linking with A10	89, crossing the Thames in a bored tunnel, with addition	onal lane for	Organisation	Highways England
		future proofing, 2km to the east of Gravesend with a westerly southern link to the A2.	-		Role	Project Sponsor
	Impacts	Summary of key impacts	Asse Quantitative	ssment Qualitative	Monetary	Distributional
			Quantitative	Qualitative	£(NPV)	7-pt scale/
					2( )	vulnerable grp
m	Business users & transport	Large time savings estimated for business travellers, including freight, due to reduced congestion	Value of journey time changes(£) £2,672m			
Economy	providers	and improved connectivity. Small vehicle operating cost benefits would also occur due to reduced congestion. Small user charge disbenefits as there will be charges on the new crossing.	Net journey time changes (£)	N/A	£3,020m	Not appraised yet
8		bongoston. Ontai acci onarge disserione as there will be sharged on the new crossing.	0 to 2min 2 to 5min > 5min		,	11 7
ш	Reliability impact on Business	The option would improve journey time reliability for journeys across the Thames by providing a	-£345m £1,154m £1,863m			
	users	completely alternative route, and relieving congestion on the existing Dartford Crossing.	N/A	N/A	£103m	
		No. 1 1 WITTO I I I I I I I I I I I I I I I I I I				
	Regeneration Wider Impacts	Not appraised using WebTAG, but see complementary wider economic modelling  Wider Impact (WI) benefits are over 70% higher than those for Route 1. Almost 80% of WI	N/A Agglomeration £981n	N/A	N/A	
	Wider impacts	benefits are from the agglomeration of business activities.				
			Output in imperfectly competitive markets £282n	IN/A	£1,264m	
			Labour supply impacts £1n	ו		
a	Noise	There is a small net benefit. Whilst there are reductions in noise along the M25/ A282 corridor,				
ent		there are increases in noise for communities along the new route.	74 people would benefit based on an estimated 12,418 people being annoyed by noise in the without scheme situation	N/A	£3m	Not appraised yet
E			decreasing to 12,344 people in the with scheme situation.	1071	2011	140t appraised yet
iro	Air Quality	All properties which are predicted to exceed or are at risk of exceeding the AQSO in the without	Two of the receptors modelled are predicted to exceed the			
Environmental	7 III Gadinty	Scheme situation would experience an improvement in air quality with the Scheme.	AQSO without the scheme (representing up to approximately			
_			60 receptors), but these receptors experience an improvemen	N/A	N/A	Not appraised yet
			compared to the without scheme. The scheme is not predicted to lead to any new exceedences.	1,77	14/7	140t appraised yet
	Greenhouse gases	The option is forecast to result in an increase in both non-traded and traded carbon emissions	Change in non-traded carbon over 60y (CO2e) 5,687,161			
			tonnes	N/A	-£260m	
			Change in traded carbon over 60y (CO2e) 15,890 tonnes			
	Landscape	A new road corridor would adversely affect the landscape character including in the vicinity of	tornes			
		Tilbury, Grays and Chadwell St Mary, green belt and intrude slightly into the AONB. A bored	N/A	Large Adverse	N/A	
		tunnel would have limited impact on the character of the Thames corridor although new road infrastructure could potentially be visible from the AONB.			1471	
	Townscape	See Landscape entry				
		, , , , , , , , , , , , , , , , , , ,	N/A	N/A	N/A	
	Historic Environment	Direct physical impacts to two scheduled monuments, one conservation area and two Grade II listed buildings. Potential impacts to the setting of a number of designated heritage assets and		Moderate		
		direct effects on non-designated archaeological remains within the scheme footprint.	N/A	Adverse	N/A	
	Biodiversity	Potential indirect effects on the Thames Estuary & Marshes SPA (loss of functionally linked land), impacts on LWSs & areas of BAP Priority Habitat. Direct loss of ancient woodland at Claylane				
		Wood and loss of deciduous (not ancient) woodland at Shorne and Ashenbank Wood SSSI.	N/A	Large Adverse	N/A	
	Water Environment	Impacts on Mardyke and crosses the Tilbury Flood Storage Area.	N/A	Slight Adverse	N/A	
Social	Commuting and Other users	Compared to business users, relatively small time savings arise for commuters and other users due to reduced congestion and improved connectivity. Vehicle operating cost disbenefits due to	Value of journey time changes(£) £721m			
Soc		increased travel and lack of perception by non-business travellers. Small road user charge	Net journey time changes (Σ)  0 to 2min 2 to 5min > 5min	N/A	£296m	Not appraised yet
		disbenefit as there will be charges on the new crossing	-£198m £353m £566m			
	Reliability impact on	The option would improve journey time reliability for journeys across the Thames by providing a	2.00			
	Commuting and Other users	completely alternative route, and relieving congestion on the existing Dartford Crossing.	N/A	N/A	£40m	
	Physical activity	The option has no impact on walking and cycling	N/A	N/A	N/A	
	Journey quality	The route would provide a new high standard free-flowing solution and would relieve traffic from	14//	1077	IV/A	
		the existing crossing at Dartford and other routes including the A2. With the WSL the A2 junction				
		has a compact junction layout arrangement, due to existing constraints, with slip/ link roads which have a design speed of 30-50 mph. Route 2 uses the A1089 (the access to Tilbury Port) for part	N/A	Moderate Beneficial	N/A	
		of the route, which will involve mixing of strategic traffic with local traffic which has a high				
		percentage of HGVs				
	Accidents	DfT's COBALT tool has been used to appraise accidents and shows a net increase in the number and value of accidents across the road network, as a result of this being a new route. However a				
		separate appraisal has also been undertaken using actual accident data across the road network,	Because it is a new route 2,453 additional accidents are	NI/A	0400	Nist susseined and set
		which shows that the option will lead to a reduction in the rate of accidents (as measured by the Fatal and Weighted Injury rate per billion vehicle kilometres).	predicted over 60 years, including 34 fatalities, 265 serious injuries and 3,424 slight casualties	N/A	-£126m	Not appraised yet
		atarana moigritod injury rate per billion verilole kilometres).				
	Security	Lighting will be provided in accordance with Highways England's TA49/07 standard for new and	N/A	Slight Adverse	N/A	Not appraised yet
	Account to gardines	replacement lighting on the strategic road network				
	Access to services Affordability	Not appraised because this criteria relates to public transport options  The appraisal has assumed the same charges for the new crossing in real terms as those at	N/A	N/A	N/A	N/A
		Dartford Crossing today	N/A	Neutral	N/A	Not appraised yet
	Severance	Safe re-provision will be made for all existing rights of way for pedestrians and cyclists that cross				
		the new trunk road. There will be permanent severance of some community facilities and public natural assets and mitigation options need to be developed	N/A	Slight Adverse	N/A	Not appraised yet
		• • • • • • • • • • • • • • • • • • •			<u> </u>	<u> </u>
	Option and non-use values	Not appraised because this criteria relates to public transport options	N/A	N/A	N/A	
_	Coat to Droad Transport	The impacts on the transport budget would be twofold; the capital cost of construction and the	Investment costs: £2,101m			
olic	Cost to Broad Transport  Budget (2010 Present Values)	subsequent maintenance and operating cost of the infrastructure offset by revenue collected from	I()nerating costs £2/6m	•		
Public	•	subsequent maintenance and operating cost of the infrastructure offset by revenue collected from the additional user charges	Operating costs £276m Operator revenue £799m (a benefit, offsetting cost over the	N/A	£1,578m	
Public Accounts	•			N/A	£1,578m	
Public Accounts	•		Operator revenue £799m (a benefit, offsetting cost over the	N/A N/A	£1,578m £550m	

## Annex 1 - TEE Table

Annex 1: TEE Table

Economic Efficiency of the Transport System (TEE): Route 2 WSL Bored Tunnel

Non-business: Commuting	ALL MODES		ROAD		BUS and COACH	RAIL		OTHER
User benefits	TOTAL		Private Cars and L	GVs	Passengers	Passengers		
Travel time	£87,080,499			£87,080,499				
Vehicle operating costs	-£64,578,699			-£64,578,699				
User charges	£124,683			£124,683				
During Construction & Maintenance	£0							
COMMUTING	£22,626,483	(1a)		£22,626,483				
Non-business: Other	ALL MODES		ROAD		BUS and COACH	RAIL		OTHER
User benefits	TOTAL		Private Cars and L	GVs	Passengers	Passengers		
Travel time	£633,744,285			£633,744,285				
Vehicle operating costs	-£358,953,283			-£358,953,283				
User charges	-£1,624,818			-£1,624,818				
During Construction & Maintenance	£0							
NET NON-BUSINESS BENEFITS: OTHER	£273,166,184	(1b)		£273,166,184				
<u>Business</u>				Business Cars &				
<u>User benefits</u>			Goods Vehicles	LGVs	Passengers	Freight	Passengers	
Travel time	£2,671,840,846		£646,983,033	£2,024,857,813				
Vehicle operating costs	£454,157,831		£302,404,515	£151,753,316				
User charges	-£105,622,227		-£51,084,465	-£54,537,762				
During Construction & Maintenance	£0							
Subtotal	£3,020,376,451	(2)	£898,303,083	£2,122,073,368				
Private sector provider impacts						Freight	Passengers	
Revenue								
Operating costs								
Investment costs								
Grant/subsidy								
Subtotal	£0	(3)						
Other business impacts								
Developer contributions		(4)						
NET BUSINESS IMPACT	£3,020,376,451	(5) = (2) + (	(3) + (4)			•		
TOTAL								
Benefits (TEE)	£3,316,169,118	(6) = (1a) +	(1b) + (5)					
	Notes: Benefits appe	· ·						
	All entries are	e discounted	d present values, in 2	010 prices and valu	es			

## Annex 2 - PA Table

#### Annex 2: Public Accounts (PA) Table

#### **Route 2 WSL Bored Tunnel**

	ALL MODES	ROAD	BUS and COACH	RAIL	OTHER
Local Government Funding	TOTAL	INFRASTRUCTURE			
Revenue					
Operating Costs					
Investment Costs					
Developer and Other Contributions					
Grant/Subsidy Payments					
NET IMPACT	£0 (7)				
Central Government Funding: Trans	<u>port</u>				
Revenue	-£799,257,784	-£799,25	7,784		
Operating costs	£276,096,332	£276,09	6,332		
Investment Costs	£2,100,706,167	£2,100,70	6,167		
Developer and Other Contributions					
Grant/Subsidy Payments					
NET IMPACT	£1,577,544,716 (8)	£1,577,54	4,716		
Central Government Funding: Non-T	ransport				
Indirect Tax Revenues	-£549,652,276 <i>(9)</i>	-£549,65	2,276		
TOTALS					
Broad Transport Budget	£1,577,544,716 (10) = (	(7) + (8)			
Wider Public Finances	-£549,652,276 (11) = (	(9)			
	Notes: Costs appear as posit	tive numbers, while revenues an	d 'Developer and Other Contribution	ns' appear as negative numbers	S.
	All entries are discounted pre	esent values in 2010 prices and v	values.		

## Annex 3 - AMCB Table

#### **Annex 3: AMCB Table**

#### **Route 2 WSL Bored Tunnel**

<b>Analysis of Monetised Costs and Benefits</b>	
Noise	£3,135,613 (12)
Local Air Quality	(13)
Greenhouse Gases	-£259,882,158
Journey Quality	(15)
Physical Activity	(16)
Accidents	-£125,900,000 <i>(17)</i>
Economic Efficiency: Consumer Users (Commuting)	£22,626,483 (1a)
Economic Efficiency: Consumer Users (Other)	£273,166,184 <i>(1b)</i>
Economic Efficiency: Business Users and Providers	£3,020,376,451 (5)
Wider Public Finances (Indirect Taxation Revenues)	£549,652,276 - (11) - sign changed from PA table, as PA table represents costs, not benefits
Present Value of Benefits (see notes) (PVB)	£3,483,174,849 (PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)
Broad Transport Budget	£1,577,544,716 (10)
Present Value of Costs (see notes) (PVC)	£1,577,544,716 (PVC) = (10)
OVERALL IMPACTS	
Net Present Value (NPV)	£1,905,630,134 NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	2.2 BCR=PVB/PVC
Note: This table includes costs and benefits which are regularly or together with some where monetisation is in prospect. There may a	r occasionally presented in monetised form in transport appraisals, also be other significant costs and benefits, some of which cannot be

Note: This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

## **Annex 4 – Biodiversity Worksheet**

#### Annex 4: TAG Biodiversity Impacts Worksheet

#### Route 2 WSL Bored

Ste Area	Description of feature/	Scale (at which	Importance (of attribute)	Step 3 Trend (in relation to	Substitution	Biodiversity and earth	Step 4 Magnitude of impact	Step 5 Assessment Score
	Ramsar criterion 2	attribute matters) International	Attribute a qualifying feature of	target) Unknown at present	possibilities  Not possible to substitute	Very high - Ramsar	Minor Negative	Slight Adverse
Thames Estuary and Marshes Ramsar	The site supports one endangered plant species and at least 14 nationally scarce plants of wetland habitats. The site also supports more than 20 British Red Data Book invertebrates.		Internationally designated site so very high importance.			Criterion 2		
Thames Estuary and Marshes Ramsar	Ramsar criterion 5 Assemblages of international importance: Species with peak counts in winter: 45118 waterfowl (5 year peak mean 1998/99-2002/2003).	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 5	Minor Negative	Slight Adverse
Thames Estuary and Marshes Ramsar	Ramsar criterion 6 species/populations occurring at levels of international importance (includes species with peak counts in autumn/winter and in spring).	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 6	Minor Negative	Slight Adverse
Thames Estuary and Marshes SPA	Article 4.1 Qualification (79/409/EEC). Over winter the area regularly supports 1% of the population in GB of <i>Circus</i> cyaneus.	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.1 qualification	Minor Negative	Slight Adverse
Thames Estuary and Marshes SPA	Article 4.2 Qualification (79/409/EEC). Over winter the area regularly supports significant populations of a number of wading birds. On passage the area regularly supports 2.6% of the population of Charadrius hiaticula.	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.2 qualification	Minor Negative	Slight Adverse
Thames Estuary and Marshes SPA	Article 4.2 Qualification (79/409/EEC): An internationally important assemblage of birds. Over winter the area regularly supports 75019 waterfowl (5 year peak mean 21/03/2000).	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.2 qualification	Minor Negative	Slight Adverse
Mucking Flats and Marshes SSSI	Botanical interest: Mudlfats and Saltmarsh.	National	Attribute a qualifying feature of Nationally designated site so high importance.	Majority Favourable with small area Unfavourable Recovering status.	Not possible to substitute	High - nationally important habitats	Neutral	Neutral
Mucking Flats and Marshes SSSI	Wintering wildfowl and waders.	National	Attribute a qualifying feature of Nationally designated site so high importance.	Majority Favourable with small area Unfavourable Recovering status.	Not possible to substitute	High - nationally important species	Minor Negative	Slight Adverse
South Thames Estuary and Marshes SSSI	Wading birds and other overwintering species (such as short-eared owl).	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining.	Not possible to substitute	High - nationally important birds	Minor Negative	Slight Adverse
South Thames Estuary and Marshes SSSI	Botanical importance (saltmarsh, freshwater habitats and grazing marshes).	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining.	Not possible to substitute	High - nationally important botany	Minor Negative	Slight Adverse
South Thames Estuary and Marshes SSSI	Invertebrate interest (saltmarsh, freshwater habitats and grazing marshes).	National	Attribute a qualifying feature of Nationally designated site - High importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining.	Not possible to substitute	High - nationally important invertebrates	Minor Negative	Slight Adverse
Shorne and Ashenbank Woods SSSI	Designated Ancient Woodland.	National	Attribute a qualifying feature of Nationally designated site so high importance.	Favourable to Unfavourable Recovering Status. Nationally, ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens.	Not possible to substitute	High - nationally important ancient woodland.	Intermediate Negative	Large Adverse
Shorne and Ashenbank Woods SSSI	Woodland invertebrates.	National	Attribute a qualifying feature of Nationally designated site so high importance.	Favourable to Unfavourable Recovering Status.	Not possible to substitute	High - nationally important invertebrates	Intermediate Negative	Large Adverse
Hangman's Wood and Deneholes SSSI	Remains of medieval chalk mines, provide the most important underground hibernation site for bats in Essex. Brown long eared, Natterer's and Daubenton's.	National	Attribute a qualifying feature of Nationally designated site - High importance.	Favourable	Not possible to substitute, medieval chalk and ancient woodland	High - nationally important for bats and ancient woodland	Neutral	Neutral
Hangman's Wood and Deneholes SSSI	Area of semi-natural habitat in which bats can feed. A relict fragment of ancient woodland, dominated by Pedunculate Oak Ash, Sycamore with occasional Wild Cherry and Elm.	National	Attribute a qualifying feature of Nationally designated site - High importance.	Favourable	Not possible to substitute, medieval chalk and ancient woodland	High - nationally important for bats and ancient woodland	Neutral	Neutral

Ste	n 2			Step 3			Step 4	Step 5
Area  Thames Estuary recommended MCZ (on hold)	Description of feature/ attribute  Marine and estuarine habitats and species.	Scale (at which attribute matters)  National	Importance (of attribute)  Attribute a qualifying feature of Nationally designated site so high importance.	Trend (in relation to target)  Marine and estuarine habitats in the Thames are being degraded through issues such as pollution and climate change.	Substitution possibilities Not possible to substitute	Biodiversity and earth heritage value  Very High - undesignated site hosting habitats/species of (European) Community interest (annexes 1 & 2, Habitats Directive, 1992).	Magnitude of impact  Neutral	Assessment Score  Neutral
Greater Thames Marshes Nature Improvement Area	Complex of habitats of value for biodiversity and as a community resource.	Regional	Attribute of value to local communities, of Medium importance.	Some goals are being achieved.	Not possible to substitute	Medium - community value and extensive area	Minor Negative	Slight Adverse
Claylane Wood - Ancient Woodland	Ancient Woodland	National	Ancient woodland habitat, high Importance for biodiversity.	Nationally ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens.	Not possible to substitute	High - important ancient woodland	Intermediate Negative	Large Adverse
Priority Habitat - Deciduous Woodland (Disrupted in several places to various degrees - see also individual Local Wildlife Sites (below)). In addition, impact on woodland around Buckland and Brook Farm (north of the East Tilbury Marshes), A126 roundabout near Bretts farm (north of Tilbury), small section on A226 south east of Chalk	Priority BAP habitat. Some will be lost/severely impacted.	Local	Medium importance, BAP habitat	Nationally lowland mixed deciduous woodland is declining due to clearance, over-grazing, and replanting with non-native species.	Replacement planting and/translocation of habitats a possibility.	Medium - BAP priority habitat	Intermediate Negative	Moderate Adverse
Priority habitat - Coastal Saltmarshes (south of river, as part of Shorne Marshes and Eastcourt Marshes)	Important for cohesion between designated sites and for sustaining populations of wading birds.	National (contiguous with similar habitat of international importance within designated sites)	Importance will be dependant on functioning within who wider network of habitats, likely to be Medium to High Importance.	Likely to be decreasing due to coastal erosion, climate change and development.	Creation of replacement habitat through managed realignment a possibility, but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Neutral	Neutral
Priority Habitat - Intertidal mudflats (particularly northern bank of the river at crossing, down stream of the Thames Estuary and Marshes (RAMSAR))	Important for cohesion between designated sites and for sustaining populations of wading birds.	National (contiguous with similar habitat of international importance within designated sites)	Likely to be Medium to High Importance.	Likely to be decreasing due to coastal erosion, climate change and development.	Creation of replacement habitat through managed realignment a possibility, but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Minor Negative	Slight Adverse
Priority Habitat - Coastal and Floodplain Grazing Marsh including freshwater ditches/ponds	Of importance for cohesion between designated sites and for sustaining populations of waterfowl and of value for notable invertebrates and plants.	National (contiguous with similar habitat of international importance within designated sites)	Low to High, dependant on functioning within the wider network of habitats.	Likely to be decreasing due to agricultural improvement, drainage and development.	creation potentially possible (e.g. managed	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Minor Negative	Slight Adverse
Priority habitat - Traditional Orchards (north of A1089 and east of Orsett - small patch of orchard lining green lane. Also running along M25 east of Upminster where M25 will be widened)	Priority BAP habitat	Local	Traditional Orchards BAP habitat - Medium importance.	Declining due to a loss of sites only partially compensated for by improved management and restoration.	Not possible to recreate mature habitats, replanting and (if possible) translocation of habitats and/or soils a possibility.	Medium - BAP priority habitat.	Major Negative	Moderate Adverse
Priority habitat - Wood-pasture and Parkland (adjacent to M2 J1 interchange)	Priority BAP habitat	Local	Wood-pasture and Parkland BAP habitat - Medium importance.	Generally believed to be declining nationally. However, there are no reliable statistics on the extent of the overall resource, nor on historical and current rates of loss or degradation of this type of habitat.	Not possible to recreate mature habitats	Medium - BAP priority habitat.	Minor Negative	Slight Adverse
Th34 Blackshots Nature Area	Local wildlife Site - rough grassland and deciduous woodland.	Local	Large area of rough grassland and important invertebrate population, as well as providing potential nesting habitats for birds such as skylark. UK BAP fly species <i>Dorycera graminum</i> found here.	Species rich grasslands are decreasing, unmanaged grassland is likely to be increasing. Nationally deciduous woodland is declining.	Replacement planting a possibility but limited space available.	Medium - BAP priority habitat.	Minor Negative	Slight Adverse
Th35 Little Thurrock Reedbeds	Local wildlife Site. Of importance for cohesion between designated sites and for sustaining populations of birds such as bearded reedling.	Local	BAP habitat. Low to Medium, dependant on functioning within the wider network of habitats.	Increasing nationally	Not possible to substitute	Medium - BAP Habitat of Principal Importance in England.	Minor Negative	Slight Adverse
Th36 Terrels Heath (contains Chadwell Wood)	Local wildlife Site with Ancient Woodland.	Local	Terrels Heath is a forest structure dominated by pendunculate Oak ( <i>Quercus robar</i> ). Ancient woodland, high importance.	Ancient woods on acid sandy soils are invariably poorer in ancient woodland ground flora than those on damp, neutral soils. However, the flora here is particularly poor, possibly due to decades of heavy recreational pressure and the previous management to the south that has left a very sparse, open canopy.	Not possible to substitute	High - important ancient woodland.	Minor Negative	Moderate Adverse
Th38 Broom Hill	Local wildlife Site	Local	Hilltop site, developed partly on shallow sand/gravel workings, of interest for its ancient acid-grassland flora. Significant populations of invertebrate species associated including 7 Red Data Book invertebrate species such as; the ant <i>Myrmica specioidesand</i> Great Green Bus-cricket ( <i>Tettigonia viridissima</i> ). High importance.	7 Red Data Book invertebrate species and a number of UK BAP species. Condition unknown.	Not possible to substitute	High - undesignated site hosts Red Data Book species.	Minor negative	Slight Adverse
TH39 Lytag Brownfield	Local Wildlife site	Local	Low to medium importance. Survey work by independent ecological consultants has revealed populations of all four Essex reptiles (Adder, Grass snake, Common Lizard, and Slowworm) making this one of the more important reptile sites in the borough.	Reptile species in decline in some areas. It is also likely that this site has UK BAP invertebrates given the presence of them on similar habitats in the area. No data currently.	Lytag Brownfield will be temporarily disturbed. Reptile translocation required. Habitat reinstatement a possibility but requires suitable substrate to maintain required pH for habitats to establish.	Low to Medium - Local Wildlife Site.	Minor Negative	Slight adverse

Ste	p 2			Step 3			Step 4	Step 5
Area	Description of feature/	Scale (at which	Importance (of attribute)	Trend (in relation to	Substitution	Biodiversity and earth	Magnitude of impact	Assessment Score
Th42 West Tilbury Hall	attribute Local wildlife Site	attribute matters) Local	Area of interesting acidic grassland flora. Low importance.		possibilities Soil translocation a possibility but requires suitable substrate to maintain the required pH for habitats to establish.	heritage value Low - Local Wildlife Site.	Major Negative	Slight Adverse
	Local wildlife Site	Local	Area behind the now privately owned	Maintenance of the	Not possible to substitute	Low to Medium - Local	Intermediate Negative	Slight Adverse
Th43 West Tilbury Church			church. Ancient grassland. Low to medium importance depending on species present.	botanical interest relies on keeping soil nutrient levels low and removing the cuttings arising from grassland management (as now in private, residential ownership).		Wildlife Site.		
Th47 Low Street Pit	Local wildlife Site	Local	Lies on the regionally important Thames terrace gravels. Deciduous woodland as well as old grassland. Supports the UK BAP species Hornet Robber fly (Asilus crabroniformis).	Deciduous woodland is declining. The Hornet Robber fly relies on the presence of animal dung that is relatively free from insecticides and worming agents for the development of its larvae. A grazing regime would also be the most appropriate way of maintaining the floristic interest of the site.	Not possible to substitute	Medium - UK BAP species and Thames Terrace habitats/species.	Minor negative	Slight Adverse
Th49 Goshems Farm	Local wildlife Site - deciduous woodland.	Local	This old landfill area supports two important species populations: the nationally rare Red Data plant Stinking Goosefoot and the UK BAP species Hornet Robber fly. Also made up of a large of deciduous woodland. Medium importance.	Red Data species but unknown at present.	Not possible to substitute	High - UK BAP species and Red Data Book plant species.	Intermediate Negative	Large Adverse
Canal and grazing Marsh, Higham (Gr17)	Local Wildlife Site Restored Higham Canal and coastal grazing marsh (UK BAP habitat).	Local	Recently established reedbeds, damp disturbed grassland and a dyke system.	Unknown	Not possible to substitute	Medium - BAP priority habitat.	Neutral	Neutral
Tentacled lagoon worm ( <i>Alkmaria</i> romijni)	Tentacled lagoon worm is protected under Schedule 5 of the Wildlife and Countryside Act 1981.	National	High importance (protected under Schedule 5 of the Wildlife and Countryside Act). Nationally scarce marine animal.	Considered scarce wihtin the UK; vulnerable to changes to, or loss of, the habitats in which they live.	Not possible to substitute	High	Neutral	Neutral
European eel ( <i>Anguilla anguilla</i> )	European eel is a UK BAP Priority Species (BAP species are now Species of Principal Importance/Priority Species).	National	Medium importance, BAP species	Listed as Critically Endangered on the IUCN Red List; on the OSPAR list of threatened and/or declining species and habitats.		Medium	Neutral	Neutral
Smelt ( <i>Osmerus eperlanus</i> )	Smelt is a UK BAP Priority Species (BAP species are now Species of Principal Importance/Priority Species).	National	Medium importance, BAP species	Declining, most of the recorded populations in Scotland are now extinct, as are a third of those from estuaries in England and Wales.	Not possible to substitute	Medium	Neutral	Neutral
Harbour Porpoise ( <i>Phocoena</i> phocoena)	Annex II of the European Commission's Habitats Directive (92/43/EEC); Schedule 5 of the Wildlife and Countryside Act.	National	High importance	Common to all UK waters 'favourable conservation status', but due to incidental fisheries by-catch, the species has been assessed as under threat/in decline in the Greater North Sea and Celtic Sea.	Not possible to substitute	High	Neutral	Neutral

#### Reference Sources

MAGIC website for designated site locations; ancient woodland locations; priority habitat locations

MAGIC website for designated site locations; ancient woodland locations; priority habitat locations
JNCC website for Ramsar, SPA, SAC and SSSI site designations
Natural England website for Local Nature Reserve designations
Thurrock Biodiversity Study 2006-2011
Essex Wildlife Trust website for locations of Local Wildlife Sites (https://www.essexwtrecords.org.uk/lowsfinder)
Kent Wildlife Trust website for locations of Local Wildlife Sites (https://cms.esriuk.com/tunbridgewells/Sites/KWT\_External/#)
Green Infrastructure Asset Baseline Report, Gravesham Borough, December 2009 (http://docs.gravesham.gov.uk/WebDocs/Environment%20and%20Planning/LDF/Green\_Infrastructure\_Assets\_Baseline\_Report\_1\_Main.pdf)
Review of Lower Thames Crossing Options: Final Review Report Appendices, AECOM, 2013
UK Biodiversity Action Plan; Priority Habitat Descriptions. BRIG (ed. Ant Maddock) 2008 (Updated Dec 2011).

## Summary Assessment Score

Large Adverse\*

#### **Qualitative Comments**

Route 2 bisects a number of designated and local wildlife sites and areas of Biodiversity Action Plan habitat. These include an area of the Thames Estuary and Marshes which is designated as an internationally important Ramsar site and SSSI, and which is also a RSPB reserve. The route bisects a number of important habitats which will result in varying degrees of disturbance, habitat loss and habitat fragmentation. Specific comments on the potential design options for a new river crossing are outlined below

The main impacts are associated with the construction phase. A completed tunnel would not impact the marine environment and the coastal/terrestrial impacts would be greatly reduced in comparison to the erection of a bridge (where permanent effects from loss of habitat and shading effects will occur) or immersed tube tunnel (with very large impacts on habitats and species during construction). The location of the tunnel entrance to the north of the crossing (and, in particular, the temporary works area associated with the tunne portal) currently has a fairly significant impact on an area of historic coastal grazing marsh and local wildlife site, which supports a diverse range of Red Data Book Invertebrates and may be also provide important functionally linked land for the SPA designated species (e.g. high tide roost). Micro-siting this entrance point to minimise impacts of habitat loss/deterioration and disturbance to SPA species is recommended. However there is potential for offset mitigation by enhancing land adjacent to the site which is currently agricultural land. Habitat loss and fragmentation of areas of ancient woodland along the southern extents of the new road, where this links to the A2/M2 in the south, would involve a very large adverse effect on Ancient Woodland habitat that is irreplaceable as discussed above.

Note the Summary Assessment Score is being skewed by the predicted habitat loss for Shorne and Ashenbank Woods SSSI and Claylane Wood.

## **Annex 5 – Historic Environment Worksheet**

#### **Annex 5: Historic Environment Impacts Worksheet**

### Route 2 WSL Bored

	Step 2		Step 3		Step 4
Feature	Description	Scale it matters	Significance	Rarity	Impact
Form	The historic landscape within the study area is predominantly rural in character and the result of post-medieval farming activity. The study area also contains portions of urban settlements such as South Ockendon, Grays, West Tilbury and Gravesend and smaller settlements such as Orsett.  The study area contains a number of listed buildings (designated heritage assets), either within settlements such as South Ockendon and Orsett or within a more rural context such as small groups of farm buildings. In total there are 42 Grade II, four Grade II* and three Grade I listed buildings within the study area (Grade II*: Orsett House, Orsett; Marshall's Cottages and Church of St James, West Tilbury; Church of St Mary, East Court Manor. Grade I: Church of St Mary Magdelene, North Ockendon; Church of St Nicholas, South Ockendon; Church of St Mary, Chadwell St Mary.). The study area also contains two conservation areas (designated assets): West Tilbury and Thong. Cobham Park is a Grade II registered park and garden.  Known archaeological remains within the study area date from the prehistoric to post-medieval periods. There are seven scheduled monuments (designated heritage assets) within the study area: a barrow at South Ockendon Hall; a medieval moated site at South Ockenden Old Hall; Orsett crop mark complex; the Springfield style enclosure at Orsett; Dene Holes in Hangmans Wood; earthworks at West Tilbury and a Second World War anti-aircraft battery at Bowaters Farm.	Conservation Areas) Act 1990 and are a material consideration at national level in the NPPF and NN-NPS. Whilst registered parks and gardens do not have statutory protection, they are a material consideration in the planning process and are considered at a national level in	,		The Scheme will have a direct phyical impact on two Grade II listed buildings: 1 and 2 Gray's Corner cottages and Thatched Cottage, both to the east of Thurrock. Both listed buildings will be removed. The Scheme will have a direct physical impact on West Tilbury Conservation Area through the construction of a new road within the southern portion of the designated area. The scheme may impact on the settings of the Grade II listed buildings to the south and west of Orsett and to the west of West Tilbury. The scheme may also impact on the settings of the West Tilbury and Thong conservations areas and Cobham Park registered park and garden. The impacts may arise as a result of the introduction of a new linear element, the road, in a currently open rural landscape.  The scheme would have a direct physical impact on the Orsett cropmark complex and the Earthworks at West Tilbury scheduled monuments through the construction of new roads within the scheduled areas. The scheme may also impact on the settings of the scheduled monuments at South Ockenden Old Hall, Ockendon Hall, Orsett, West Tilbury and Bowaters Farm. The impacts may arise as a result of the introduction of a new linear element, the road, in a currently open rural landscape.  Construction excavations associated with proposed new road and tunnel may impact on non-designated archaeological remains within the scheme footprint via their complete or partial removal.
Survival	The survival of the listed buildings and the conservations areas is comparable with others in the region and is generally good. The survival of Cobham Park reigstered park and garden is generally good.  The survival of the scheduled monuments is generally good. The survival of the archaeological remains has not yet been fully determined.  The condition of the listed buildings and conservation areas is generally	The NPPF and NN-NPS takes the survival of heritage assets into account at a national level.  The NPPF and NN-NPS takes the condition of heritage	Survival of the designated heritage assets is of moderate to high significance as they contribute to the character of the area.  Survival of the non-designated archaeological remains is of low to moderate significance as surviving remains of these types are important in terms of our understanding of the human past.  The condition of the listed buildings and	Surviving listed Grade II listed buildings are not rare regionally or nationally, although surviving Grade I and Grade II* listed buildings are rare on both scales.  With the exception of the Springfield style enclosure at Orsett and the Bowater Farm antiaircraft battery, the survival of which is rare on both regional and national levels, the survival of the scheduled monuments is of moderate rarity value.  Surviving non-designated archaeological remains are not rare regionally.  Listed buildings and conservation areas in good	The scheme would not impact on the survival of designated assets within the study area, with the exception of the Orsett cropmark complex and the Earthworks at West Tilbury scheduled monuments which would be subject to the direct physical impacts as the result of road construction within the scheduled areas.  The scheme would not impact on the survival of non-designated assets within the study area as a whole, but would have impact within the scheme footprint.  The scheme would not impact on the condition of designated assets within the
Condition	good. The condition of Cobham Park registered park and garden is genrally good.  The condition of the scheduled monuments is generally good, with the exception of the Orsett cropmark complex and Bowaters Farm anti-aircraft battery, the condition of which are poor. The condition of the non-designated archaeological remains is currently unknown.	assets into account at a national level.	conservation areas and registered park and garden is of moderate significance as they have they have a beneficial effect on the character and amenity value of the study area.  The condition of scheduled monuments and non-designated archaeological remains is of high and moderate significance respectively, as in good condition they can inform our understanding of the human past.	condition are relatively common in this region and have low rarity value. Registered parks and gardens in good condition are also relatively common, but have moderate rarity due to their relative scarcity.  Scheduled monuments of the nature and condition of those within the study area have a	study area, with the exception of the Orsett cropmark complex and Earthworks at West Tilbuty scheduled monuments which would be subject to the direct physical impacts as the result of road construction within the designated areas.  The scheme would have not impact on the condition of non-designated assets within the study area as a whole, but would have some impact within the scheme footprint.
Complexity	The listed buildings are not unusually complex and represent a standard mix of agricultural, residential, ecclesiastical and commercial buildings. Cobham Park registered park and garden is relatively complex as it represents several phases of development.  Archaeological remains, both scheduled monuments and non-designated, represent activity from a number of periods and in relation to a number of industrial, settlement, funerary and agricultural processes. They are moderately complex but not unusual in a regional context.	The NPPF and NN-NPS takes the complexity of heritage assets into account at a national level.	The complexity of the historic environment resource has moderate significance as it represents both time-depth and potential to provide positive benefits to the character and amenity value and is also indicative of potential value in terms of our understanding of the human past.	The level of complexity within the historic environment resource is common on a regional level and as such is of low rarity.	The scheme would not impact on the complexity of designated assets within the study area.  The scheme would not impact on the complexity of non-designated assets within the study area as a whole and the scheme footprint.
Context	The study area lies within the Greater London / Thames Estuary areas and the historic environment resource within the study area reflect this wider context.	The NPPF and NN-NPS takes the context of heritage assets into account at a national level.	The context of the historic environment resource within the study area informs their settings and as such is of moderate to high significance.	The context of the historic environment resource within the study area is relatively common and as such is of low rarity.	The scheme would not impact on the context of the historic environment resource within the study area.

	Step 2		Step 3		Step 4
Feature	Description	Scale it matters	Significance	Rarity	Impact
Period	The listed buildings and conservation areas date from the post medieval to modern periods. Cobham Park registered park and garden dates from the medieval to modern periods.  The scheduled monuments date from the Bronze Age to the modern period, whilst the non-designated archaeological remains date from the prehistoric period onwards.	assets into account at a national level.	historic environment resource is of high	The range of periods represented by the historic environment resource within the study is common to the region and as such is of low rarity.	The scheme would not impact on the periods represented by the historic environment resource within the study area.

#### Reference Sources

TAG Unit A3 (November 2014); DMRB Volume11, Section 3, Part 2 (2007); National Heritage List for England; Greater London Historic Environment Record; Kent Historic Environment Record; Essex Historic Environment Record, Thames Estuary Partnership Archaeological Research Framework (1999); Thames Estuary Partnership Greater Thames Research Framework (2010)

#### Step 5 - Summary Assessment Score

#### Moderate Adverse

#### **Qualitative Comments**

The scheme covers an area that is largely open and rural in character but containing urban areas that expanded during the 19th and 20th centuries. Two Grade II listed buildings will experience direct physical impacts through their removal: 1 and 2 Gray's Corner Cottages and Thatched Cottage, both to the east of Thurrock. The effect of these impacts is predicted to be Large Adverse. Potential impacts to the settings of the following designated heritage assets have been identified as a result of scheme: scheduled monuments at South Ockendon Hall, Orsett, West Tilbury and Bowaters Farm, Grade II listed buildings to the south and west of Orsett and to the west of West Tilbury and Thong conservations areas, Cobham Park registered park and garden. These effects are predicted to be Slight Adverse with regard to the listed buildings and Moerate Adverse with regard to the conservation areas, registered park and garden and scheduled monuments.

Road construction within the scheduled areas of the Orsett cropmark complex and the Earthworks at West Tilbury scheduled monument, these effects are predicted to be Large Adverse. However, due to the poor condition of the Orsett Cropmark complex scheduled monument, these effects are predicted to be Moderate Adverse. Construction excavations associated with the proposed road and tunnel may have a physical impact on any non-designated archaeological remains within the scheme footprint are predicted.

## **Annex 6 – Landscape / Townscape Worksheet**

#### Annex 6: Landscape Impacts Worksheet

### Route 2 WSL Bored

Pattern transfer operiod ridge transfer operiod ridge transfer operiod ridge operiod r	ith areas of arable land, horse pasture, crossed by roads such as the A13 and A1089 and with areas of suburban housing and school playing fields.  Between the proposed junction with the M25 at North Ockendon and Baker treet Route 2 WSL passes through relatively flat open countryside of rege arable fields and areas of historic clay pits now used for landfill.	Local	Rarity  Rare in a local context  Rare in a local context  Common	Importance  Varies farmland is medium in local context, Shorne woods rare and the urban edge common.  High in a local context	Substitutability a Varies along the route. Substitutability of farmland a recreation land is medium while the woodland is low.  Low  High	Moderate adverse. Route 2 WSL would have a direct and indirect impact on the pattern of the existing landscape. In places the route would cut through the gently undulating landform as it passes under the A226 Rochester Road and Thong Lane. At the junction with the A2 the road would be raised up on an embankment which would create a visual barrier. Fields which create a distinct pattern on the landscape would be bisected by the road, although these are larger in size than they would have been historically.  Neutral. The tunnel portals would be located to the north and south of the Thames corridor and have no impact.  Slight adverse. Where Route 2 passes between existing settlements and follows the line of existing roads. Moderate adverse. Where the existing pattern is more rural, around Baker Street and to the north and north-east of Tilbury.  Moderate adverse. Route 2 WSL would have a direct impact on the pattern of the existing landscape. Fields which create a distinct pattern on the landscape
eds scr mir	dge backed by expansive marshland with rough grazing and sparse crub. On the north side of the river there are extensive areas of former ineral workings some of which have been backfilled as landfill.  buth of Baker Street Route 2 passes through an urban fringe landscape, the areas of arable land, horse pasture, crossed by roads such as the A13 and A1089 and with areas of suburban housing and school playing fields.  between the proposed junction with the M25 at North Ockendon and Baker reet Route 2 WSL passes through relatively flat open countryside of rige arable fields and areas of historic clay pits now used for landfill.  buth of the Thames corridor the level of tranquillity varies considerably the location. There are peaceful country lanes and small villages, although owhere is it completely tranquil due to distant road noise and the visual	Local	Common	9		Slight adverse. Where Route 2 passes between existing settlements and follows the line of existing roads. Moderate adverse. Where the existing pattern is more rural, around Baker Street and to the north and north-east of Tilbury.
Bet Strolars	ith areas of arable land, horse pasture, crossed by roads such as the A13 id A1089 and with areas of suburban housing and school playing fields.  Between the proposed junction with the M25 at North Ockendon and Baker reet Route 2 WSL passes through relatively flat open countryside of rge arable fields and areas of historic clay pits now used for landfill.  Bouth of the Thames corridor the level of tranquillity varies considerably the location. There are peaceful country lanes and small villages, although owhere is it completely tranquil due to distant road noise and the visual	Local				rural, around Baker Street and to the north and north-east of Tilbury.
Str. larg	reet Route 2 WSL passes through relatively flat open countryside of rge arable fields and areas of historic clay pits now used for landfill.  buth of the Thames corridor the level of tranquillity varies considerably th location. There are peaceful country lanes and small villages, although bwhere is it completely tranquil due to distant road noise and the visual		Common	Medium	High	Moderate adverse. Route 2 WSL would have a direct impact on the pattern of the existing landscape. Fields which create a distinct pattern on the landscape.
with nov	th location. There are peaceful country lanes and small villages, although owhere is it completely tranquil due to distant road noise and the visual	Local				would be bisected by the road.
			Locally medium	Medium	Low	Moderate adverse in the vicinity of Route 2 WSL. Whilst there is some road noise in most areas at present this would increase considerably. The presence of roa infrastructure would also have an impact on visual tranquillity. For residents of Thong, Riverview Park, and Chalk the route will change the view and increase noise, having a detrimental impact on tranquillity.
sur from	ithin the Thames corridor there are expansive views over the river and irrounding marshland from riverside paths which are often some distance om the nearest road. There is always some visual intrusion of man made ructures such as jetties, river traffic and Tilbury power station.	Local	Common	High in local context	Low	Slight adverse. The tunnel would pass below the Thames corridor the portal being located to the south of the Lower Higham Road. Noise levels and visual intrusion would be much the same as they are at present, with the exception of locations closest to the portal and ventilation building.
Tranquillity						
with whi are lan	orth of the Thames corridor the level of tranquillity varies considerably th location. There are large roads such as the M25, A13 and A1089 hich generate traffic noise und disrupt tranquility while there are open eas of countryside between that are broken only by the occasional small ne. Nowhere is it completely tranquil due to distant road noise and the sual intrusion of small settlements and pylons.	Local	Common	Low	High	Large adverse away from the existing large roads a new road would introduce additional noise and visual clutter into a largely rural scene. For some residents of Tilbury, West Tilbury, Grays, Chadwell St Mary, Orsett Heath, Baker Street and South Ockendon the route will change the view and increase noise, having a detrimental impact on tranquillity.
Mc	ost of the route is located within Green Belt	Regional	Regionally medium	High in regional context	Low	Large adverse. The Green Belt is a valued rural separation between the urban edge of large settlements such as Grays, Tilbury and Gravesend, nearby villages. A new road would introduce a new urban element into this landscape.
and	outh of the A2 is Cobham Hall which is included in the register of parks and gardens comprising intact 18C parkland, gardens, estate woodlands and golf course.	National	Rare	High in a national context	Low	Neutral. A slip road at the junction with the A2 would be located within the registered park. However in reality it is outside of the current park boundary. The registered park boundary should be altered to accommodate current transport infrastructure.
Cas	outhern Valley Golf Course and driving range and land associated with ascades Leisure Centre. Included in Gravesham Local Plan 2nd review an area for Green Grid Site Protection.	Local	Rare locally	High in local context	Medium	Moderate adverse. Route 2 WSL passes through the golf course which would have to be partly re-located.
Na	ational Cycle Routes 1 and 13 and other public rights of way.	National / local	Rare / common	High / low	High as easily relocated	Moderate adverse for rights of way and national cycle routes located close to Route 2 WSL due to the visual impact of road infrastructure and increased noise levels.
	axon Shore way leisure route along the Thames, and public right of way northern side of the Thames.	Regional / local	Rare regionally	High in a local context	Low	Neutral. The tunnel would pass below the paths.
	ent Downs Area of Outstanding Natural Beauty (AONB) and Shorne loods Country Park.	National	Rare nationally	High in national context	Low	Slight adverse. Route 2 WSL and the junction with the A2 would mostly be located outside of AONB with only a slip road located within it. This would have little impact due to the existing A2 and infrastructure. There would be views from parts of the AONB at Shorne Woods of new road infrastructure to the north and west. There would be an impact on the setting of the AONB from the north west.
Tha	names and Medway canal route (no longer navigable). Not designated.	Local	Rare locally	Medium in a local context	Low	Neutral The portal and road would be located some distance to the south.
Co	onservation Area at Thong.	Regional	Medium	High in regional context	Low	Slight adverse. Route 2 WSL is close enough to the northern part of the conservation area to have an adverse impact on its setting.
List Filk the Ch	sted buildings located close to Route 2 WSL south of the Thames: lborough Farmhouse, Barn to the north west of Filborough Farmhouse, e granary at Little Filborough Farm, East Court Manor (all grade II), the hurch of St Mary in Chalk (grade II*) and White Horse Cottage in Thong rade II).	Grade II listed buildings regional grade II* national	Rare	High in regional / national context	Low	There would be a <b>slight adverse</b> impact on the setting of the listed buildings in Chalk and a <b>neutral</b> impact on the listed building in Thong which would be further from the proposed route.
Cultural	cheduled monument. Coalhouse Fort battery and artillery defences.	National	Rare	High at a national level	Low	Neutral. A tunnel will have no impact on the setting to the monument.

	Step 2		St	ep 3		Step 4
Features	Description	Scale it matters	Rarity	Importance	Substitutability	Impact
	East Tilbury Battery Scheduled Monument	National	Rare	High at a national level	Low	Neutral. Little remains of the monument and Route 2 WSL is a considerable distance away and would have no impact.
	Second World War Battery at Bowaters Farm Scheduled Monument.	National	Rare	High at a national level	Low	Moderate adverse. Route 2 WSL runs close to the monument. Although this is largely hidden from view by scrub there would be an impact on its setting.
	West Tilbury Scheduled monument at Hall Hill (has potential to show development from pre-Saxon to the medieval period), West Tilbury conservation area & listed buildings (grade II).	National scheduled monument, regional conservation area, local listed buildings.	Nationally / regionally / locally rare	High in national / regional / local context	Low	Moderate adverse. The village of West Tilbury with its various designations is located on the top of hill which is an important landmark standing out from the flat areas of former marsh to the south. Route 2 WSL would have a considerable impact on the setting.
	Chadwell House listed building, Chadwell St. Mary (grade II).	Regional	Regionally rare	High in regional context	Low	Slight adverse. Route 2 WSL would have some impact on the setting of the house from the east and south.
	Listed buildings to the south of the Route 2 WSL / A13 junction: Heath Place, Heath Cottage both off Hornsby Lane; Whitecrofts Farmhouse; thatched cottage south of Nevilles Farm; 2 Baker Street. All are grade II.	Regional	Regionally rare	High in regional context	Low	Slight adverse. Route 2 WSL would follow the route of existing roads south of the A13. However the roads are likely to be increased in size, with more signage and an intensification in use, all of which would have an impact on the setting of the buildings.
	Grade II Listed buildings at Baker Street.	Regional	Regionally rare	High in regional context	Low	Moderate adverse. The A 13 junction would be very close to a listed windmill which will adversely affect its setting. The remainder of the buildings are further away and there would only be a slight adverse impact on their setting.
	Crop mark complex, Orsett directly on Route 2 WSL its junction with the A13. Very little visible at surface level.	National	Rare	High in national context	Low	Neutral landscape impact as the monument is below ground.
	Scheduled monument and grade II listed building – gatehouse and moat of South Ockendon Hall and Scheduled monument - Roman barrow.	Scheduled monument National / listed building regional	Scheduled monument rare nationally/ listed building rare regionally	Scheduled monument high in national context/ listed building high in regional context	Low	Moderate adverse - The current monuments are surrounded by a flat, broad expanse of arable fields. Route 2 WSL, which would be very close, would have a detrimental impact on the setting of the monuments from the north.
	2 grade II Listed buildings at Kemps Farm.	Regional	Regionally rare	High in regional context	Low	Slight adverse. The M25 has an impact on the setting of the buildings currently. A new road junction would increase the level of impact.
	3 grade II listed buildings, a grade 1 listed building and a conservation area at North Ockendon.	Regional / national for grade I listed building	Regionally rare	High in regional context	Low	Neutral - The proposed Route 2 WSL junction with the M25 is a considerable distance from North Ockendon which is already impacted by the presence of the M25. Route 2 WSL would be largely screened by existing trees and hedges.
	South of the A2 the grounds of Cobham Hall are a Registered Park and Garden comprising an intact 18th century parkland, gardens, estate woodlands and golf course.	National	Rare	High in National context	Low	Neutral. Part of junction with the A2 would be located inside of the registered park, although in reality this is outside of the of the current park boundary.
	Shorne Woods Country Park is made up of ancient woodland, woodland and heathland. The park has a visitor centre, car park, leisure facilities and walks.	Local	Rare	High in local context	Low	Neutral. None of Route 2 WSL would pass through the woodland.
	South of the Thames river corridor the landcover is of arable farmland with hedgerows and trees grouped around small settlements. To the west is the suburban edge of Gravesend with associated recreational land uses such as a leisure centre, golf course and driving range.		Common	Low in local context	Medium	Moderate adverse. The current largely agricultural landcover would change along the route to one dominated by transport infrastructure. There would probably be a change in the use of the land between the road and the edge of Gravesend as many of the fields would be too small to farm viably.
Landcover	The characteristic landcover of the Thames river corridor consists of open flat grazing marshes, with sparse scrub and tree cover, with emergent plants along ditches. The Thames is lined with inter tidal mud flats and gravel foreshore. On the north side there are extensive former mineral workings some of which have been backfilled with landfill.	Regional	Rare	High in regional context	Low	A bored tunnel would have <b>neutral</b> impact immediately adjacent to the river. For the above ground sections the current agricultural landcover would change along Route 2 WSL to one dominated by transport infrastructure. In the long term there would be the potential for the route to create changes as surrounding agricultural land would be bisected and would become less viable to farm.
	From the A13 to the north of Tilbury the landcover is of a mix of arable fields, horse pasture, roads and suburban settlements	Local	Low	Low	High	Slight adverse. Most of the route follows the line of the existing A1089.
	From the M25 junction to the A13 junction with Route 2 WSL the landcover is mostly of arable fields, with hedges and boundary trees. There old clay pits to the west of South Ockendon that are now used as landfill.	Local	Medium	Medium in local context	High. The most important features the trees and hedges can easily be replaced.	Moderate adverse The current agricultural landcover would change along the route to one dominated by transport infrastructure.
Summary of character	The Thames river corridor has a strong identity with large expansive horizontal vistas dominated by the interplay of water and sky. The area to the north along Route 2 consists of open arable farmland north of the A13, with large suburban settlements and urban fringe areas to the south. South of the Thames corridor consists of large arable fields with hedgerows and trees grouped in association with small settlements. Recreational facilities such as a golf course and leisure centre fringe the suburban edge of Gravesend to the west. The land rises up to the south and the AONB with areas of woodland and heathland beyond which is the A2, HS1 transport corridor.	Regional	Medium regionally	Medium regionally	Medium	A bored tunnel would have a <b>neutral impact</b> in the Thames corridor with the remainder of the route having the same impacts as a bridge.

#### Reference Sources

Department of Transport TAG Unit A3 Environmental Impact Appraisal May 2014, Magic.gov.uk, Google Maps satellite photography, OS Maps, Thurrock Local Plan 1997, Thurrock UDP deposit draft 2003 (unadopted). National Character Area 81 Greater Thames Estuary, National Character Area 81 Greater Thames Estuary, National Character Area 113 North Kent Plain, The Landscape Assessment of Kent 2004, Essex Landscape Character Assessment, Gravesham Local Plan 2nd review

#### Step 5 - Summary Assessment Score

Large adverse

#### **Qualitative Comments**

Route 2 WSL would create a new road corridor and introduce a significant change to the existing landscape character which is designated as Green Belt. This is due to the introduction or a major new transport corridor with its associated with Route 2 WSL would impact on locally, regionally and nationally valued features including scheduled monuments and listed buildings.

## **Annex 7 – Water Worksheet**

#### Annex 7: Water Environment Impacts Worksheet

#### Route 2 WSL Bored

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
Study area: River Thames	l	I	l	I				I	<u>I</u>
Potential Impacts: Morphological and hydrodynamic changes to the River Thames due to river crossing	River Thames Estuarine /	F 2 h	High Recommended Marine Conservation Zone. Heavily modified water body at Moderate Ecological Potential and	Regional /				Negligible	Low significance
	Water Body Thames Middle)	products / recreation / aesthetics / cultural heritage / value to economy / navigation	failing Chemical Status. Important river of national significance with commercial and social value, including depository for effluent discharges, abstraction of water supply, recreation and navigation. South Thames Estuary and Marshes SSSI and Ramsar site to south	National (excludes biodiversity considerations)	Rare	Not feasible	Very High	Negligible Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant
Study Area: Mardyke	Г	Г	Г	Π				T	I
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain		Water supply / biodiversity / transport & dilution waste	Medium Waterbody currently at Moderate Ecological Status. Target Good Ecological Status by 2027 Water available for abstraction	Regional (ref WFD water body status)	Moderate (ref target WFD status, water	Not feasible	Medium	(Moderate adverse) Slight adverse Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant (Low significance)
Potential Impacts: Routine runoff and spillage risk during operation of the new road	GB10005/02/990		licensing, subject to limitations (Roding Beam Ingrebourne and Mardyke CAMS)		supply availability)			(Moderate adverse) Negligible (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain		Water supply / biodiversity / transport & dilution waste	Medium Waterbody currently at Poor Ecological Potential. Target Good Ecological Potential by 2027 Water available for abstraction	Regional (ref WFD water body status)	Moderate (ref Datarget WFD status, water supply availability)	Not feasible	Medium	Slight adverse Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road			licensing, subject to limitations (Roding Beam Ingrebourne and Mardyke CAMS)	, ,				(Moderate adverse) Negligible (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
	fardyke and Fobbing (R11) VFD water Body ID 18106037027970 Icludes West and East Tilbury	Water supply / biodiversity / transport & dilution waste products / recreation		Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	Slight adverse Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road	main drains		licensing, subject to limitations (Roding Beam Ingrebourne and Mardyke CAMS)					(Moderate adverse) Negligible (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Study Area: Thames and Medway Canal									
Potential Impacts: Morphological and hydrodynamic changes to the River Thames due to river crossing	Thames and Medway Canal		Medium (biodiversity evaluated separately) Thames and Medway Canal good potential, no other water quality data available at this stage. Could support	Regional (ref WFD water body status)				Negligible Assumes bored tunnel section has no impact on surface water courses	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road	(Ca18) (GB70610011)	recreation / navigation (potential)	protected ecological species. It is not known whether these water bodies have any intrinsic social or economic value. Not currently used for navigation. Appraisal on water environment not biodiversity			Limited feasibility	Medium	Negligible Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted. Note: Best practice drainage design precludes discharge to canals	Insignificant
Study Area: Minor watercourses and drain	age ditches at South Thames I	Estuary and Marshes (excluding Thames and Medw	ay canal)						
Potential Impacts: Morphological changes to minor watercourses and drainage networks	Minor water courses and drains of Shorne, Eastcourt, Great Clane Lane and Filborough		Medium Could support protected ecological			l imite d		Negligible Assumes bored tunnel section has no impact on surface water courses	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road	Marshes, South Thames Estuary and Marshes SSSI and Ramsar site	Biodiversity / recreation / amenity	species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity	Local	Common	Limited feasibility	Medium	Negligible Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant
Study Area: Minor watercourses and drain	nage ditches north of the River	Thames (see also Mardyke water body)							
Potential Impacts: Morphological changes to drainage networks	Minor watercourses and		Medium Could support protected ecological					Slight adverse Assumes watercourse crossings and or displacement includes appropriate mitigation	Insignificant
	drainage ditches at West / East Tilbury Marshes	Biodiversity / recreation / amenity	Could support protected ecological species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity	Local	Common	Limited feasibility	Medium	(Moderate adverse) Negligible Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant Low significance
Study Area: Lakes and ponds									
Loss of or other physical impact on standing water bodies	Standing water features (natural and man made) on land to N and S of River	Biodiversity / recreation / amenity / water supply	Low - Medium Could support protected ecological	Local	Common	Limited	Low	Negligible: No significant standing waters crossed or intercepted	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road	Thames including ponds and lakes and standing water in marsh areas	(small reservoirs and dams)	species. Some reservoirs and local (largely) agricultural water supplies			feasibility		Negligible: Assumes no drainage to standing water in accordance with best practice	Insignificant

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
Study Area: Groundwater north of River	Thames								
	South Essex Thurrock Chalk (GB40601G401100)	WFD water body status; water supply / resources; groundwater dependent ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Source Protection Zone 3 (Nr J29) Local commercial / industrial / agricultural licenced supplies Roding Beam Ingrebourne and Mardyke CAMS - no water available for further abstraction		Rare (CAMS shows restricted water availability)	Not feasible	High (based on resource availability, WFD target )	(Moderate adverse) Depends on whether permanent structures and or permanent dewatering (including at portal) impact groundwater flow Slight adverse with mitigation. Assumes any drainage to ground managed in accordance with best practice	Low significance (significant)
Potential Impact: Impact on groundwater quality from potentially polluting surface activities/ highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels and tunnel portals (if required) or disruption to natural groundwater flow by underground structures. Long term impacts from		WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Local commercial / industrial / agricultural licenced supplies	Regional (ref WFD water body status)	Moderate	Not feasible	Medium	Negligible - slight adverse Assumes at grade road would not significantly impact groundwater and cuttings have minor impact on shallow groundwater. Drainage to ground managed in accordance with best practice. No exposure of this formation at Thames crossing	Insignificant
mobilisation of leachates from contaminated land / old landfill		WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good)	Regional (ref WFD water body status	Moderate	Not feasible	Medium	Negligible: Little exposure of this formation Assumes any drainage to ground managed in accordance with best practice	Insignificant
		Groundwater dependant ecosystems (biodiversity); local water supply (agriculture)	Low	Local	Common	Not feasible	Low	Slight to moderate adverse. Depends on whether permanent structures and or permanent dewatering (including at portal) impact shallow groundwater flow Assumes any drainage to ground managed in accordance with best practice. Also assumes any landfill leachate appropriately managed	Insignificant
Study Area: Groundwater south of River	Thames							1	
Potential Impact: Impact on groundwater quality from potentially polluting surface activities / highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels and tunnel portals (if required) or disruption to natural groundwater flow by underground structures.		WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Local commercial / industrial / agricultural licenced supplies	Regional (ref WFD water body status)	Rare (CAMS shows restricted water availability)	Not feasible	High (based on resource availability, WFD target)	(Moderate adverse) Depends on whether permanent structures and or permanent dewatering (including at portal) impact groundwater flow Slight adverse with mitigation. Assumes any drainage to ground managed in accordance with best practice	Low significance (significant)
Potential Impact: Impact on groundwater quality from potentially polluting surface activities / highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels (if required) or disruption to natural groundwater flow by underground structures. Derogation of water in SSSI		Groundwater dependant ecosystems (biodiversity); local water supply (agriculture)	Low (Ramsar/ SSSI covered by biodiversity)	Local (National / International value covered by biodiversity)	Common	Not feasible	Low	Slight adverse Bored tunnel would pass beneath any shallow aquifer north of portal but may be impacted by long term dewatering at portal. Assumes any drainage to ground managed in accordance with best practice	Insignificant
Study Area: River Thames Flood Zone 2/3	and associated defences								
Potential Impacts: Direct risk of flooding to highway from watercourse or tidal source (Thames)	River Thames crossing route	Transport link - improves efficiency of existing network	High	Regional	Moderate	Feasible (alternative crossing locations)	High	Slight adverse - portals and approaches off (defended floodplain) crossing closures due to flood conditions unlikely, further mitigation through design and integrated defences	Low significance
Potential impacts: Impedance of flood flows in River Thames channel due to crossing resulting in obstruction to flow	River Thames channel	Conveyance of flood flows	High - managed watercourse draining large upstream catchment	Local (immediate vicinity of crossing and City of London upstream)	Moderate	Not feasible	High	Negligible (bored tunnel would not interact with Thames channel flows)	Insignificant
Potential Impacts: Loss of flood storage volume (including loss through impedance of flood flows) due to the development (e.g. embankments, cuttings) or permanent spoil disposal sites leading to increased flood risk	River Thames floodplain	Conveyance and storage of flood flows: Mostly defended floodplain at present in vicinity of proposed route.  TE2100 Policy P4 implies improved defences in the future will ensure route remains in the defended floodplain	Medium - significant potential storage volume but not currently used for flood storage as the natural floodplain is defended	Local	Moderate	Feasible: Loss of (defended) floodplain storage substitutable	currently used	Slight adverse: Assumes minimal loss of floodplain storage within defended River Thames floodplain	Insignificant
Potential impacts: Increase in flood risk by affecting existing flood defence or by preventing future flood defence development (e.g. actions under Thames Estuary TE 2100 planning)		Protection of property / assets from flooding	High - provides protection for large urban area	Regional	Moderate	Not feasible: Unlikely to be substitutable	High	Slight adverse: Assumes minimal loss of floodplain storage within defended River Thames floodplain	Insignificant
Study Area: Mardyke Flood Zone 2/3 and	associated defences			I			<u> </u>		<b>.</b>
Potential Impacts: Direct risk of flooding to highway from watercourse or tidal source (Mardyke)		Transport link - improves efficiency of existing network	High	Regional	Common	Feasible (alternative crossing locations)	High	(Moderate Adverse) Slight adverse (mitigation available, design to manage flood risk - defended floodplain)	Low significance (Significant)
Potential Impacts: Loss of flood storage volume (including loss through impedance of flood flows) due to the development (e.g. embankments, cuttings) or permanent spoil disposal sites leading to increased flood risk	Mardyke floodplain	TE2100 Policy P4 implies improved defences in the	Medium - potential flood storage shown in vicinity of route (EA flood Map) but shown as defended flood plain.	Local	Common	Feasible: Loss of (defended) floodplain storage substitutable	Low	(Moderate adverse) -potential to increase flood risk upstream for mostly rural area. Slight adverse with mitigation - viaduct spans flood plain.	Low significance (Significant)
Potential Impacts: Risk of afflux flooding (upstream) due to crossing of watercourse or land drain.	Mardyke channel	Conveyance of flood flows	High - river channel shown (EA Flood Map) to convey flood flows at least up to 100-yr return period.	Local	Moderate	Not feasible	High	(Moderate adverse) -potential to increase flood risk upstream for mostly rural area. Slight adverse with mitigation - viaduct spans flood plain.	Low significance (Significant)
Potential impacts: Increase in flood risk by affecting existing flood defence or by preventing future flood defence development (e.g. actions under Thames Estuary TE 2100 planning)		Protection of property / assets from flooding	Low? - none shown on EA floodmap in vicinity of route	Local	Moderate	n/a - no defences shown (EA Flood map) in vicinity of proposed route	n/a	n/a - no defences shown (EA Flood map) in vicinity of proposed route	Insignificant - no defences shown (EA Flood map) in vicinity of proposed route

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
Study Area: Area surrounding Main Rivers	s, Ordinary Watercourses, land	drains and ditches, including marshes							
Potential Impacts: Risk of afflux flooding (upstream) due to crossing of watercourse or load drain	Minor drainage networks within the land to N and S of River Thames, including drainage of Stone, Purfleet and West Thurrock Marshes ("West Thurrock Main Sewer")	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	Low	(Moderate adverse) (potential increase in flood risk). Slight adverse to negligible with mitigation	Insignificant Low significance
Potential Impacts: Risk of increased runoff to watercourse or land drain causing increase in flood risk from watercourse	As above	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	Low	(Moderate adverse) (potential increase in flood risk). Slight adverse to negligible with mitigation	Insignificant Low significance
Potential Impacts: Risk of flooding resulting from change in watercourse/drain flow regime due to morphological changes for development	As above	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	Low	(Moderate adverse) (potential increase in flood risk). Slight adverse to negligible with mitigation	Insignificant Low significance
Study Area: Entire route.	•		•						•
	Various floodplains and surface water drainage areas		Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	(Moderate adverse) (potential increase in flood risk) Slight adverse after mitigation	Insignificant Low significance
	Various floodplains and surface water drainage areas		Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	(Moderate adverse) (potential increase in flood risk) Slight adverse after mitigation	Insignificant Low significance
	Various floodplains and surface water drainage areas		Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	(Moderate adverse) (potential increase in flood risk) Slight adverse after mitigation	Insignificant Low significance

weblag TAG Unit A3. Environmental Impact Appraisal. Impacts on the Water Environment Sub-objective, Department for Transport, May 2014 Review of Lower Thames Crossing Options: Final Review Report Appendices. DIT/ AECOM April 2013. River Basin Management Plan. Thames River Basin District. Environment Agency 2009 River Basin Management Plan. Anglian River Basin District. Environment Agency 2009 Darent and Cray Abstraction Licensing Strategy. (CAMS) Environment Agency 2013 Roding, Beam, Ingrebourne and Mardyke Abstraction Licensing Strategy (CAMS) Environment Agency 2013 Environment Agency Website: "What's in your backyard" Thames Estuary 210. TE2100 Plan. Environment Agency, 2012. Thurrock Surface Water Management Plan (SWMP). URS. 2013. Themselds Exitate Management Plan (SWMP). URS. 2013.

nameside Surface Water Management Plan (SWMP). JBA. 2013.

Trialnesbur Surface water Mariagenient Plant (Sywint), John. 2013.
Havering Flood Risk Management Strategy (FRMS). London Borough of Havering. 2015.
South Essex Catchment Flood Management Plan (CFMP). Environment Agency. 2009.
North Kent Rivers Catchment Flood Management Plan (CFMP). Environment Agency. 2009.

Highways Agency Drainage Data Management System (HA DDMS)

#### Summary Assessment Score

#### (Post mitigation) Slight adverse impacts

## **Qualitative Comments**

Note 1: Risks from construction are only considered where they may have a permanent impact on the water environment once construction is completed.

Note 2: Impacts on biodiversity may occur as a result of changes in water courses, river morphology, sedimentation, water quality and/or flow. Impacts on habitats / ecosystems / flora / fauna are covered separately under biodiversity and not included here to avoid "double counting"

Note 3: For some features, the magnitude of impacts is shown without mitigation (bold red font in parentheses) and with mitigation (bold, the convention for webTAG assessment). In these cases significance of effect is shown both without (red font in parentheses) and with mitigation.

Surface Water: The bridge crossing over the Thames will need to be developed to minimise impacts on river morphology from the bridge, although these are expected to be relatively localised with small increases inflow velocity within +/-2000m and there is little impact on HWL. Navigation will be affected by the social control of the piers and bank structures, but the design will ensure main navigable channels remain relatively unaltered. The bored tunnel would have little impact on the quality or morphology of the River Thames. Assuming the current bed profile is restored post construction, impacts from the immersed tunnel depend primarily on the scale of any permanent effects (if any) that arise through the construction process (morphology, sedimentation, water quality, fisheries, navigational channels). Whilst these may have local impact, within the context of the Thames Middle water body overall, these are considered to be likely to be at worst moderate adverse. The long term impacts of sedimentation change (brought about during construction) are mostly related to tidal and inter tidal habitats, assessed under biodiversity.

npacts on the Mardyke (WFD water body) will depend on the nature of the crossings adopted, fully spanning and viaduct crossings are likely to have only slight impacts, where smaller channel crossings are employed, mitigation is generally available to reduce impacts to slight adverse

mpacts are considered mostly slight adverse once mitigation is applied, although pending a full understanding of the impacts of the construction of the immersed tunnel, the impacts on the Tidal waters of the Thames remain moderate adverse.

Groundwater: Issues with rising groundwater levels have been identified regionally although it is understood these are less problematic in this immediate area. A tunnel crossing will require temporary dewatering during construction and may need longer term dewatering at portals. Larger groundwater resources and public supplies, primarily from the Chalk at depth are unlikely to be impacted, although there may be some impact on local licensed commercial/ industrial / agricultural supplies from shallow groundwater in the gravels, these are not thought to be significant. Impact at source protection zones may be mitigated by adopting appropriate construction and drainage practices. Through possible impacts on groundwater quality and flow from the construction of a long bored tunnel there may be residual slight adverse impacts on completion.

WFD status: A Water Framework Directive assessment will be required due to the potential for direct effects on biological, chemical and physical WFD parameters for both surface waters (Thames, Mardyke, Thames and Medway canal) and WFD groundwater bodies (north and south of the river). With appropriate mitigation, it is not anticipated that the River Thames crossing or impacts on the Mardyke or groundwaters will lead to a reduction on WFD status or will prevent these water bodies reaching good status or potential in the future. For the assessment, it is generally assumed that the target 2027 status of good applies, even though current status of most water bodies is poor.

The bridge option has some potential to increase flood risk in the River Thames channel upstream due to piers and other structures impeding channel conveyance. The bored and immersed tube tunnels would have no impact on channel conveyance. The impact of the bridge on channel conveyance is likely to be nitigated through design (adequate span, minimise pier dimensions)

unnel options would be at higher risk of route closure due to high flood levels (i.e. through breach or overtopping of existing defences).

All bridge and tunnel options would require a design that integrates with (or does not compromise) TE2100 River Thames flood defence plans. At the River Thames flood defence locations the current Route 2 bridge design indicates the bridge would be significantly higher than the flood defences south of the River Thames which are located at the approximate transition between a raised viaduct and suspended bridge (no defences are shown on the north bank of the River Thames as here high ground forms the defence line). The Route 2 bored tunnel and immersed tunnel options have portals set back from the River Thames (south embankment) flood defences. However, there would still be a need to consider the impact of a tunnel on flood defences e.g. due to interference with flood defence piling by the tunnel.

TE2100 policies at the location of the Route 2 crossing are:
P4 for Policy Unit Purifiest, Grays and Tilbury, north of the River Thames (take further action to keep up with climate change and land use change so that flooding does not increase)
P3 for Policy Unit North Kenth Marshes, south of the River Thames (continue with existing or alternative actions to manage flood risk). TE2100 includes an action to provide a secondary defence to Gravesend to protect from flooding from the tidal River Thames from the east. There is an opportunity for the Route 2 road embankment to provide this structural defence.

CFMP policies for Route 2 south of the River Thames (North Kent Rivers CFMP) are P3 for the North Kent Marshes Policy Unit (areas of low to moderate flood risk where we are generally managing existing flood risk effectively - i.e. no anticipated increase in FRM measures) and P1 for the North Kent Downs

Policy Unit (areas of little or no flood risk where we will continue to monitor and advise).

CFMP policies for Route 2 north of the River Thames (South Essex CFMP - Thames Urban Tidal Policy Unit) are P4 for the Thames Urban Tidal Policy Unit (take further FRM actions to keep pace with climate change) and P6 for the Upper Mardyke Policy Unit (store water or manage run-off in ocations that provide overall flood risk reduction or environmental benefits). Where Route 2 crosses the Mardyke floodplain there may be opportunities to increase flood storage upstream of the road to provide benefits downstream.

oute 2 crosses the Mardyke flood plain. Whilst this may present a flood risk to the proposed road and the potential for the road to increase flood risk upstream, there is also potential for the road embankment to be designed to hold back flood water and hence alleviate flood risk downstream (consistent with South

hurrock SWMP (URS 2013) identifies Critical Drainage Areas (CDAs). Route 2 crosses the identified CDA\_008, which includes Tilbury Flood Storage Area, designed to store surface water and so protect Tilbury from flooding. The Environment Agency has stated that no net reduction in available storage within the cheme would be considered acceptable. For Route 2 to be considered further, principles for mitigating any displaced storage within Tilbury FSA would need to be agreed with the EA and / or Thurrock Council.

Thameside SWMP (JBA 2013) is a Stage 1 SWMP and does not provide much detail in relation to the Route 2 alignment and implications for local flood risk.

The surface water drainage strategy / design (in accordance with HE guidance and standards) should be agreed with the relevant Lead Local Flood Risk Authorities. It is likely this will require that surface water runoff from the proposed crossing does not exceed existing rates (using SUDs where feasible).

## **Annex 8 - Noise Worksheet**

Annex 8: Noise Worksheet **Route 2 WSL Bored Tunnel APPRAISAL - NOISE POLLUTION** Present value base year: 2010 2015 Current year: Proposal Opening Year: 2025 Average Household Size: 2.36 Project (Road or Rail): Road No. of households experiencing 'without scheme' & 'with scheme' noise levels (given in dB<sub>Leg</sub>) in Opening Year 45-47.9 48-50.9 51-53.9 54-56.9 57-59.9 60-62.9 63-65.9 66-68.9 69-71.9 72-74.9 75-77.9 78-80.9 Without scheme <45 45-47.9 9344 1068 423 4337 48-50.9 51-53.9 54-56.9 57-59.9 54 117 175 2437 228 275 3331 667 1283 29 125 180 1202 4566 913 19 60-62.9 91 2639 63-65.9 66-68.9 69-71.9 72-74.9 453 68 48 78-80.9 No. of households experiencing 'without scheme' & 'with scheme' noise levels (given in dB<sub>Leq</sub>) in 15th Year After Opening With 45-47.9 48-50.9 51-53.9 54-56.9 57-59.9 60-62.9 63-65.9 66-68.9 69-71.9 72-74.9 Without scheme <45 45-47.9 8963 1041 283 342 48-50.9 51-53.9 54-56.9 1194 5030 361 54 18 1070 4706 152 57-59.9 0 38 614 2491 193 109 10 60-62.9 63-65.9 158 490 66-68.9 69-71.9 72-74.9 Net Present Value of Noise of Proposal £3,135,613 \*positive value reflects a **net benefit** (i.e. noise reduction) (60 Year Period) 12418 Estimated Population Annoyed (Do-Minimum): Estimated Population Annoyed (Do-Something): 12344 Net Noise Annoyance Change in 15th Year After -74 positive value reflects an increase in people annoyed by noise

Opening (no. of people):

# Appendix 7.2 Appraisal Summary Table Route 3 WSL (BT)

Appraisal Summary Table Route 3 WSL (BT)

Annex 1: TEE table

Annex 2: PA table

Annex 3: AMCB table

Annex 4: Biodiversity worksheet

Annex 5: Historic environment worksheet

Annex 6: Landscape/ townscape worksheet

Annex 7: Water worksheet

Annex 8: Noise worksheet

Appra	aisal Summary Table	Route 3, Western Southern Link, Bored Tunnel	Date produced: 22 Jan 2016		С	ontact:
	Name of scheme:	Route 3 Bored Tunnel with Western Southern Link - Core Growth, Central Case costs	s, Current values of time, additional lane in tunnel		Name	Chris Taylor
D	escription of scheme:	New Dual 2 lane trunk road (70mph) from M25 between J29 and J30, crossing the Th to the east of Gravesend with a westerly southern link to the A2.	names in a bored tunnel, with an additional lane for futu	re proofing, 2km	Organisation Role	Highways England Project Sponsor
	Impacts	Summary of key impacts	Δοςο	ssment	Hole	1 Tojout openior
	pasto		Quantitative	Qualitative	Monetary £(NPV)	Distributional 7-pt scale/ vulnerable grp
my	Business users & transport	Large time savings estimated for business travellers, including freight, due to reduced congestion	Value of journey time changes(£) £2,531m			
Economy	providers	and improved connectivity. Small vehicle operating cost benefits would also occur due to reduced congestion. Small user charge disbenefits as there will be charges on the new crossing.	Net journey time changes (£)  0 to 2min 2 to 5min > 5min	N/A	£2,954m	Not appraised yet
Ecc			-£516m £1,124m £1,923m			
	Reliability impact on Business users	The option would improve journey time reliability for journeys across the Thames by providing a completely alternative route, and relieving congestion on the existing Dartford Crossing.	N/A	N/A	£104m	
	Regeneration	Not appraised using WebTAG, but see complementary wider economic modelling	N/A	N/A	N/A	
	Wider Impacts	Wider Impact (WI) benefits are 80% higher than those for Route 1. Almost 80% of WI benefits are from the agglomeration of business activities.	Agglomeration £1,056r	1		
		mont the aggiorneration of business activities.	Output in imperfectly competitive markets £295r	N/A	£1,353m	
			Labour supply impacts £1r	ח		
Environmental	Noise	There is a small net benefit. Whilst there are reductions in noise along the M25/ A282 corridor, there are increases in noise for communities along the new route.	282 people would benefit based on an estimated 12,418 people being annoyed by noise in the without scheme situation decreasing to 12,136 people in the with scheme situation.	N/A	£12m	Not appraised yet
Envir	Air Quality	All properties which are predicted to exceed or are at risk of exceeding the AQSO in the without Scheme situation would experience an improvement in air quality with the Scheme.	Two of the receptors modelled are predicted to exceed the AQSO without the scheme (representing up to approximately 60 receptors), but these receptors experience an improvemen compared to the without scheme. The scheme is not predicted to lead to any new exceedences.	t N/A	N/A	Not appraised yet
	Greenhouse gases	The option is forecast to result in an increase in both non-traded and traded carbon emissions	Change in non-traded carbon over 60y (CO2e)  Change in traded carbon over 60y (CO2e)  Change in traded carbon over 60y (CO2e)  5,979,862 tonnes  16,783 tonnes	- N/A	-£273m	
	Landscape	A new road would adversely affect the landscape character including green belt and intrude slightly into the AONB. A bored tunnel would have limited impact on the character of the Thames corridor although new road infrastructure could potentially be visible from the AONB.	N/A	Moderate Adverse	N/A	
	Townscape	See Landscape entry	N/A	N/A	N/A	
	Historic Environment	Direct physical impacts to one scheduled monument and two Grade II listed buildings. Potential impacts to the setting of a number of designated heritage assets and direct effects on non-designated archaeological remains within the scheme footprint.	N/A	Moderate Adverse	N/A	
	Biodiversity	Potential indirect effects on the Thames Estuary & Marshes SPA (loss of functionally linked land). Impacts on LWSs & areas of BAP Priority Habitat. Direct loss of ancient woodland at Claylane Wood and loss of deciduous (not ancient) woodland at Shorne and Ashenbank Wood SSSI.	N/A	Large Adverse	N/A	
	Water Environment	Impacts on Mardyke and on flood plain.	N/A	Slight Adverse	N/A	
Social	Commuting and Other users	Compared to business users, relatively small time savings arise for commuters and other users due to reduced congestion and improved connectivity. Vehicle operating cost disbenefits due to increased travel and lack of perception by non-business travellers. Small road user charge disbenefit as there will be charges on the new crossing	Value of journey time changes(£)         £588m           Net journey time changes (£)         0 to 2min         2 to 5min         > 5min           -£371m         £352m         £607m	N/A	£171m	Not appraised yet
	Reliability impact on Commuting and Other users	The option would improve journey time reliability for journeys across the Thames by providing a completely alternative route, and relieving congestion on the existing Dartford Crossing.	N/A	N/A	£39m	
	Physical activity	The option has no impact on walking and cycling	N/A	Neutral	N/A	
	Journey quality	The route would provide a new high standard free-flowing solution and would relieve traffic from the existing crossing at Dartford and other routes including the A2. With the WSL the A2 junction has a compact junction layout arrangement, due to existing constraints, with slip/ link roads which have a design speed of 30-50 mph.	N/A	Moderate beneficial	N/A	
	Accidents	DfT's COBALT tool has been used to appraise accidents and shows a net increase in the number and value of accidents across the road network, as a result of this being a new route. However a separate appraisal has also been undertaken using actual accident data across the road network, which shows that the option will lead to a reduction in the rate of accidents (as measured by the Fatal and Weighted Injury rate per billion vehicle kilometres).	Because it is a new route 2,456 additional accidents are predicted over 60 years, including 35 fatalities, 274 serious injuries and 3,415 slight casualties	N/A	-£128m	Not appraised yet
	Security	Lighting will be provided in accordance with Highways England's TA49/07 standard for new and	N/A	Slight Adverse	N/A	Not appraised yet
	Access to services	replacement lighting on the strategic road network  Not appraised because this criteria relates to public transport options	N/A	N/A	N/A	N/A
	Affordability	The appraisal has assumed the same charges for the new crossing in real terms as those at	N/A	Neutral	N/A	Not appraised yet
	Severance	Dartford Crossing today  Safe re-provision will be made for all existing rights of way for pedestrians and cyclists that cross the new trunk road. There will be permanent severance of some community facilities and public natural assets and mitigation options need to be developed	N/A	Slight Adverse	N/A	Not appraised yet
	Onking and					
ည္တ	Option and non-use values  Cost to Broad Transport	Not appraised because this criteria relates to public transport options  The impacts on the transport budget would be twofold; the capital cost of construction and the	N/A Investment costs: £2,098m	N/A	N/A	
Public Accounts	•	subsequent maintenance and operating cost of the infrastructure offset by revenue collected from the additional user charges	Operating costs £293m Operator revenue £827m (a benefit, offsetting cost over the longer term)	N/A	£1,564m	
	Indirect Tax Revenues	A tax benefit to central government is forecast as a result of additional traffic using the road network and particularly the Dartford Crossing	N/A	N/A	£565m	

## Annex 1 - TEE Table

Economic Efficiency of the Transport System (TEE): Route 3/WSL

Annex 1: TEE Table

Non-business: Commuting	ALL MODES		ROAD		BUS and COACH	RAIL		OTHER
User benefits	TOTAL		Private Cars an	d LGVs	Passengers	Passengers	5	
Travel time	£73,944,064			£73,944,064				
Vehicle operating costs	-£62,276,287			-£62,276,287				
User charges	£109,062			£109,062	1			
Maintenance	£0							
COMMUTING	£11,776,839	(1a)		£11,776,839				
Non-business: Other	ALL MODES		ROAD		BUS and COACH	RAIL		OTHER
User benefits	TOTAL		Private Cars an	d LGVs	Passengers	Passengers	3	
Travel time	£513,810,308			£513,810,308				
Vehicle operating costs	-£352,847,419			-£352,847,419				
User charges	-£1,724,986			-£1,724,986				
Maintenance	£0			21,721,000				
OTHER	£159,237,903	(1b)		£159,237,903				
					<u> </u>	_		
Business								
<del></del>			Goods	<b>Business Cars</b>				
<u>User benefits</u>			Vehicles	& LGVs	Passengers	Freight	Passengers	
Travel time	£2,530,994,917		£653,351,657	£1,877,643,261				
Vehicle operating costs	£538,751,450		£371,260,153	£167,491,297				
User charges	-£115,705,561		-£59,107,375	-£56,598,186				
Maintenance								
Subtotal	£2,954,040,806	(2)	£965,504,435	£1,988,536,371				
Private sector provider impacts						Freight	Passengers	
Revenue								
Operating costs								
Investment costs								
Grant/subsidy								
Subtotal	£0	(3)						
Other business impacts						-	•	•
Developer contributions		(4)						
NET BUSINESS IMPACT	£2,954,040,806	(5) = (2) +	(3) + (4)					l .
TOTAL								
Economic Efficiency Benefits (TEE)	£3,125,055,548	(6) = (1a) +	(1b) + (5)					
	Notes: Benefits a	ppear as po	ositive numbers, w	hile costs appea	r as negative number	·s.		
			nted present value		•			
<u>.                                    </u>								

## Annex 2 - PA Table

#### Annex 2: Public Accounts (PA) Table

#### **Route 3 WSL Bored Tunnel**

	ALL MODES	ROAD	BUS and COACH	RAIL	OTHER
Local Government Funding	TOTAL	INFRASTRUCTURE	_		
Revenue					
Operating Costs					
Investment Costs					
Developer and Other Contributions					
Grant/Subsidy Payments					
NET IMPACT	£0 (7)				
Central Government Funding: Transport	rt				
Revenue	-£827,045,667	-£827,045,667	7		
Operating costs	£292,904,443	£292,904,443	3		
Investment Costs	£2,097,700,297	£2,097,700,297	7		
Developer and Other Contributions					
Grant/Subsidy Payments					
NET IMPACT	£1,563,559,073 (8)	£1,563,559,073	3		
Central Government Funding: Non-Trai	nsport				
Indirect Tax Revenues	-£564,770,665 <i>(9)</i>	-£564,770,665	5		
TOTALS					
Broad Transport Budget	£1,563,559,073 (10) =	(7) + (8)			
Wider Public Finances	-£564,770,665 (11) =				
		itive numbers, while revenues and 'Desent values in 2010 prices and value	eveloper and Other Contributions' appeares.	as negative numbers.	

## Annex 3 - AMCB Table

#### **Annex 3: AMCB Table**

#### **Route 3 WSL Bored Tunnel**

<b>Analysis of Monetised</b>	Costs and Benefits	
Noise	£11,908,816	(12)
Local Air Quality	- ,,-	(13)
Greenhouse Gases	-£273,307,300	( - /
Journey Quality	, ,	(15)
Physical Activity		(16)
Accidents	-£128,050,000	, ,
	£11,776,839	
Economic Efficiency: Consumer Users (Commuting)	2	(1.4)
Economic Efficiency: Consumer Users (Other)	£159,237,903	(1b)
Economic Efficiency: Business Users and Providers	£2,954,040,806	(5)
Wider Public Finances (Indirect Taxation Revenues)		- (11) - sign changed from PA table, as PA table represents costs, not benefits
Present Value of Benefits (see notes) (PVB)		(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)
Broad Transport Budget	£1,563,559,073	(10)
Present Value of Costs (see notes) (PVC)	£1,563,559,073	(PVC) = (10)
OVERALL IMPACTS		
Net Present Value (NPV)	£1,736,818,657	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	2.1	BCR=PVB/PVC
·		l

Note: This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

## **Annex 4 – Biodiversity Worksheet**

#### Annex 4: TAG Biodiversity Impacts Worksheet

#### Route 3 WSL Bored

S	tep 2			Step 3			Step 4	Step 5
Area	Description of feature/ attribute	Scale (at which attribute matters)	Importance (of attribute)	Trend (in relation to target)	Substitution possibilities	Biodiversity and earth heritage value	Magnitude of impact	Assessment Score
Thames Estuary and Marshes Ramsar	Ramsar criterion 2 The site supports one endangered plant species and at least 14 nationally scarce plants of wetland habitats. The site also supports more than 20 British Red Data Book invertebrates.	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 2	Minor Negative	Slight Adverse
Thames Estuary and Marshes Ramsar	Ramsar criterion 5 Assemblages of international importance: Species with peak counts in winter: 45118 waterfowl (5 year peak mean 1998/99-2002/2003)	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 5	Minor Negative	Slight Adverse
Thames Estuary and Marshes Ramsar	Ramsar criterion 6 species/populations occurring at levels of international importance (includes species with peak counts in autumn/winter and in spring)	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 6	Minor Negative	Slight Adverse
Thames Estuary and Marshes SPA	Article 4.1 Qualification (79/409/EEC). Over winter the area regularly supports 1% of the population in GB of Circus cyaneus	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.1 qualification	Minor Negative	Slight Adverse
Thames Estuary and Marshes SPA	Article 4.2 Qualification (79/409/EEC). Over winter the area regularly supports significant populations of a number of wading birds. On passage the area regularly supports 2.6% of the population of Charadrius hiaticula	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.2 qualification	Minor Negative	Slight Adverse
Thames Estuary and Marshes SPA	Article 4.2 Qualification (79/409/EEC): An internationally important assemblage of birds. Over winter the area regularly supports 75019 waterfowl (5 year peak mean 21/03/2000).	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.2 qualification	Minor Negative	Slight Adverse
Mucking Flats and Marshes SSSI	Botanical interest: Mudifats and Saltmarsh	National	Attribute a qualifying feature of Nationally designated site so high importance.	Majority Favourable with small area Unfavourable Recovering status.	Not possible to substitute	High - nationally important habitats	Neutral	Neutral
Mucking Flats and Marshes SSSI	Wintering wildfowl and waders	National	Attribute a qualifying feature of Nationally designated site so high importance.	Majority Favourable with small area Unfavourable Recovering status.	Not possible to substitute	High - nationally important species	Minor Negative	Slight Adverse
South Thames Estuary and Marshes SSSI	Wading birds and other overwintering species (such as short-eared owl)	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining	Not possible to substitute	High - nationally important birds	Intermediate Negative	Large Adverse
South Thames Estuary and Marshes SSSI	Botanical importance (saltmarsh, freshwater habitats and grazing marshes)	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining	Not possible to substitute	High - nationally important botany	Minor Negative	Slight Adverse
South Thames Estuary and Marshes SSSI	Invertebrate interest (saltmarsh, freshwater habitats and grazing marshes)	National	Attribute a qualifying feature of Nationally designated site - High importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining	Not possible to substitute	High - nationally important invertebrates	Minor Negative	Slight Adverse
Shorne and Ashenbank Woods SSSI	Designated Ancient Woodland	National	Ancient woodland is a qualifying feature of Nationally designated site so high importance.	Favourable to Unfavourable Recovering Status. Nationally, ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	High - nationally important ancient woodland	Intermediate Negative	Large Adverse
Shorne and Ashenbank Woods SSSI	Woodland invertebrates	National	Attribute a qualifying feature of Nationally designated site so high importance.	Favourable to Unfavourable Recovering Status	Not possible to substitute	High - nationally important invertebrates	Intermediate Negative	Large Adverse
Thames Estuary recommended MCZ (on hold)	Marine and estuarine habitats and species	National	Attribute a qualifying feature of Nationally designated site so high importance.	Marine and estuarine habitats in the Thames are being degraded through issues such as pollution and climate change.	Not possible to substitute	Very High - undesignated site hosting habitats/species of (European) Community interest (annexes 1 & 2, Habitats Directive, 1992)		Neutral

Si	tep 2			Step 3			Step 4	Step 5
Area	Description of feature/ attribute	Scale (at which attribute matters)	Importance (of attribute)	Trend (in relation to target)	Substitution possibilities	heritage value	Magnitude of impact	Assessment Score
Greater Thames Marshes Nature Improvement Area	Complex of habitats of value for biodiversity and as a community resource	Regional	Attribute of value to local communities, of Medium importance	Some goals are being achieved.	Not possible to substitute	Medium - community value and extensive area	Minor Negative	Slight Adverse
Claylane Wood- Ancient Woodland	Ancient Woodland	National	Ancient woodland habitat, high Importance for biodiversity.	Nationally ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	High - important ancient woodland	Intermediate Negative	Large Adverse
Priority Habitat - Deciduous Woodland (local wildlife sites (below) and around Buckland; Brook Farm (north of the East Tilbury Marshes); small section on A226 south east of Chalk)	Priority BAP habitat	Local	Medium importance, BAP habitat	Nationally lowland mixed deciduous woodland is declining due to clearance, overgrazing, and replanting with non-native species.		Medium - BAP priority habitat	Intermediate Negative	Moderate Adverse
Priority habitat - Coastal Saltmarshes (south of river, as part of Shorne Marshes and Eastcourt Marshes)	Important for cohesion between designated sites and for sustaining populations of wading birds.	National (contiguous with similar habitat of international importance within designated sites)	Importance will be dependant on functioning within who wider network of habitats, likely to be Medium to High Importance	Likely to be decreasing due to coastal erosion, climate change and development	Creation of replacement habitat through managed realignment a possibility, but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Neutral	Neutral
Priority Habitat - Intertidal mudflats (particularly northern bank of the river at crossing, down stream of the Thames Estuary and Marshes (Ramsar))	Important for cohesion between designated sites and for sustaining populations of wading birds.	National (contiguous with similar habitat of international importance within designated sites)	Likely to be Medium to High Importance	Likely to be decreasing due to coastal erosion, climate change and development	Creation of replacement habitat through managed realignment a possibility, but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Minor Negative	Slight Adverse
Priority Habitat - Coastal and Floodplain Grazing Marsh including freshwater ditches/ponds.	Of importance for cohesion between designated sites and for sustaining populations of waterfowl and of value for notable invertebrates and plants.	National (contiguous with similar habitat of international importance within designated sites)	Low to High, dependant on functioning within the wider network of habitats	Likely to be decreasing due to agricultural improvement, drainage and development	Replacement habitat creation potentially possible (e.g. managed realignment or creation of freshwater wetland habitats), but very limited opportunities locally due to lack of available land.	priority habitat which is likely to support SPA qualifying species.	Minor Negative	Slight Adverse
Priority habitat - Traditional Orchards (north of A1089 and east of Orsett - small patch of orchard lining green lane. Also running along M25 east of Upminster where M25 will be widened)	Priority BAP habitat	Local	Traditional Orchards BAP habitat - Medium importance	Declining due to a loss of sites only partially compensated for by improved management and restoration.	Not possible to recreate mature habitats, replanting and (if possible) translocation of habitats and/or soils a possibility		Major Negative	Moderate Adverse
Priority habitat - Wood-pasture and Parkland (adjacent to M2 J1 interchange)	Priority BAP habitat	Local	Wood-pasture and Parkland BAP habitat Medium importance	Generally believed to be declining nationally. However, there are no reliable statistics on the extent of the overall resource, nor on historical and current rates of loss or degradation of this type of habitat.	Not possible to recreate mature habitats	Medium - BAP priority habitat	Minor Negative	Slight Adverse
Blackshots Nature Area (Th34)	Local wildlife Site - rough grassland and deciduous woodland.	Local	Large area of rough grassland and important invertebrate population, as well as providing potential nesting habitats for birds such as skylark. UK BAP fly species <i>Dorycera graminum</i> found here.		Replacement planting a possibility but limited space available.	Medium - BAP priority habitat and species	Major Negative	Moderate Adverse
Terrels Heath (Th36) includes Chadwell Wood (ancient woodland)	Local Wildlife site and Ancient Woodland.	Local	Terrels Heath is a forest structure dominated by pendculate Oak ( <i>Quercus robar</i> ). Ancient woodland - high importance.	Nationally ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	High - important ancient woodland	Neutral	Neutral
Lytag Brownfield (Th39)	Local Wildlife Site Acid grassland; reptiles	Local	HCr19; SCr4. Brownfield site with acid grassland that supports all four common species of reptile (adder, grass snake, common lizard and slow worm). Medium importance	Believed to be favourable, but identified as a site a risk from development.	Lytag Brownfield will be temporarily disturbed. Reptile translocation required. Habitat reinstatement a possibility but requires suitable substrate to maintain required pH for habitats to establish.	habitat	Minor Negative	Slight adverse
Mucking Heath (Th41)	Local Wildlife Site Flora; invertebrates	Local	Thames Terrace grasslands and ancient heathland. Site supports 4 nationally rare and 50 nationally scarce invertebrate species. Medium importance.		Not possible to substitute	Medium importance Thames Terrace grassland and invertebrates	Intermediate negative	Moderate Adverse
Rainbow Shaw (Th45)	Local wildlife Site	Local	Rainbow Shaw is thought to be a small ancient woodland fragment. Low to medium importance.	Unknown at present	Creation of replacement habitat possible.	Low - Local Wildlife Site	Minor negative	Slight adverse

	tep 2	0.1.(	T	Step 3	la 1	lee e e e	Step 4	Step 5
Area	Description of feature/ attribute	Scale (at which attribute matters)	Importance (of attribute)	, , , , , , , , , , , , , , , , , , , ,	Substitution possibilities	heritage value		Assessment Score
Linford Pit (Th46)	Local wildlife Site	Local	This brownfield site supports an important invertebrate fauna and lies within a very significant cluster of such sites.	This Site has a number of Red Data Book (Endangered) invertebrates, including the bees Andrena florea and Nomada fulvicornis (both RDB3) and the wasps Cerceris quinquefasciata (RDB3 and a national BAP species) and Hedychrum niemelai (also RDB3), as well as several nationally scarce spiders and the nationally rare fly Myopa polystigma (RDB3).	Creation of replacement habitat not possible.	High - Red Data Bok species	Neutral	Neutral
Low Street Pit (Th47)	Local wildlife Site	Local	Lies on the regionally important Thames terrace gravels. Deciduous woodland as well as old grassland. Supports the UK BAP species Hornet Robber fly (Asilus crabroniformis)	Deciduous woodland is declining. The Hornet Robber fly relies on the presence of animal dung that is relatively free from insecticides and worming agents for the development of its larvae. A grazing regime would also be the most appropriate way of maintaining the floristic interest of the site	Not possible to substitute	Medium - UK BAP species and Thames Terrace habitats/species	Major Negative	Moderate Adverse
Goshems Farm (Th49)	Local wildlife Site - deciduous woodland.	Local	This old landfill area supports two important species populations: the nationally rare Red Data plant Stinking Goosefoot and the UK BAP species Hornet Robber fly. Also made up of a large of deciduous woodland. Medium importance.	Red Data species but unknown at present.	,	High - UK BAP species and Red Data Book plant species.	Intermediate Negative	Large Adverse
Canal and grazing Marsh, Higham (Gr17)	Local Wildlife Site Restored Higham Canal and coastal grazing marsh (UK BAP habitat)	Local	Recently established reedbeds, damp disturbed grassland and a dyke system	Unknown	Not possible to substitute	Medium - BAP priority habitat	Neutral	Neutral
Tentacled lagoon worm ( <i>Alkmaria</i> romijni)	Tentacled lagoon worm is protected under Schedule 5 of the Wildlife and Countryside Act 1981	National	High importance (protected under Schedule 5 of the Wildlife and Countryside Act). Nationally scarce marine animal	Considered scarce within the UK; vulnerable to changes to, or loss of, the habitats in which they live	Not possible to substitute	High	Neutral	Neutral
European eel ( <i>Anguilla anguilla</i> )	European eel is a UK BAP Priority Species (BAP species are now Species of Principal Importance/Priority Species)	National	Medium importance, BAP species	Listed as Critically Endangered on the IUCN Red List; on the OSPAR list of threatened and/or declining species and habitats.	Not possible to substitute	Medium	Neutral	Neutral
Smelt ( <i>Osmerus eperlanus</i> )	Smelt is a UK BAP Priority Species (BAP species are now Species of Principal Importance/Priority Species)	National	Medium importance, BAP species	Declining, most of the recorded populations in Scotland are now extinct, as are a third of those from estuaries in England and Wales	Not possible to substitute	Medium	Neutral	Neutral
Harbour Porpoise ( <i>Phocoena</i> phocoena)	Annex II of the European Commission's Habitats Directive (92/43/EEC); Schedule 5 of the Wildlife and Countryside Act	National	High importance	Common to all UK waters 'favourable conservation status', but due to incidental fisheries by-catch, the species has been assessed as under threat/in decline in the Greater North Sea and Celtic Sea.	Not possible to substitute	High	Neutral	Neutral

MAGIC website for designated site locations; ancient woodland locations; priority habitat locations

JNCC website for Ramsar, SPA, SAC and SSSI site designations Natural England website for Local Nature Reserve designations

Thurrock Biodiversity Study 2006-2011
Essex Wildlife Trust website for locations of Local Wildlife Sites (http://www.essexwtrecords.org.uk/lowsfinder)
Kent Wildlife Trust website for locations of Local Wildlife Sites (https://cms.esriuk.com/tunbridgewells/Sites/KWT\_External/#)

Green Infrastructure Asset Baseline Report, Gravesham Borough, December 2009 (http://docs.gravesham.gov.uk/WebDocs/Environment%20and%20Planning/LDF/Green\_Infrastructure\_Assets\_Baseline\_Report\_1\_Main.pdf)
Review of Lower Thames Crossing Options: Final Review Report Appendices, AECOM, 2013
UK Biodiversity Action Plan; Priority Habitat Descriptions. BRIG (ed. Ant Maddock) 2008 (Updated Dec 2011).

# Summary Assessment Score

# Large Adverse\*

# Qualitative Comments

Route 3 bisects three designated sites, 9 local wildlife sites and an additional 10 areas of Biodiversity Action Plan habitat. These include an area of the Thames Estuary and Marshes which is designated as an internationally important Ramsar site and SSSI, and which is also a RSPB reserve. The route also bisects a number of important habitats, which will result in varying degrees of disturbance, habitat loss and habitat fragmentation. Specific comments on the potential design options for a new river crossing are outlined below:

The main impacts are associated with the construction phase. A completed tunnel would not impact the marine environment and the coastal/terrestrial impacts would be greatly reduced in comparison to the erection of a bridge (where permanent effects from loss of habitat and shading effects will occur) or immersed tube tunnel (with very large impacts on habitats and species during construction). The location of the tunnel entrance to the north of the crossing (and, in particular, the temporary works area associated with the tunnel portal) currently has a fairly significant impact on an area of historic coastal grazing marsh and local wildlife site, which supports a diverse range of Red Data Book Invertebrates and may be also provide important functionally linked land for the SPA designated species (e.g. high tide roost). Microsting this entrance point to minimise impacts of habitat loss/deterioration and disturbance to SPA species is recommended. However there is potential for offset mitigation by enhancing land adjacent to the site which is currently agricultural land. Habitat loss and fragmentation of areas of ancient woodland along the southern extents of the new road, where this links to the A2/M2 in the south, involve a very large adverse effect on Ancient Woodland habitat that is irreplaceable as discussed above.

Note the Summary Assessment Score is being skewed by the predicted habitat loss for Shorne and Ashenbank Woods SSSI and Claylane Wood.

# **Annex 5 – Historic Environment Worksheet**

# **Annex 5: Historic Environment Impacts Worksheet**

# Route 3 WSL Bored

	Step 2		Step 3		Step 4		
Feature	Description	Scale it matters	Significance	Rarity	Impact		
Form	The historic landscape within the study area is predominantly rural in character and the result of post-medieval farming activity. The study area also contains portions of urban settlements such as South Ockendon, Grays, West Tilbury, Gravesend and smaller settlements such as Orsett.  The study area contains a number of listed buildings (designated heritage assets), either within settlements such as South Ockendon and Orsett or within a more rural context such as small groups of farm buildings. In total there are 36 Grade II, three Grade II* and two Grade I listed buildings within the study area (Grade II* Marshalls Cottages and Chruch of St James, both at West Tilbury and Church of St Mary at East Court Manor. Grade I: Church of St Mary of Magdalene, North Ockendon and Church of St Nicholas, South Ockendon). The study area also contains three conservation areas (designated assets): West Tilbury, East Tilbury and Thong. Cobham Park is a Grade II registered park and garden.  Known archaeological remains within the study area date from the prehistoric to post-medieval periods. There are eight scheduled monuments (designated heritage assets) within the study area: a Barrow at South Ockendon Hall; a medieval moated site at South Ockenden Old Hall; Orsett crop mark complex; the Springfield style enclosure at Orsett; a causewayed enclosure to the south of Thurrock; Dene Holes in Hangmans Wood; earthworks at West Tilbury and a Second World War anti-aircraft battery at Bowaters Farm.	a national level under the Planning (Listed Buildings and Conservation Areas) Act 1990 and are a material consideration at national level in the NPPF and NN-NPS. Whilst registered parks and gardens do not have statutory protection, they area a material consideration in the planning process and are considered at a national level in the NPPF and NN-NPS.  The scheduled monuments are also designated heritage assets and are afforded protection at a national level under the Ancient Monuments and Archaeological Areas Act 1979. They are also a material consideration at national level in the NPPF and NN-NPS. The treatment of non-designated archaeological remains within the planning process is also considered at a national level in the NPPF and NN-NPS even though they may be of lesser value than designated heritage assets.	of medium value. The East Tilbury conservation area is of high value whilst the other three conservation areas are of medium value. Cobham Park Grade II registered park and garden is of medium value.  The scheduled monuments are of high value and the non-designated archaeological remains range in value from low to medium.	modernist factory town. The other three conservation areas are relatively well represented regionally and nationally. Cobham Park registered park and garden contains considerable time depth	Grade II listed buildings to the south and west of Thurrock and to the west of West Tilbury. The scheme may also impact on the settings of the West Tilbury, East Tilbury and Thong conservations areas and Cobham Park registered park and garden. The impacts may arise as a result of the introduction of a new linear element, the road, in a currently open rural landscape  The scheme may also impact on the settings of the scheduled monuments at South Ockenden Old Hall, South Ockendon Hall, Orsett, south of Orsett, West Tilbury and Bowaters Farm. The impacts may arise as a result of the introduction of a new linear element, the road, in a currently open rural landscape. In addition, the scheme would have a direct physical impact on the Orsett cropmark complex scheduled monument through the construction of a new road within the scheduled area.		
Survival	The survival of the listed buildings and the conservations areas is comparable with others in the region and is generally good. The survival of Cobham Park reigstered park and garden is generally good.  The survival of the scheduled monuments is generally good. The survival of the archaeological remains has not yet been fully determined.	The NPPF and NN-NPS takes the survival of heritage assets into account at a national level.	Survival of the designated heritage assets is of moderate to high significance as they contribute to the character of the area.  Survival of the non-designated archaeological remains is of low to moderate significance as surviving remains of these types are important in terms of our understanding of the human past.	Surviving listed Grade II listed buildings are not rare regionally or nationally, although surviving Grade I and Grade II* listed buildings are rare on both scales.  With the exception of the Springfield style enclosure at Orsett and the Bowaters Farm antiaircraft battery, the survival of which is rare on both regional and national levels, the survival of the scheduled monuments is of moderate rarity value.  Surviving non-designated archaeological remains are not rare regionally.	The scheme would not impact on the survival of designated assets within the study area, with the exception of the Orsett cropmark complex which would be subject to the direct physical impacts as the result of road construction within the scheduled area.  The scheme would not impact on the survival of non-designated assets within the study area as a whole, but would have impact within the scheme footprint.		
Condition	The historic landscape is constantly evolving, the condition of landscape features is considered to be good.  The condition of the listed buildings and conservation areas is generally good. The condition of Cobham Park registered park and garden is genrally good.  The condition of the scheduled monuments is generally good, with the exception of the Orsett cropmark complex and Bowaters Farm anti-aircraft battery, the condition of which are poor. The condition of the non-designated archaeological remains is currently unknown.	The NPPF and NN-NPS takes the condition of heritage assets into account at a national level.	The condition of the listed buildings and conservation areas is of moderate significance as they have a beneficial effect on the character and amenity value of the study area.  The condition of scheduled monuments and non-designated archaeological remains is of high and moderate significance respectively, as in good condition they can inform our understanding of the human past.	have low rarity value.  Scheduled monuments of the nature and condition of those within the study area have a high rarity value.	The scheme would impact on the condition of three designated assets within the study area: two Grade II listed buildings to the west of Thurrock (1 and 2 Gray's Corner Cottages and Thatched Cottage), which would be removed and the Orsett cropmark complex scheduled monument, which would be subject to the direct physical impacts as the result of road construction within the scheduled area.  The scheme would have no impact on the condition of non-designated assets within the study area as a whole, but would have some impact within the scheme footprint.		
Complexity	The listed buildings are not unusually complex and represents a standard mix of agricultural, residential, ecclesiastical and commercial buildings. Cobham Park registered park and garden is relatively complex as it represents several phases of development.  Archaeological remains, both scheduled monuments and non-designated, represent activity from a number of periods and in relation to a number of industrial, settlement, funerary and agricultural processes. They are moderately complex but not unusual in a regional context.	The NPPF and NN-NPS takes the complexity of heritage assets into account at a national level.	The complexity of the historic environment resource has moderate significance as it represents both time-depth and potential to provide positive benefits to the character and amenity value and is also indicative of potential value in terms of our understanding of the human past.	The level of complexity within the historic environment resource is common on a regional level and as such is of low rarity.	The scheme would not impact on the complexity of designated assets within the study area.  The scheme would not impact on the complexity of non-designated assets within the study area as a whole and the scheme footprint.		

	Step 2		Step 3		Step 4
Feature	Description	Scale it matters	Significance	Rarity	Impact
Context	The study area lies within the Greater London / Thames Estuary areas and the historic environment resource within the study area reflects this wider context.	assets into account at a national level.	The context of the historic environment resource within the study area informs their settings and as such is of moderate to high significance.		The scheme would not impact on the context of the historic environment resource within the study area.
Period	The listed buildings and conservation areas date from the post-medieval to modern periods.  The scheduled monuments date from the Neolithic to the modern period, whilst the non-designated archaeological remains date from the prehistoric period onwards.	assets into account at a national level.			The scheme would not impact on the periods represented by the historic environment resource within the study area.

TAG Unit A3 (November 2014); DMRB Volume11, Section 3, Part 2 (2007); National Heritage List for England; Greater London Historic Environment Record; Essex Historic Environment Record, Thames Estuary Partnership Archaeological Research Framework (1999); Thames Estuary Partnership Greater Thames Research Framework (2010)

#### Step 5 - Summary Assessment Score

Moderate Adverse

#### **Qualitative Comments**

The scheme covers an area that is largely open and rural in character but containing urban areas that expanded during the 19th and 20th centuries. Two Grade II listed buildings (1 and 2 Gray's Corner Cottages and Thatched Cottage, both to the west of Thurrock) would exprience direct physical impacts through their removal. The effect of these impacts is predicted to be Large Adverse. Potential impacts to the settings of the following designated heritage assets have been identified as a result of scheme: scheduled monuments at South Ockendon Old Hall, South Ockendon Hall, Orsett, south of Thurrock, West Tilbury and Bowaters Farm, Grade II listed buildings to the south and west of Thurrock and to the west of West Tilbury; West Tilbury; East Tilbury and Thong conservations areas. These effects are predicted to be Slight Adverse with regard to the listed buildings and Moderate Adverse with regard to the conservation areas, registered park and garden and scheduled monuments. Road construction within the scheduled area of the Orsett cropmark complex will cause a direct physical impact to this designated asset. However, due to the poor condition of the scheduled monument, the effects are predicted to be Moderate Adverse. Construction excavations associated with the proposed road and tunnel may have a physical impact on any non-designated archaeological remains within the scheme footprint are predicted.

# **Annex 6 – Landscape / Townscape Worksheet**

# Annex 6: Landscape Impacts Worksheet

# **Route 3 WSL Bored**

	Step 2			tep 3		Step 4
Features	Description	Scale it matters	Rarity	Importance	Substitutability	Impact
	South of the Thames corridor the landscape is gently undulating with large open arable fields and few hedgerows, which are mainly along the roads and around the small settlements. The land rises up to the wooded ridge of Shorne Woods Country Park, with the A2 and high speed rail transport corridor to the south. To the west is the suburban edge of Gravesend with housing and recreational facilities such as a golf course and leisure centre.	Local	Rare in a local context	Varies, farmland is medium in a local context, Shorne woods rare and the urban edge common.	Varies along the route. Substitutability of farmland and recreation land is medium while the woodland is low.	<b>Moderate adverse.</b> Route 3 WSL would have a direct and indirect impact on the pattern of the existing landscape. In places the route would cut through the gently undulating landform as it passes under the A226 Rochester Road and Thong Lane. At the junction with the A2 the road would be raised up on an embankment which would create a visual barrier. Fields which create a distinct pattern on the landscape would be bisected by the road, although these are larger in size than they would have been historically, with most hedges removed or poorly maintained.
Pattern	The Thames river corridor consists of flood embankments along the river edge backed by expansive marshlands with rough grazing and sparse scrub. On the north side there are extensive areas of old mineral workings some of which have been backfilled as landfill.	Local	Rare in a local context	High in a local context	Low	Neutral. The tunnel portals would be located to the north and south of the Thames corridor.
	South of Orsett to the Thames corridor Route 3 passes, through gently undulating countryside of medium and large fields, with occasional farm buildings. The area is crossed by a number of overhead electric power lines.	Local	Common	Medium locally	High	<b>Moderate adverse.</b> The road would break up the existing pattern of the landscape in particular at the A13 junction.
	Adjacent to Orsett the route cuts through a historic parkland landscape that forms the setting of the village.	Local	Locally rare	High in a local context	Medium	<b>Moderate adverse</b> . Route 3 WSL would run along the edge of the parkland and would fundamentally change its character.
	Between the proposed junction with the M25 at North Ockendon and Orsett Route 3 WSL would pass through relatively flat open countryside of large arable fields, and close to areas of historic clay pits, now used for landfill.	Local	Common	Medium locally	High	<b>Moderate adverse</b> . Route 3 WSL would have a direct impact on the pattern of the existing landscape. Fields which create a distinct pattern on the landscape would be bisected by the road.
	South of the Thames corridor the level of tranquillity varies considerably with location. There are peaceful country lanes and small villages, although nowhere is it completely tranquil due to distant road noise and the visual intrusion of urban settlements, roads and pylons.	Local	Locally rare	Varies, medium for most of the route while the country lanes and villages are high	Low	<b>Moderate adverse</b> in the vicinity of Route 3 WSL. While there is some road noise in most areas at present this would increase considerably in most locations. The presence of road infrastructure would also have an impact on visual tranquillity. For residents of Thong, Riverview Park, and Chalk the route will change the view and increase noise, having a detrimental impact on tranquillity.
Tranquillity	Within the Thames corridor there are expansive views over the river and surrounding marshland from the riverside paths which are often some distance from the nearest road. There is always the visual intrusion of man made structures such as jetties, river traffic and Tilbury power station.	Local	Common	High in local context	Low	<b>Slight adverse.</b> A tunnel would pass below the Thames corridor the portal being located to the south of the Lower Higham Road. Noise levels and visual intrusion would be much the same as they are at present, with the exception of locations closest to the portal and ventilation building.
	The level of tranquillity varies considerably with location north of the Thames corridor. There are major arterial roads such as the M25 and A13 which generate traffic noise and disrupt visual tranquillity, while there are open areas of countryside between, that are broken only by the occasional small road. Nowhere is it completely tranquil due to distant road noise and the visual intrusion of urban settlements and pylons.		Common	Medium	High	Moderate adverse Away from the existing large roads Route 3 WSL would introduce additional noise and intrusive visual clutter into the scene. For some residents of East Tilbury, West Tilbury, Linford, east of Chadwell St Mary, Baker Street Orsett and South Ockendon the route change the view and increase noise, having a detrimental impact on tranquillity.
	Most of the route is located within Green Belt.	Regional	Regionally medium	High in regional context	Low	Moderate adverse. The Green Belt is a valued rural separation between the urban edge of large settlements such as Grays, Tilbury and Gravesend nearby villages. A new road would introduce a new urban element into this landscape.
	Public rights of way.	Local	Common	Medium	High	Impact depends on the right of way but some will be crossed by the route and this would have a <b>Moderate adverse</b> impact on the users of the paths.
	register of parks and gardens comprising intact 18C parkland, gardens, estate woodlands and golf course.	National	Rare	High in a national context	Low	<b>Neutral.</b> A slip road at the Route 3 WSL A2 junction would be located within the registered park, however in reality it is outside of the current park boundary. The registered park boundary should be altered to accommodate current transport infrastructure.
	Kent Downs Area of Outstanding Natural Beauty (AONB) and Shorne Woods Country Park.	National	Rare nationally	High in national context	Low	Slight adverse. Route 3 WSL and the junction with the A2 would mostly be located outside of AONB with a slip road located within it. This would have little impact due to the existing A2 and infrastructure. There would be views from parts of the AONB at Shorne Woods of new road infrastructure to the north and west. There would be an impact on the setting of the AONB from the north west.

	Step 2			Step 3	T	Step 4
Features	Description	Scale it matters	Rarity	Importance	Substitutability	Impact
	Conservation Area at Thong.	Regional	Medium	High in regional context	Low	Slight adverse. Route 3 WSL is close enough to the northern part of the conservation area to have an adverse impact on it.
	Southern Valley Golf Course and driving range and land associated with Cascades Leisure Centre. Included in Gravesham Local Plan 2nd review as an area for Green Grid Site Protection.	Local	Medium	Medium in local context	Medium	<b>Moderate adverse</b> . Route 3 WSL passes through the golf course which would have to be partly relocated.
	Listed buildings located close to Route 3 WSL south of the Thames: Filborough Farmhouse, Barn to the north west of Filborough Farmhouse, the granary at Little Filborough Farm East Court Manor, Church of St Mary in Chalk (grade II*) and White Horse Cottage in Thong.	National/regional	Nationally/ regionally rare	High in national/regional context	Low	There would be a <b>slight adverse</b> impact on the setting of the listed buildings in Chalk and a <b>neutral</b> impact on the listed building in Thong which would be further from the proposed route.
	Thames and Medway canal route (no longer navigable). Not designated.	Local	Rare locally	Medium in a local context	Low	Neutral The portal and road would be located some distance to the south.
	National Cycle Routes 1 and 13 and other public rights of way.	National/local	Rare/common	High/low	High as easily relocated	<b>Moderate adverse</b> for rights of way and national cycle routes located close Route 3 WSL due to the visual impact of road infrastructure and increased noise levels.
	Saxon Shore Way leisure route along the Thames and public right of way on northern side of the Thames.	Regional/local	Rare regionally	High in a local context	Low	Neutral. The tunnel would pass below the paths.
	Scheduled monument. Coalhouse Fort battery and artillery defences.	National	Rare	High at a national level	Low	Neutral. A tunnel will have no impact on the setting to the monument.
	Tilbury Fort Scheduled monument.	National	Rare	High at a national level	Low	Neutral. A tunnel will have no impact on the setting to the monument.
Cultural						
	Scheduled monument at Bowaters Farm WWII anti aircraft battery.	National	Rare	High at a national level	Low	The monument is largely hidden from view by scrub and despite the closeness of Route 3 ESL it would only have a <b>slight adverse</b> impact on the setting.
	Grade II listed building at Bucklands Farm.	Regional	Rare	High	Low	The building is surrounded by trees and the road would have only a <b>slight adverse</b> impact on its setting
	East Tilbury Conservation area and listed buildings.	Regional	Rare	High	Low	Some distance away from the conservation area which is an unusual modernist development of housing and factories. For most of the area the impact would be <b>neutral</b> with <b>slight adverse</b> on the setting of th western edge.
	Grade II listed buildings close to the proposed Route 3 ESL junction with the A13. Whitecrofts, Heath House, Murrels Cottage.	Regional	Rare regionally	High regionally	Low	<b>Moderate adverse</b> to the setting of Heath House & Murrels Cottage due to the closeness of the junction Slight adverse impact to Whitcrofts.
	Scheduled monument. Causewayed enclosure and Anglo-Saxon cemetery close to proposed junction of Route 3 WSL with the A13.	National	Rare	High in national context	Low	Moderate adverse. The monument is not clearly visible from ground level but from the air. While not having a direct impact on the structure of the monument the proposed junction would change its landscape setting which could be important in understanding the causewayed enclosure in particular.
	4 listed buildings west of Orsett: two at Orsett House (one grade II and the other grade II*), Poplars Farm (grade II), and south of the B188 (grade II).	Grade 1 and 2* national value, grade II regional	Rare	High	Low	Moderate adverse to the setting of those at Orsett House due to the closeness of the road, with Poplars Farm Slight adverse.
		National for grade 1 listed building. Regional local for conservation area and grade II listed buildings	Rare nationally/locally	High in national/local context	Low	Neutral. Although within 500m of Route 3 WSL all of the buildings and the conservation area are screened by surrounding development.

	Step 2		St	ер 3		Step 4
Features	Description	Scale it matters	Rarity	Importance	Substitutability	Impact
	Scheduled monument. Springfield type enclosure and iron age enclosures at Baker Street.	National	Rare	High in national context	Low	Neutral - The monument is not visible at ground level.
	Scheduled monument - Bishop Bonners Palace Orsett.	National	Rare	High in national context	Low	Slight adverse - The monument is largely screened from Route 3 WSL by trees.
	Scheduled monument and listed building (gatehouse and moat of South Ockendon Hall) and Scheduled Monument Roman barrow. All over 500m from the Route 3 WSL.	National	Rare	High in national context	Low	Slight adverse - The current monuments are surrounded by a flat, broad expanse of arable fields.  Despite the distance from the proposed route the road infrastructure would have some impact on their setting.
	3 grade II listed buildings, a grade 1 listed building & North Ockendon conservation area	Regional/national for grade 1 listed building	Rare nationally/regionally	High in national/regional context	Low	Slight adverse - North Ockendon is already impacted by the presence of the M25. Route 3 WSL would be largely screened by existing trees and hedges.
	South of the A2 the grounds of Cobham Hall are a Registered Park and Garden comprising an intact 18th century parkland, gardens, estate woodlands and golf course.	National	Rare	High in National context	Low	<b>Neutral.</b> Part of junction with the A2 would be located inside of the registered park, although in reality this is outside of the of the current park boundary. The registered park boundary should be altered to accommodate current transport infrastructure.
	Shorne Woods Country Park is made up of ancient woodland, woodland and heathland. The park has a visitor centre, car park, leisure facilities and walks.	Local	Rare	High in local context	Low	Neutral. None of Route 3 WSL passes through the woodland.
	South of the Thames river corridor the landcover consists of arable farmland with hedgerows and trees grouped around small settlements. To the west is the suburban edge of Gravesend with associated recreational land uses such as a leisure centre, golf course and driving range.	Local	Common	Low in local context	Medium	<b>Moderate adverse</b> . The current agricultural landcover would change along the route to one dominated by transport infrastructure. There would probably be a change in the use of the land between the road and the edge of Gravesend as many of the fields would be too small to farm.
Landcover	The characteristic landcover of the Thames river corridor consists of open flat grazing marsh with sparse scrub and trees cover with emergent plants along ditches. The Thames is lined with inter tidal mud flats and gravel foreshore. On the north side there are extensive former mineral workings some of which have been backfilled with landfill.	Regional	Rare	High in regional context	Low	A bored tunnel would have <b>neutral</b> impact immediacy adjacent to the river. Above ground the current agricultural landcover would change along the route to one dominated by transport infrastructure, in the long term there would be the potential for Route 3 WSL to create changes to the surrounding agricultural land which would be bisected and would become less viable to farm.
	North of the Thames corridor the landcover is mostly of arable fields, with hedges and boundary trees. Crossed by a number of small roads and 2 major roads. Areas of old clay pits now used as landfill. Parkland landscape to the west of Orsett.		common	Medium in local context	Relatively easy to improve/plant hedges and trees nearby	Moderate adverse in the immediate vicinity of Route 3 WSL, which would change the existing rural landcover to a transport dominated one.
Summary of character	Open gently rolling arable countryside with sparse hedges and boundary trees, with surviving areas of historic field patterns, minor roads and small settlements. Prominent features consist of arterial roads, pylons, and the distant urban edge of large settlements.	Regional	Regionally medium	Regionally medium	Medium	Moderate adverse. Although there are major roads running through the parts landscape Route 3 WSL would introduce a new transport corridor through areas that are largely rural in character.

Department of Transport TAG Unit A3 Environmental Impact Appraisal May 2014, Magic.gov.uk, Google Maps satellite photography, OS Maps, Thurrock UDP deposit draft 2003 (unadopted). National Character Area 111 Northern Thames Basin, National Character Area 81 Greater Thames Estuary,

### **Step 5 - Summary Assessment Score**

### Moderate adverse

#### **Qualitative Comments**

Route 3 WSL would create a new road corridor and introduce a significant change to the existing landscape character which is designated as Green Belt. Infrastructure associated with the road such as embankments, retaining structures, bridges, signage and lighting, would be notable additional built elements within the open rural landscape. The new road corridor and junction infrastructure associated with Route 3 WSL would impact directly and indirectly on locally, regionally and nationally valued features including scheduled monuments and listed buildings.

# **Annex 7 – Water Worksheet**

#### Annex 7: Water Environment Impacts Worksheet

#### Route 3 WSL Bored

Route 3 WSL Bored									
Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
Study area: River Thames	l					1			
Potential Impacts: Morphological and hydrodynamic changes to the River Thames due to river crossing  Potential Impacts: Routine runoff and spillage risk during operation of the new road	River Thames Estuarine / transitional waters (WFD Water Body Thames Middle) ID No: GB530603911402	Water supply / biodiversity / transport & dilution waste products / recreation / aesthetics / cultural heritage / value to economy / navigation	High Recommended Marine Conservation Zone. Heavily modified water body at Moderate Ecological Potential and failing Chemical Status. Important river of national significance with commercial and social value, including depository for effluent discharges, abstraction of water supply, recreation and, navigation. South Thames Estuary and Marshes SSSI and Ramsar site to south	Regional / National (excludes biodiversity considerations)	Rare	Not feasible	Very High	Negligible  Negligible Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Low significance
Study Area: Mar Dyke	L					1			
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke and Fobbing (R1) WFD Water body ID GB106037027990	Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Moderate Ecological Status. Target Good Ecological Status by 2027 Water available for abstraction licensing, subject to limitations (Roding	Regional (ref WFD water body status)	supply	Not feasible	Medium	Slight adverse Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible  (Moderate adverse)	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road			Beam Ingrebourne and Mardyke CAMS)		availability)			Negligible (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke and Fobbing (R3) WFD water body ID GB106037028020	Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Poor Ecological Potential. Target Good Ecological Potential by 2027 Water available for abstraction licensing, subject to limitations (Roding	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply	Not feasible	Medium	(Moderate adverse) Slight adverse Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant (Low significance)
Potential Impacts: Routine runoff and spillage risk during operation of the new road			Beam Ingrebourne and Mardyke CAMS)		availability)			(Moderate adverse)  Negligible (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke and Fobbing (R11) WFD water Body ID GB106037027970 Includes West and East Tilbury	Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Moderate Ecological Potential. Target Good Ecological Potential by 2027 Water available for abstraction	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply	Not feasible	Medium	Slight adverse Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road	main drains	products / recreation	licensing, subject to limitations (Roding Beam Ingrebourne and Mardyke CAMS)		availability)			(Moderate adverse) Negligible (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Study Area: Thames and Medway	Canal			•	-		•		
Potential Impacts: Morphological and hydrodynamic changes to the River Thames due to river crossing	Thames and Medway Canal	Biodiversity / transport & dilution	Medium (biodiversity evaluated separately) Thames and Medway Canal good potential, no other water quality data available at this stage. Could support	Regional (ref WFD	Madagata	Limited	Madium	Negligible Assumes bored tunnel section passes beneath canal and has no impact on surface water courses	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road	(Ca18) (GB70610011)	waste products / recreation / navigation (potential)	protected ecological species. It is not known whether these water bodies have any intrinsic social or economic value. Not currently used for navigation. Appraisal on water environment not biodiversity	water body status)	Moderate	feasibility	Medium	Negligible Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted. Note: Best practice drainage design precludes discharge to canals	Insignificant
Study Area: Minor watercourses a	nd drainage ditches at South Tr	names Estuary and Marshes (exc	luding Thames and Medway canal)						
Potential Impacts: Morphological changes to minor watercourses and drainage networks	Minor water courses and drains of Shorne, Eastcourt, Great Clane Lane and Filborough Marshes. South Thames Estuary and Marshes SSSI and	Biodiversity / recreation / amenity	Medium Could support protected ecological species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity	Local	Common	Limited feasibility	Medium	Negligible Assumes bored tunnel section has no impact on surface water courses	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road	Ramsar site		water chiviliani in the block of sity					Negligible Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant
Study Area: Minor watercourses a	and drainage ditches north of th	e River Thames (see also Mardy	ke water body)						
Potential Impacts: Morphological changes to drainage networks			Medium					Slight adverse Assumes watercourse crossings and or displacement includes appropriate mitigation	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road	Minor watercourses and drainage ditches at East Tilbury Marshes	Biodiversity / recreation / amenity	Could support protected ecological species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity	Local	Common	Limited feasibility	Medium	(Moderate adverse) Negligible Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant Low significance
Study Area: Lakes and ponds						•			•
Loss of or other physical impact on standing water bodies	Standing water features (natural and man made) on land to N and S of River Thames	Biodiversity / recreation / amenity / water supply (small reservoirs	Low - Medium Could support protected ecological species. Some reservoirs and local	Local	Common	Limited feasibility	Low	Negligible: No significant standing waters crossed or intercepted	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road	including ponds and lakes and standing water in marsh areas	and dams)	(largely) agricultural water supplies			. Guolbilly		Negligible: Assumes no drainage to standing water in accordance with best practice	Insignificant

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
Study Area: Groundwater north o	f River Thames	l	l		<u>l</u>	<u>l</u>	l	I	
	South Essex Thurrock Chalk (GB40601G401100)	WFD water body status; water supply / resources; groundwater dependent ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Source Protection Zones 2 and 3 (Linford / East Tilbury) Local commercial / industrial /agricultural licenced supplies Roding Beam Ingrebourne and Mardyke CAMS - no water available for further abstraction	Regional (ref WFD water body status)	Rare (CAMS shows restricted water availability)	Not feasible	High (based on resource availability, WFD target )	(Moderate adverse) Depends on whether permanent structures and or permanent dewatering (including at portal) impact groundwater flow Slight adverse with mitigation. Assumes any drainage to ground managed in accordance with best practice.	Low significance (significant)
Potential Impact: Impact on groundwater quality from potentially polluting surface activities / highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels and tunnel portals (if required) or disruption to natural groundwater flow by underground structures.	Essex gravels (GB40503G000400)	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Local commercial /industrial/agricultural licenced supplies	Regional (ref WFD water body status	Moderate	Not feasible	Medium	Negligible - slight adverse Assumes at grade road would not significantly impact groundwater and cuttings have minor impact on shallow groundwater. Drainage to ground managed in accordance with best practice. No exposure of this formation at Thames crossing	Insignificant
Long term impacts from mobilisation of leachates from contaminated land / old landfill	South Essex Lower London Tertiaries (G16) (GB40602G401000)	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium - low WFD water body status (current poor, target good).	Regional (ref WFD water body status	Moderate	Not feasible	Medium	Negligible: Little exposure of this formation Assumes any drainage to ground managed in accordance with best practice.	Insignificant
	Shallow groundwater in alluvium, gravels and other superficial deposits (non WFD water bodies)	Groundwater dependant ecosystems (biodiversity); local water supply (agriculture)	Low	Local	Common	Not feasible	Low	Slight to moderate adverse. Depends on whether permanent structures and or permanent dewatering (including at portal) impact shallow groundwater flow Assumes any drainage to ground managed in accordance with best practice. Also assumes any landfill leachate appropriately managed	Insignificant
Study Area: Groundwater south o	f River Thames								
groundwater flow from permanent	North Kent Medway Chalk WFD Water body ID GB40601G500300	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Local commercial / industrial / agricultural licenced supplies	Regional (ref WFD water body status)	Rare (CAMS shows restricted water availability)	Not feasible	High (based on resource availability, WFD target)	(Moderate adverse) Depends on whether permanent structures and or permanent dewatering (including at portal) impact groundwater flow Slight adverse with mitigation. Assumes any drainage to ground managed in accordance with best practice	Low significance (significant)
dewatering of cuttings and tunnels	Shallow groundwater (terrace gravels / alluvium) feeding South Thames Estuary and Marshes SSSI	groundwater dependant ecosystems (biodiversity); local water supply (agriculture)	Low (Ramsar/ SSSI covered by biodiversity)	Local (National / International value covered by biodiversity)	Common	Not feasible	Low	Slight adverse Bored tunnel would pass beneath any shallow aquifer north of portal but may be impacted by long term dewatering at portal. Assumes any drainage to ground managed in accordance with best practice	Insignificant
Study Area: River Thames Flood Zo	one 2/3 and associated defence	es							
Potential Impacts: Direct risk of flooding to highway from watercourse or tidal source (Thames)	River Thames crossing route	Transport link - improves efficiency of existing network	High	Regional	Moderate	Feasible (alternative crossing locations)	High	Slight adverse - portals and approaches off (defended floodplain) crossing closures due to flood conditions unlikely, further mitigation through design and integrated defences	Low significance
Potential impacts: Impedance of flood flows in River Thames channel due to crossing resulting in obstruction to flow	River Thames channel	Conveyance of flood flows	High - managed watercourse draining large upstream catchment	Local (immediate vicinity of crossing and City of London upstream)	Moderate	Not feasible	High	Negligible (bored tunnel would not interact with Thames channel flows)	Insignificant
Potential Impacts: Loss of flood storage volume (including loss through impedance of flood flows) due to the development (e.g. embankments, cuttings) or permanent spoil disposal sites leading to increased flood risk	River Thames floodplain	Conveyance and storage of flood flows: Mostly defended floodplain at present in vicinity of proposed route.  TE2100 Policy P4 implies improved defences in the future will ensure route remains in the defended floodplain	Medium - significant potential storage volume but not currently used for flood storage as the natural floodplain is defended	Local	Moderate	Feasible: Loss of (defended) floodplain storage substitutable	Medium (not currently used for flood storage)	Slight adverse: Assumes minimal loss of floodplain storage within defended River Thames floodplain	Insignificant
Potential impacts: Increase in flood risk by affecting existing flood defence or by preventing future flood defence development (e.g. actions under Thames Estuary TE 2100 planning)	River Thames flood defences	Protection of property/assets from flooding	High - provides protection for large urban area	Local	Moderate	Not feasible: Unlikely to be substitutable	High	Slight adverse: Assumes minimal loss of floodplain storage within defended River Thames floodplain	Insignificant
Study Area: Mardyke Flood Zone 2	/ 3 and associated defences			_		•			
Potential Impacts: Direct risk of flooding to highway from watercourse or tidal source (Mar Dyke)	River Thames crossing route	Transport link - improves efficiency of existing network	High	Regional	Common	Feasible (alternative crossing locations)	High	(Moderate Adverse) Slight adverse (mitigation available, design to manage flood risk - defended floodplain)	Low significance (Significant)
Potential Impacts: Loss of flood storage volume (including loss through impedance of flood flows) due to the development (e.g. embankments, cuttings) or permanent spoil disposal sites leading to increased flood risk	Mardyke floodplain	Conveyance and storage of flood flows: Defended floodplain at present in vicinity of proposed route.  TE2100 Policy P4 implies improved defences in the future will ensure route remains in the defended floodplain	Medium - potential flood storage shown in vicinity of route (EA flood Map) but shown as defended flood plain	Local	Common	Feasible: Loss of (defended) floodplain storage substitutable	Low	(Moderate adverse) -potential to increase flood risk upstream for mostly rural area. Slight adverse with mitigation - viaduct spans flood plain	Low significance (Significant)
Potential Impacts: Risk of afflux flooding (upstream) due to crossing of watercourse or land drain	Mardyke channel	Conveyance of flood flows	High - river channel shown (EA Flood Map) to convey flood flows at least up to 100-yr return period	Local	Moderate	Not feasible	High	(Moderate adverse) -potential to increase flood risk upstream for mostly rural area.  Slight adverse with mitigation - viaduct spans flood plain	Low significance (Significant)

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
Potential impacts: Increase in flood risk by affecting existing flood defence or by preventing future flood defence development (e.g. actions under Thames Estuary TE 2100 planning)	Mardyke flood defences	Protection of property / assets from flooding	Low? - none shown on EA floodmap in vicinity of route	Local	Moderate	n/a - no defences shown (EA Flood map) in vicinity of proposed route		n/a - no defences shown (EA Flood map) in vicinity of proposed route	Insignificant - no defences shown (EA Flood map) in vicinity of proposed route
Study Area: Area surrounding Mair	n Rivers, Ordinary Watercourse	s, land drains and ditches, inclu	ding marshes						
Potential Impacts: Risk of afflux flooding (upstream) due to crossing of watercourse or land drain	Minor drainage networks within the land to N and S of River Thames, including drainage of Stone, Purfleet and West Thurrock Marshes ("West Thurrock Main Sewer")	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	Low	(Moderate adverse) (potential increase in flood risk).  Slight adverse to negligible with mitigation	Insignificant Low significance
Potential Impacts: Risk of increased runoff to watercourse or land drain causing increase in flood risk from watercourse	As above	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	low	(Moderate adverse) (potential increase in flood risk).  Slight adverse to negligible with mitigation	Insignificant Low significance
Potential Impacts: Risk of flooding resulting from change in watercourse/drain flow regime due to morphological changes for development	As above	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	Low	(Moderate adverse) (potential increase in flood risk). Slight adverse to negligible with mitigation	Insignificant Low significance
Study Area: Entire route.									
Potential Impacts: Risk of flooding from overland surface water flows (surface water "pluvial" flooding)	Various floodplains and surface water drainage areas	Flood risk: People and property	Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	(Moderate adverse) (potential increase in flood risk) Slight adverse after mitigation	Insignificant Low significance
Potential Impacts: Risk of flooding from groundwater	Various floodplains and surface water drainage areas	Flood risk: People and property	Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	(Moderate adverse) (potential increase in flood risk) Slight adverse after mitigation	Insignificant Low significance
Potential Impacts: Risk of flooding from drains, sewers, and water mains	Various floodplains and surface water drainage areas	Flood risk: People and property	Medium Located across multiple flood zones	Local	Common	Limited feasibility		(Moderate adverse) (potential increase in flood risk) Slight adverse after mitigation	Insignificant Low significance

webtag TAG Unit A3. Environmental Impact Appraisal. Impacts on the Water Environment Sub-objective, Department for Transport, May 2014 Review of Lower Thames Crossing Options: Final Review Report Appendices. DfT/ AECOM April 2013. River Basin Management Plan. Thames River Basin District. Environment Agency 2009 River Basin Management Plan. Anglian River Basin District. Environment Agency 2009 Darent and Cray Abstraction Licensing Strategy. (CAMS) Environment Agency 2013 Rodling, Beam, Ingrebourne and Mardyke Abstraction Licensing Strategy (CAMS) Environment Agency 2013 Environment Agency Website: "What's in your backyard" Thames Estuary 2100. TE2100 Plan. Environment Agency. 2012. Thurrock Surface Water Management Plan. Environment Agency. 2012. hurrock Surface Water Management Plan (SWMP). URS. 2013. hameside Surface Water Management Plan (SWMP). JBA. 2013.

lavering Flood Risk Management Strategy (FRMS). London Borough of Havering. 2015.

bouth Essex Catchment Flood Management Plan (CFMP). Environment Agency. 2009.

North Kent Rivers Catchment Flood Management Plan (CFMP). Environment Agency. 2009.

lighways Agency Drainage Data Management System (HA DDMS)

#### **Summary Assessment Score**

Post mitigation loderate Adverse impacts

### **Qualitative Comments**

Note 1: Risks from construction are only considered where they may have a permanent impact on the water environment once construction is completed.

Note 2: Impacts on biodiversity may occur as a result of changes in water courses, river morphology, sedimentation, water quality and/or flow. Impacts on habitats / ecosystems / flora / fauna are covered separately under biodiversity and not included here to avoid "double counting"

e features, the magnitude of impacts is shown without mitigation (bold red font in parentheses) and with mitigation (bold, the convention for webTAG assessment). In these cases significance of effect is shown both without (red font in parentheses) and with miti

Surface Water: The bridge crossing over the Thames will need to be developed to minimise impacts on river morphology from the bridge, although these are expected to be relatively localised with small increases inflow velocity within +/-2000m and there is little impact on HWL. Navigation will be affected by the position of the piers and bank structures, but the design will ensure main navigable channels remain relatively unaltered. The bored tunnel would have little impact on the quality or morphology of the River Thames. Assuming the current bed profile is restored post construction, impacts from the meresed tunnel depend primarily on the scale of any permanent effects (if any) that arise through the construction process (morphology, sedimentation, water quality, fisheries, navigational channels). Whilst these may have local impact, within the context of the Thames Middle water body overall, these are considered to be likely to be at worst moderate adverse. The long term impacts of sedimentation change (brought about during construction) are mostly related to tidal and inter tidal habitats, assessed under biodiversity.

npacts on the Mardyke (WFD water body) will depend on the nature of the crossings adopted, fully spanning and viaduct crossings are likely to have only slight impacts, where smaller channel crossings are employed, mitigation is generally available to reduce impacts to slight adverse.

npacts are considered mostly slight adverse once mitigation is applied, although pending a full understanding of the impacts of the construction of the immersed tunnel, these impacts on the Tidal waters of the Thames remain moderate adverse

ns that provide overall flood risk reduction or environmental benefits). Where Route 3 crosses the Mardyke floodplain there may be opportunities to increase flood storage upstream of the road to provide benefits downstrean

Groundwater: Issues with rising groundwater levels have been identified regionally although it is understood these are less problematic in this immediate area. A tunnel crossing will require temporary dewatering during construction and may need longer term dewatering at portals. Larger groundwater esources and public supplies, primarily from the Chalk at depth are unlikely to be impacted, although there may be some impact on local licensed commercial/ industrial/ agricultural supplies from shallow groundwater in the gravels, these are not thought to be significant. Through possible impacts on roundwater quality and flow from the construction of a long bored tunnel there may be residual slight adverse impacts on completion.

WFD status: A Water Framework Directive assessment will be required due to the potential for direct effects on biological, chemical and physical WFD parameters for both surface waters (Thames, Mardyke, Thames and Medway canal) and WFD groundwater bodies (north and south of the river). With appropriate mitigation, it is not anticipated that the River Thames crossing or impacts on the Mardyke or groundwaters will lead to a reduction on WFD status or will prevent these water bodies reaching good status or potential in the future. For the assessment, it is generally assumed that the target 2027 status of good applies, even though current status of most water bodies is poor.

South Essex CFMP policy).

The bridge option has some potential to increase flood risk in the River Thames channel upstream due to piers and other structures impeding channel conveyance. The bored and immersed tube tunnels would have no impact on channel conveyance. The impact of the bridge on channel conveyance is likely be mitigated through design (adequate span, minimise pier dimensions).

Funnel options would be at higher risk of route closure due to high flood levels (i.e. through breach or overtopping of existing defences).

Ill bridge and tunnel options would require a design that integrates with (or does not compromise) TE2100 River Thames flood defence plans. At the River Thames flood defence locations the current Route 3 bridge design indicates the bridge would be significantly higher (and on viaduct) than the flood defences south of the River Thames which are located at the approximate transition between a raised viaduct and suspended bridge (no defences are shown on the north bank of the River Thames as here high ground forms the defence line). The Route 3 bored tunnel and immersed tunnel options have portals set back from the River Thames (south embankment) flood defences. However, there would still be a need to consider the impact of a tunnel on flood defence e.g. due to interference with flood defence piling by the tunnel.

TE2100 policies at the location of the Route 3 crossing are:

24 for Policy Unit Purfleet, Grays and Tilbury, north of the River Thames (take further action to keep up with climate change and land use change so that flooding does not increase)

nd Mucking Mar north of the river Thames (*continue with existing or alternative actions to* 

P3 for Policy Unit North Kent Marshes, south of the River Thames (continue with existing or alternative actions to manage flood risk). TE2100 includes an action to provide a secondary defence to Gravesend to protect from flooding from the tidal River Thames from the east. There is an opportunity for the Route 3 road embankment to provide this structural defence.

CFMP policies for Route 3 south of the River Thames (North Kent Rivers CFMP) are P3 for the North Kent Marshes Policy Unit (areas of low to moderate flood risk where we are generally managing existing flood risk effectively - i.e. no anticipated increase in FRM measures) and P1 for the North Kent Downs Policy Unit (areas of little or no flood risk where we will continue to monitor and advise).

CFMP policies for Route 3 north of the River Thames (South Essex CFMP - Thames Urban Tidal Policy Unit) are P4 for the Thames Urban Tidal Policy Unit (ake further FRM actions to keep pace with climate change) and P6 for the Upper Mardyke Policy Unit (store water or manage run-off in

crosses the Mardyke flood plain. Whilst this may present a flood risk to the proposed road and the potential for the road to increase flood risk upstream, there is also potential for the road embankment to be designed to hold back flood water and hence alleviate flood risk downstream (consistent with

hurrock SWMP (URS 2013) identifies Critical Drainage Areas (CDAs). Route option C2 passes through CDA\_012, and so the road should be designed so that any drainage problems in this area are not exacerbated (with improvements provided where feasible). Thameside SWMP (JBA 2013) is a Stage 1 SWMP and does not provide much detail in relation to the Option C3 route alignment and implications for local flood risk.

The surface water drainage strategy / design (in accordance with HE guidance and standards) should be agreed with the relevant Lead Local Flood Risk Authorities. It is likely this will require that surface water runoff from the proposed crossing does not exceed existing rates (using SUDs where feasible).

# **Annex 8 - Noise Worksheet**

Annex 8: Noise Worksheet Route 3 WSL Bored Tunnel

#### **APPRAISAL - NOISE POLLUTION**

Present value base year: 2010

Current year: 2015

Proposal Opening Year: 2025

Average Household Size: 2.36

Project (Road or Rail): Road

No. of households experiencing 'without scheme' & 'with scheme' noise levels (given in dB<sub>Lea</sub>) in Opening Year

	With scheme	<45	45-47 Q	18-50 Q	51 <sub>-</sub> 53 Q	54-56 0	57-50 Q	60-62 Q	63-65 Q	66-68 Q	60-71 Q	72-74 Q	75 <sub>-</sub> 77 Q	78-80.9	81+
Without	Scrience	V43	45-47.3	40-30.9	31-33.9	34-30.9	37-33.3	00-02.9	03-03.9	00-00.9	03-71.3	72-74.5	15-11.5	70-00.9	01+
scheme															
<45		3922	1810	1731	1368	681	403	224	117	26	12	6	0	0	0
45-47.9		1873	1263	1009	767	500	322	182	119	20	18	3	0	0	0
48-50.9		1852	1092	1371	965	626	430	263	155	46	20	3	0	0	0
51-53.9		1476	884	1048	1238	603	442	290	165	54	12	4	0	0	0
54-56.9		724	540	602	721	1115	349	314	156	53	17	4	0	0	0
57-59.9		400	337	402	415	470	856	320	157	45	24	5	0	0	0
60-62.9		224	235	301	285	293	403	1553	227	70	13	11	0	0	0
63-65.9		98	116	153	172	165	170	347	2057	96	18	7	0	0	0
66-68.9		37	50	80	67	82	77	57	287	1518	48	3	0	0	0
69-71.9		3	14	22	16	24	29	24	34	196	762	16	0	0	0
72-74.9		2	4	6	6	7	11	6	9	14	50	170	2	0	0
75-77.9		0	1	0	2	1	0	3	0	0	0	47	50	0	0
78-80.9		0	0	0	0	0	0	0	0	0	0	2	9	3	0
81+		0	0	0	0	0	0	0	0	0	0	0	0	0	0

	With														
	scheme	<45	45-47.9	48-50.9	51-53.9	54-56.9	57-59.9	60-62.9	63-65.9	66-68.9	69-71.9	72-74.9	75-77.9	78-80.9	81+
Without															
scheme															
<45		3659	1695	1691	1368	715	384	231	122	29	13	6	0	0	0
45-47.9		1796	1227	998	789	502	329	202	110	27	19	4	0	0	0
48-50.9		1820	1108	1395	990	647	441	281	161	47	23	3	0	0	0
51-53.9		1452	850	1059	1268	582	431	284	181	62	12	4	0	0	0
54-56.9		715	556	593	770	1197	364	340	147	59	19	4	0	0	0
57-59.9		393	318	398	426	460	868	342	172	48	29	2	0	0	0
60-62.9		230	240	315	305	316	351	1491	232	95	17	14	0	0	0
63-65.9		91	109	164	179	158	168	323	2108	107	17	7	0	0	0
66-68.9		36	54	77	77	91	100	62	244	1540	38	3	0	0	0
69-71.9		3	13	26	15	25	27	24	59	202	854	20	0	0	0
72-74.9		2	3	7	6	6	12	7	9	10	73	185	2	0	0
75-77.9		0	-	0	2	-	0	3	0	0	0	30	71	0	0

Net Present Value of Noise of Proposal (60 Year Period)

78-80.9

£11,908,816

positive value reflects a net benefit (i.e. noise reduction)

Estimated Population Annoyed (Do-Minimum): Estimated Population Annoyed (Do-Something): 12418 12136

Net Noise Annoyance Change in 15th Year After Opening (no. of people):

-282

\*positive value reflects an increase in people annoyed by noise

# **Appendix 7.3 Appraisal Summary Table Route 4 WSL (BT)**

Appraisal Summary Table Route 2 WSL (BT)

Annex 1: TEE table

Annex 2: PA table

Annex 3: AMCB table

Annex 4: Biodiversity worksheet

Annex 5: Historic environment worksheet

Annex 6: Landscape/ townscape worksheet

Annex 7: Water worksheet

Annex 8: Noise worksheet

Appra	aisal Summary Table	Route 4, Western Southern Link, Bored Tunnel	Date produced:	22	Jan	2016		C	ontact:
	Name of scheme:	Route 4 Bored Tunnel with Western Southern Link - Core Growth, Central Case costs	s, Current values o	of time, additional	lane in tunn	el		Name	Chris Taylor
D	escription of scheme:	New Dual 2 lane trunk road (70mph) from M25 J29, linking with A127 and running pa	rallel to A128, cros				ith additional	Organisation	Highways England
		lane for future proofing, 2km to the east of Gravesend with a westerly southern link to	the A2.					Role	Project Sponsor
	Impacts	Summary of key impacts		0		Asses	sment		Distribution of
				Quantitative			Qualitative	Monetary £(NPV)	Distributional 7-pt scale/
								2(111 7)	vulnerable grp
my	Business users & transport	Large time savings estimated for business travellers, including freight, due to reduced congestion		ney time change		2,603m			
Economy	providers	and improved connectivity. Small vehicle operating cost benefits would also occur due to reduced congestion. Small user charge disbenefits as there will be charges on the new crossing.	Net jo	2 to 5min	<b>nges (£)</b> > 5n	oin	N/A	£2,965m	Not appraised yet
Ecc			-£479m	£1089m	£1,99				
	, ,								
	users	completely alternative route, and relieving congestion on the existing Dartford Crossing.		N/A			N/A	£106m	
	Regeneration	Not appraised using WebTAG, but see complementary wider economic modelling		N/A			N/A	N/A	
	Wider Impacts	Wider Impact (WI) benefits are more than double those for Route 1. More than 80% of WI benefits are from the agglomeration of business activities.	Agglomeration			£1,390m			
		perents are from the aggiorneration of business activities.	Output in imperfec	tly competitive ma	arkets	£287m	N/A	£1,678m	
			Labour supply impacts £1n			£1m			
al	Noise	There is a small net benefit. Whilst there are reductions in noise along the M25/ A282 corridor,	397 people would be	enefit based on an e	estimated 12,4	118			
ent		there are increases in noise for communities along the new route.	people being annoye	,			N/A	£15m	Not appraised yet
E			decreasing to 12,02	i people in the with	scrieme situa	uori.		2.0	riot appraised yet
Environmental	Air Quality	All properties which are predicted to exceed or are at risk of exceeding the AQSO in the without							
ᇤ		Scheme situation would experience an improvement in air quality with the Scheme.	Two of the receptors AQSO without the so						
			60 receptors), but the				N/A	N/A	Not appraised yet
			compared to the without scheme. The scheme is not predicted to lead to any new exceedences.						
	Greenhouse gases	The option is forecast to result in an increase in both non-traded and traded carbon emissions			6	316,088			
	J		Change in non-trade	ed carbon over 60y	(UUZe) -	tonnes	N/A	-£289m	
			Change in traded ca	arbon over 60y (CO	∠e)	17,442 tonnes	14//	2200111	
	Landscape	A new road would adversely affect the landscape character including green belt and intrude				torines			
		slightly into the AONB. A bored tunnel would have limited impact on the character of the Thames corridor although new road infrastructure could potentially be visible from the AONB.		N/A		Moderate Adverse	N/A		
		contact dialogithou road ilinactidata acata potentially be visible from the Marke.			Adverse				
	Townscape	See Landscape entry		N/A			N/A	N/A	
	Historic Environment	Direct physical impacts to one Grade II* registered park and garden, one conservation area and one Grade II listed building. Potential impacts to the setting of a number of designated heritage							
		assets and direct effects on non-designated archaeological remains within the scheme footprint.		N/A			Large Adverse	N/A	
	Biodiversity	Potential indirect effects on the Thames Estuary & Marshes SPA (loss of functionally linked land).							
	·	Impacts on LWSs, areas of BAP Priority Habitat & direct loss of habitat from ancient woodlands and loss of deciduous (not ancient) woodland from Shorne and Ashenbank Wood SSSI.		N/A			Very Large	N/A	
		and loss of deciduous (not ancient) woodland from Shome and Asheribank wood 5551.		1471			Adverse	IN/A	
	Water Environment	Negligible impacts on Mardyke.		N/A			Slight Adverse	N/A	
	Commuting and Other users	Compared to business users, relatively small time savings arise for commuters and other users	Value of jour	ney time change	es(f)	£632m	Oligin / tavelbe	IN/A	
Social		due to reduced congestion and improved connectivity. Vehicle operating cost disbenefits due to		ourney time cha	- V /	LOOLIII	N/A	£179m	Not considered out
Ŋ		increased travel and lack of perception by non-business travellers. Small road user charge disbenefit as there will be charges on the new crossing	0 to 2min	2 to 5min	> 5n		IN/A	£179111	Not appraised yet
	Reliability impact on	The option would improve journey time reliability for journeys across the Thames by providing a	-£341m	£364m	£609	9m			
	Commuting and Other users	completely alternative route, and relieving congestion on the existing Dartford Crossing.		N/A			N/A	£40m	
	Physical activity	The option has no impact on walking and cycling		N/A			N/A	NI/A	
	Journey quality	The route would provide a new high standard free-flowing solution and would relieve traffic from		IN/A			IN/A	N/A	
		the existing crossing at Dartford and other routes including the A2. With the WSL the A2 junction							
		has a compact junction layout arrangement, due to existing constraints, with slip/ link roads which have a design speed of 30-50 mph. Route 4 uses the A127 (a heavily used dual carriageway		N/A			Moderate Beneficial	N/A	
		County road) for part of the route, which will involve mixing of strategic and County road traffic							
	Accidents	DfT's COBALT tool has been used to appraise accidents and shows a net increase in the number							
		and value of accidents across the road network, as a result of this being a new route. However a	Because it is a ne	ew route 2,288 add	itional accider	nts are			
		separate appraisal has also been undertaken using actual accident data across the road network, which shows that the option will lead to a reduction in the rate of accidents (as measured by the	predicted over 60	years, including 35	fatalities, 258		N/A	-£121m	Not appraised yet
		Fatal and Weighted Injury rate per billion vehicle kilometres).	injurie	es and 3,245 slight o	asualties				
	Security	Lighting will be provided in accordance with Highways England's TA49/07 standard for new and					<b>O</b> II 1		
	•	replacement lighting on the strategic road network	N/A			Slight Adverse	N/A	Not appraised yet	
	Access to services Affordability	Not appraised because this criteria relates to public transport options  The appraisal has assumed the same charges for the new crossing in real terms as those at	N/A		N/A	N/A	N/A		
	,	Dartford Crossing today		N/A			Neutral	N/A	Not appraised yet
	Severance	Safe re-provision will be made for all existing rights of way for pedestrians and cyclists that cross the new trunk road. There will be permanent severance of some community facilities and public							
		natural assets and mitigation options need to be developed		N/A			Slight Adverse	N/A	Not appraised yet
	Option and non-use values	Not appraised because this criteria relates to public transport options		N/A			N/A	N/A	
ic ts	Cost to Broad Transport	The impacts on the transport budget would be twofold; the capital cost of construction and the	Investment costs: £2				IN/A	IN/A	
Public counts	Budget (2010 Present Values)	subsequent maintenance and operating cost of the infrastructure offset by revenue collected from	Operating costs £30		cotting ocat	or the	N/A	£1,757m	
Public Accounts		the additional user charges	Operator revenue £8 longer term)	ozom (a benenil, OII	ooung cost of	, or til <del>e</del>	***	2.,. 5	
٩	Indirect Tax Revenues	A tax benefit to central government is forecast as a result of additional traffic using the road		N/A			N/A	0000	
		network and particularly the Dartford Crossing		IN/A			IN/A	£603m	

# Annex 1 - TEE Table

Annex 1: TEE Table

#### Economic Efficiency of the Transport System (TEE): Route 4/WSL

Non-business: Commuting	ALL MODES		ROAD		BUS and COACH	RAIL		OTHER
User benefits	TOTAL		Private Cars and L	GVs	Passengers	Passengers		
Travel time	£76,530,261			£76,530,261				
Vehicle operating costs	-£67,605,062			-£67,605,062				
User charges	£98,558			£98,558				
During Construction & Maintenance	£0							
COMMUTING	£9,023,757 (	(1a)		£9,023,757				
Non-business: Other	ALL MODES		ROAD		BUS and COACH	RAIL		OTHER
User benefits	TOTAL		Private Cars and L	GVs	Passengers	Passengers		
Travel time	£555,682,179			£555,682,179				
Vehicle operating costs	-£383,358,007			-£383,358,007				
User charges	-£1,870,014			-£1,870,014				
During Construction & Maintenance	£0							
NET NON-BUSINESS BENEFITS: OTHER	£170,454,158 (	(1b)		£170,454,158				
L .								
Business				Business Cars &				
User benefits			Goods Vehicles	LGVs	Passengers	Freight	Passengers	
Travel time	£2,603,048,124		£630,288,024	£1,972,760,100				
Vehicle operating costs	£460,095,818		£299,551,311	£160,544,508				
User charges	-£97,736,627		-£40,800,776	-£56,935,851				
During Construction & Maintenance	£0							
Subtotal	£2,965,407,315 (	(2)	£889,038,558	£2,076,368,757				
Private sector provider impacts						Freight	Passengers	
Revenue								
Operating costs								
Investment costs								
Grant/subsidy								
Subtotal	£0 (	(3)						
Other business impacts							_	
Developer contributions	(	(4)						
NET BUSINESS IMPACT	£2,965,407,315 (£	5) = (2) +	(3) + (4)					
TOTAL								
Benefits (TEE)	£3,144,885,230 (6	6) - (1a) ,	· (1b) + (5)					
Dononia (TEE)				uto annoar se secsiti	vo numboro			
	Notes: Benefits appear All entries are of	•	ve numbers, while co d present values, in 2					

# Annex 2 - PA Table

# Annex 2: Public Accounts (PA) Table

### **Route 4 WSL Bored Tunnel**

	ALL MODES		ROAD	BUS and COACH	RAIL	OTHER
Local Government Funding	TOTAL	<u>_</u>	INFRASTRUCTURE	-		
Revenue						
Operating Costs						
Investment Costs		_				
Developer and Other Contributions						
Grant/Subsidy Payments						
NET IMPACT	£0 ()	7)				
Central Government Funding: Transpo	<u>rt</u>					
Revenue	-£823,066,379	ſ	-£823,066,379			
Operating costs	£301,710,435		£301,710,435			
Investment Costs	£2,278,670,913		£2,278,670,913			
Developer and Other Contributions						
Grant/Subsidy Payments						
NET IMPACT	£1,757,314,969 (8	8)	£1,757,314,969			
Central Government Funding: Non-Trai	nsport					
Indirect Tax Revenues	-£603,060,572 (S	9)	-£603,060,572			
TOTALS						
Broad Transport Budget	£1,757,314,969	10) = (7) + (	(8)			
Wider Public Finances		11) = (9)				
	Notes: Costs appear a	s positive n	iumbers, while revenues a	nd 'Developer and Other Contributions' a	appear as negative number	S.
	All entries are discount	ted present	values in 2010 prices and	values.		

# Annex 3 - AMCB Table

#### **Annex 3: AMCB Table**

#### **Route 4 WSL Bored Tunnel**

Analysis of Monetised Costs a	and Benefits	
Noise	£14,907,398	(12)
Local Air Quality		(13)
Greenhouse Gases	-£288,689,684	
Journey Quality		(15)
Physical Activity		(16)
Accidents	-£121,008,400	(17)
Economic Efficiency: Consumer Users (Commuting)	£9,023,757	(1a)
Economic Efficiency: Consumer Users (Other)	£170,454,158	(1b)
Economic Efficiency: Business Users and Providers	£2,965,407,315	(5)
Wider Public Finances (Indirect Taxation Revenues)	£603,060,572	- (11) - sign changed from PA table, as PA table represents costs, not benefits
Present Value of Benefits (see notes) (PVB)	£3,353,155,116	(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)
Broad Transport Budget	£1,757,314,969	(10)
Present Value of Costs (see notes) (PVC)	£1,757,314,969	(PVC) = (10)
OVERALL IMPACTS		
Net Present Value (NPV)	£1,595,840,148	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	1.9	BCR=PVB/PVC

Note: This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

# **Annex 4 – Biodiversity Worksheet**

# Annex 4: TAG Biodiversity Impacts Worksheet

### Route 4 WSL Bored

Ste Area	Description of feature/ attribute  Ramsar criterion 2	Scale (at which attribute matters)	Importance (of attribute)  Attribute a qualifying feature of	Step 3 Trend (in relation to target) Unknown at present	possibilities	Biodiversity and earth heritage value Very high - Ramsar	Step 4 Magnitude of impact Minor Negative	Step 5 Assessment Score Slight Adverse
Thames Estuary and Marshes Ramsar	Hamsar criterion 2 The site supports one endangered plant species and at least 14 nationally scarce plants of wetland habitats. The site also supports more than 20 British Red Data Book invertebrates.	international	Attribute a qualifying reature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	very nigh - Hamsar Criterion 2	Minor Negative	Slight Adverse
Thames Estuary and Marshes Ramsar	Ramsar criterion 5 Assemblages of international importance: Species with peak counts in winter: 45118 waterfowl (5 year peak mean 1998/99-2002/2003)	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 5	Minor Negative	Slight Adverse
Thames Estuary and Marshes Ramsar	Ramsar criterion 6 species/populations occurring at levels of international importance (includes species with peak counts in autumn/winter and in spring)	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 6	Minor Negative	Slight Adverse
Thames Estuary and Marshes SPA	Article 4.1 Qualification (79/409/EEC). Over winter the area regularly supports 1% of the population in GB of Circus cyaneus	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.1 qualification	Minor Negative	Slight Adverse
Thames Estuary and Marshes SPA	Article 4.2 Qualification (79/409/EEC). Over winter the area regularly supports significant populations of a number of wading birds. On passage the area regularly supports 2.6% of the population of Charadrius hiaticula	International	Attribute a qualifying feature of Internationally designated site so very high importance.			Very high - Article 4.2 qualification	Minor Negative	Slight Adverse
Thames Estuary and Marshes SPA	Article 4.2 Qualification (79/409/EEC): An internationally important assemblage of birds. Over winter the area regularly supports 75019 waterfowl (5 year peak mean 21/03/2000).  Attribute a qualifying feature of Internationally Internationally Internationally International Internationally International Internationally International International International International Internationally International In		Unknown at present	Not possible to substitute	Very high - Article 4.2 qualification	Minor Negative	Slight Adverse	
Mucking Flats and Marshes SSSI	Botanical interest: Mudflats and Saltmarsh	ats and National Attribute a qualifying feature of Nationally designated site so high importance.		Majority Favourable with small area Unfavourable Recovering status.			Neutral	Neutral
Mucking Flats and Marshes SSSI	importance.		Nationally designated site so high			High - nationally important species	Minor Negative	Slight Adverse
	Designated Ancient Woodland	National	Attribute a qualifying feature of	Favourable to Unfavourable	Not possible to substitute	High - nationally	Intermediate Negative	Large Adverse
Shorne and Ashenbank Woods SSSI			Nationally designated site so high importance.	Recovering Status	To possible to describe	important ancient woodland	monitorial regular	
Shorne and Ashenbank Woods SSSI	Woodland invertebrates	National	Attribute a qualifying feature of Nationally designated site so high importance.	Favourable to Unfavourable Recovering Status	Not possible to substitute	High - nationally important invertebrates	Intermediate Negative	Large Adverse
South Thames Estuary and Marshes SSSI	Wading birds and other overwintering species (such as short-eared owl)	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining	Not possible to substitute	High - nationally important birds	Minor Negative	Slight Adverse
South Thames Estuary and Marshes SSSI	Botanical importance (saltmarsh, freshwater habitats and grazing marshes)	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining	Not possible to substitute	High - nationally important botany	Minor Negative	Slight Adverse
South Thames Estuary and Marshes SSSI	Invertebrate interest (saltmarsh, freshwater habitats and grazing marshes)	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining	Not possible to substitute	High - nationally important invertebrates	Minor Negative	Slight Adverse
Thorndon Park SSSI	Botanical importance (semi-natural broad-leaved woodland)	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, some areas Unfavourable Declining	Not possible to substitute	High - nationally important	Minor Negative	Slight Adverse
Thames Estuary recommended MCZ (on hold)	Marine and estuarine habitats and species	National	Attribute a qualifying feature of Nationally designated site so high importance.	Marine and estuarine habitats in the Thames are being degraded through issues such as pollution and climate change.	Not possible to substitute	Very High - undesignated site hosting habitats/species of (European) Community interest (annexes 1 & 2, Habitats Directive, 1992)	Neutral	Neutral
	Ancient Woodland	National	Ancient woodland habitat, high Importance for biodiversity	Nationally, ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	High - important ancient woodland	Major Negative	Very Large Adverse

Str	ep 2	I		Step 3			Step 4	Step 5
Area	Description of feature/ attribute	Scale (at which attribute matters)	Importance (of attribute)	Trend (in relation to target)	Substitution possibilities	Biodiversity and earth heritage value	Magnitude of impact	Assessment Score
	Complex of habitats of value for biodiversity and as a community	Regional	Attribute of value to local communities, of Medium importance	Some goals are being achieved.		Medium - community value and extensive	Minor Negative	Slight Adverse
Greater Thames Marshes Nature	resource		or weathin importance	aoriievea.	nature of the area involved			
Improvement Area								
	Local Wildlife Site Ancient woodland	Local	Lowland mixed deciduous woodland (BAP Habitat) and ancient woodland -	Nationally, ancient woodland is being lost or degraded due	Not possible to substitute	High - important ancient woodland	Major Negative	Very Large Adverse
			high importance	to habitat loss and environmental factors such as				
Hobbs Hole (Bre66)				climate change and imported tree pathogens				
, ,								
	Local Wildlife Site	Local	Lowland mixed deciduous woodland	Nationally, ancient woodland	Not possible to substitute	High - important ancient	Major Negative	Very Large Adverse
	Ancient woodland		(BAP Habitat) and ancient woodland - high importance	is being lost or degraded due to habitat loss and environmental factors such as		woodland		
Codham Hall Woods (Bre59)				climate change and imported tree pathogens				
	Local Wildlife Site Ancient woodland	Local	Lowland mixed deciduous woodland (BAP Habitat) and ancient woodland -	Nationally, ancient woodland is being lost or degraded due	Not possible to substitute	High - important ancient woodland	Intermediate Negative	Large Adverse
W			high importance	to habitat loss and environmental factors such as				
Warley Hall Wood (Bre85)				climate change and imported tree pathogens				
	Local Wildlife Site Wood-pasture and parkland;	Local	Lowland meadows; Lowland mixed deciduous woodland; Hedgerows (BAP		Not possible to substitute	High - important ancient woodland	Minor Negative	Slight Adverse
Thorndon Country Park South	lowland meadows; neutral grassland; small-component		Habitats) and ancient woodland - high importance	However, there are no reliable statistics on the extent of the				
(Bre106) includes Mill wood (ancient woodland)	mosaics; accessible natural greenspace			overall resource, nor on historical and				
(4				current rates of loss or degradation of this type of habitat. Nationally, ancient				
				woodland is being lost or				
	Local Wildlife Site Lowland Mixed Deciduous	Local	Lowland mixed deciduous woodland - Medium (BAP Habitat)	Nationally, deciduous woodland is declining due to	Not possible to substitute mature habitats	Medium - BAP priority habitat	Major Negative	Moderate Adverse
Barrett's Shaw (Bre105)	Woodland on Non-ancient Sites			clearance, over-grazing and replanting with non-native species.				
Darrett's Onaw (Die 103)				species.				
	Local Wildlife Site Ancient woodland	Local	Lowland mixed deciduous woodland (BAP Habitat) and ancient woodland -	Nationally, ancient woodland is being lost or degraded due	Not possible to substitute	High - important ancient woodland	Minor Negative	Slight Adverse
Davind Chair (Brest 10)			high importance	to habitat loss and environmental factors such as				
Round Shaw (Bre112)				climate change and imported tree pathogens				
	Local Wildlife Site Ancient woodland	Local	Lowland mixed deciduous woodland - Medium (BAP Habitat)	Nationally, ancient woodland is being lost or degraded due	Not possible to substitute	High - important ancient woodland	Major Negative	Very Large Adverse
				to habitat loss and environmental factors such as				
Straight Path Shaw (Bre113)				climate change and imported tree pathogens				
	Local Wildlife Site Ancient woodland	Local	Lowland mixed deciduous woodland (BAP Habitat) and ancient woodland -	Nationally, ancient woodland is being lost or degraded due	Not possible to substitute	High - important ancient woodland	Major Negative	Very Large Adverse
			high importance	to habitat loss and environmental factors such as				
Thick/Hollow Bottom Shaws (Bre115)				climate change and imported tree pathogens				
(5.5.1.6)								
	Local Wildlife Site Neutral grassland	Local	Neutral grassland and hedgerows - Medium (BAP Habitats)	Favourable condition	Habitat/soil translocation a possibility but requires	Medium - BAP priority habitat	Neutral	Neutral
All Saints Churchyard and Keepers					suitable substrate to maintain required pH.			
Cottages Meadow (Bre118)								
	Local Wildlife Site	Local	Lowland mixed deciduous woodland	Nationally, ancient woodland	Not possible to substitute	High - important ancient	Minor Negative	Slight Adverse
	Ancient woodland; habitat extension mosaics		(BAP Habitat) and ancient woodland - high importance	is being lost or degraded due to habitat loss and	·	woodland	Ü	
Eastlands Spring (Bre134)				environmental factors such as climate change and imported				
Lastianus Spring (Die 134)				tree pathogens				
	Local Wildlife Site	Local	HCr19; SCr4; SCr11; SCr12; SCr13.	Red Data Book (Endangered)	Not possible to substitute	High - undesignated	Neutral	Neutral
	Invertebrates; reptiles		Important acid grassland; six Red Data Book invertebrates 16 nationally scarce species and three UK BAP bees			site hosts Red Data Book species and UK BAP species		
Orsett Camp Quarry (Th44)			species; reptiles include adder, common lizard and slow worm. High			DAI Species		
			importance					
	Local Wildlife Site Flora; invertebrates	Local	Thames Terrace grasslands and ancient heathland. Site supports 4	Unknown at present, but a rare grassland habitat and	Not possible to substitute	Medium importance Thames Terrace	Neutral	Neutral
Mucking Heath (Th41)			nationally rare and 50 nationally scarce invertebrate species. Medium	associated invertebrate fauna, associated with Thames Terrace soils.		grassland and invertebrates		
			importance.	maines renace solls.				
	Local Wildlife Site	Local	Acid grassland which supports BAP invertebrate (Bombus humilis). Medium	Developing site (former sand			Neutral	Neutral
	Acid grassland		importance.	i (pit)	possibility but requires suitable substrate to maintain required pH.	habitat		
Buckingham Hill (Th50)					акан течиней рп.			
	Local Wildlife Cite	Local	Anaignt woodland habites let !	Nationally assistant "	Not possible to subset	High important	Minor Nogether	Clight Advan-
	Local Wildlife Site Ancient woodland	Local	Ancient woodland habitat - high importance for biodiversity	Nationally, ancient woodland is being lost or degraded due to habitat loss and	Not possible to substitute	High - important ancient woodland	ivillior Negative	Slight Adverse
Rainbow Shaw (Th45)				to habitat loss and environmental factors such as climate change and imported				
· · · · · · ·				tree pathogens				
	Land Mariana Com	Land	10044 80 10	A min of a	Diff	I.Pb.	Mean No. 11	Ollista A.
	Local Wildlife Site Invertebrates	Local	SCr11; SCr12. An important brownfield site that supports 5 Red Data Book	unfavourable (caused by	Difficult to substitute established brownfield	High - undesignated site hosts Red Data	Minor Negative	Slight Adverse
			invertebrates including two bees (Andrena florea and Nomada	extremes of management and adverse heavily localised	sites	Book species		
Linford Pit (Th46)			fulvicornis) two wasps (Cerceris quinquefasciata (a BAP species) and Hedychrum niemelai) and a rare fly	recreational pressure)				
			(Myopa polystigma). High importance					
	<u>I</u>	<u> </u>						<u> </u>

Ste Area	p 2 Description of feature/ attribute	Scale (at which	Importance (of attribute)	Step 3 Trend (in relation to target)	Substitution	Biodiversity and earth	Step 4 Magnitude of impact	Step 5 Assessment Score
	Local Wildlife Site	attribute matters)	HCr2(b); HCr5; HCr6(b); HCr6(d). Wet	Current condition not known,	possibilities Not possible to substitute	heritage value Medium - BAP priority	Neutral	Neutral
Linford Wood (Th51)	Wet woodland complex		woodland UK BAP habitat. Medium importance.	but habitat requires management to maintain diversity of scrub and woodland types.	without similar hydrology to maintain water table required for wet woodland	habitat		
Low Street Pit (Th47)	Local Wildlife Site Invertebrates; flora	Local	HCr11; SCr11; SCr12; SCr13. Thames Terrace grassland supports a diverse invertebrate fauna including UK BAP invertebrate (Hornet Robber fly ( <i>Asilus</i> <i>crabroniformis</i> )) Medium importance.	Unknown at present, but a rare grassland habitat and associated invertebrate fauna, associated with Thames Terrace soils.	Not possible to substitute	Medium importance Thames Terrace grassland and invertebrates	Major Negative	Moderate Adverse
Lytag Brownfield (Th39)	Local Wildlife Site Acid grassland; reptiles	Local	HCr19; SCr4. Brownfield site with acid grassland that supports all four common species of reptile (adder, grass snake, common lizard and slow worm). Medium importance	Believed to be favourable, but identified as a site a risk from development.	Lytag Brownfield will be temporarily disturbed. Reptile translocation required. Habitat reinstatement a possibility but requires suitable substrate to maintain required pH for habitats to establish.	Medium - BAP priority habitat	Minor Negative	Slight Adverse
Goshems Farm (Th49)	Local wildlife Site - deciduous woodland.	Local	This old landfill area supports two important species populations: the nationally rare Red Data plant Stinking Goosefoot and the UK BAP species Hornet Robber fly. Also made up of a large of deciduous woodland. High importance.	Red Data species but unknown at present.	Creation of replacement habitat possible?	High - UK BAP species and Red Data Book plant species.	Intermediate Negative	Large Adverse
Canal and grazing Marsh, Higham (Gr17)	ocal Wildlife Site lestored Higham Canal and oastal grazing marsh (UK BAP abitat)  Local Recently established reedbeds, damp disturbed grassland and a dyke system Medium importance				Medium - BAP priority habitat	Neutral	Neutral	
ancient woodland immediately to the north west of M25 J29	Ancient Woodland	National	Ancient woodland habitat high importance for biodiversity.	Nationally, ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens	Not possible to substitute	High - important ancient woodland	Major Negative	Large Adverse
Priority Habitat - Deciduous Woodland (south west of M25 J29; north east of M25 J29; south of A127 East Horndon interchange; adjacent to railway line south of Dunton Hall; north west of Linford; east of Low Street; areas included in East Tilbury Marshes; north of the A226 opposite Church Lane; adjacent to the A2 immediately west of Shorne and Ashenbank Woods SSSI)	Priority habitat	Local	Medium importance, BAP habitat	Nationally, deciduous woodland is declining due to clearance, over-grazing and replanting with non-native species.	Not possible to substitute mature habitats. Replacement planting and/or translocation of habitats and/or soils a possibility	Medium - BAP priority habitat	Major Negative	Moderate Adverse
Priority Habitat - Deciduous Woodland (north of A127 opposite Great Warley Hall; adjacent to railway line south of Dunton Hall; north of Horndon on the Hill; south west of Dame Elyns; east of Buckland; north east of East Court Manor; adjacent to the A2 immediately west of Shorne and Ashenbank Woods SSSI; adjacent to A2 west of Claylane Wood)		Local	Medium importance, BAP habitat	Nationally, deciduous woodland is declining due to clearance, over-grazing and replanting with non-native species.	Not possible to substitute mature habitats. Replacement planting and/or translocation of habitats and/or soils a possibility	Medium - BAP priority habitat	Minor Negative	Slight Adverse
Priority Habitat - Wood-pasture and Parkland (between Round Shaw and Hollow Bottom Shaw/Thick Shaw north of the A127)	Priority habitat	Local			Not possible to substitute mature habitats.	Medium - BAP priority habitat	Minor Negative	Slight Adverse
Priority Habitat - Wood-pasture and Parkland (between Round Shaw and Hollow Bottom Shaw/Thick Shaw south of the A127)	Priority habitat	Local	Medium importance, BAP habitat	Generally believed to be declining nationally. However, there are no reliable statistics on the extent of the overall resource, nor on historical and current rates of loss or degradation of this type of habitat.	Not possible to substitute mature habitats.	Medium - BAP priority habitat	Major Negative	Moderate Adverse
Priority Habitat - Traditional Orchards (south of Horndon on the Hill; south west of Dame Elyns)	Priority habitat	Local	Medium importance, BAP habitat	Declining due to a loss of sites only partially compensated for by improved management and restoration.	Not possible to substitute mature habitats.	Medium - BAP priority habitat	Minor Negative	Slight Adverse
Priority Habitat - Traditional Orchards (on Church Lane north of A226)	Priority habitat	Local	Medium importance, BAP habitat	Declining due to a loss of sites only partially compensated for by improved management and restoration.	Not possible to substitute mature habitats.	Medium - BAP priority habitat	Major Negative	Moderate Adverse
Priority Habitat Coastal and Floodplain Grazing Marsh (East Tilbury Marshes north of Thames; MoD firing range, Thames Estuary and Marshes Ramsar and South Thames Estuary and Marshes SSSI south of Thames)	Priority habitat. Of importance for cohesion between designated sites and for sustaining populations of waterfowl and of value for notable invertebrates and plants.	National (contiguous with similar habitat of international importance within designated sites)	Medium to high importance, dependant on functioning within the wider network of habitats	Likely to be decreasing due to agricultural improvement, drainage and development	Not possible to substitute easily as reliant on suitable groundwater conditions (hydrology) for replacement habitat to establish.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Minor Negative	Slight Adverse
Priority Habitat - Coastal Saltmarsh (east of Tilbury Power Station)	Priority habitat. Important for cohesion between designated sites and for sustaining populations of wading birds.	National (contiguous with similar habitat of international importance within designated sites)	Importance will be dependant on functioning within the wider network of habitats, likely to be Medium to High Importance	Likely to be decreasing due to coastal erosion, climate change and development	Creation of replacement habitat through managed realignment a possibility, but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Neutral	Neutral
Priority Habitat - Mudflats (East of Tilbury Power Station)	Priority habitat. Important for cohesion between designated sites and for sustaining populations of wading birds.	National (contiguous with similar habitat of international importance within designated sites)	Importance will be dependant on functioning within the wider network of habitats, likely to be Medium to High Importance	Likely to be decreasing due to coastal erosion, climate change and development	Creation of replacement habitat through managed realignment a possibility, but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Minor Negative	Slight Adverse

Ste	ep 2			Step 3			Step 4	Step 5
Area	Description of feature/ attribute	Scale (at which attribute matters)	Importance (of attribute)	Trend (in relation to target)	Substitution possibilities	Biodiversity and earth heritage value	Magnitude of impact	Assessment Score
Tentacled lagoon worm (Alkmaria romijni)	Tentacled lagoon worm is protected under Schedule 5 of the Wildlife and Countryside Act 1981	National	High importance (protected under Schedule 5 of the Wildlife and Countryside Act). Nationally scarce marine animal	Considered scarce within the UK; vulnerable to changes to, or loss of, the habitats in which they live	Not possible to substitute		Neutral	Neutral
European eel (Anguilla anguilla)	European eel is a UK BAP Priority Species (BAP species are now Species of Principal Importance/Priority Species)	National	Medium importance, BAP species	Listed as Critically Endangered on the IUCN Red List; on the OSPAR list of threatened and/or declining species and habitats.		Medium	Neutral	Neutral
Smelt (Osmerus eperlanus)	Smelt is a UK BAP Priority Species (BAP species are now Species of Principal Importance/Priority Species)	National	Medium importance, BAP species	Declining, most of the recorded populations in Scotland are now extinct, as are a third of those from estuaries in England and Wales	Not possible to substitute	Medium	Neutral	Neutral
Harbour Porpoise ( <i>Phocoena</i> phocoena)	Annex II of the European Commission's Habitats Directive (92/43/EEC); Schedule 5 of the Wildlife and Countryside Act	National	High importance	Common to all UK waters 'favourable conservation status', but due to incidental fisheries by-catch, the species has been assessed as under threat/in decline in the Greater North Sea and Celtic Sea.	Not possible to substitute	High	Neutral	Neutral

MAGIC website for designated site locations; ancient woodland locations; priority habitat locations JNCC website for Ramsar, SPA, SAC and SSSI site designations Natural England website for Local Nature Reserve designations

Thurnock Biodiversity Study 2006-2011

Essex Wildlife Trust website for locations of Local Wildlife Sites (http://www.essexwtrecords.org.uk/lowsfinder)

Kent Wildlife Trust website for locations of Local Wildlife Sites (http:://www.essexwtrecords.org.uk/lowsfinder)

Kent Wildlife Trust website for locations of Local Wildlife Sites (http:://www.essexwtrecords.org.uk/lowsfinder)

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Review of Lower Thames Crossing Options: Final Review Report Appendices, AECOM, 2013

UK Biodiversity Action Plan; Priority Habitat Descriptions. BRIG (ed. Ant Maddock) 2008 (Updated Dec 2011).

#### Summary Assessment Score

Very Large Adverse\*

### Qualitative Comments

Route 4 bisects 3 designated sites, 11 local wildlife sites and and additional 14 areas of Biodiversity Action Plan habitat. These include an area of the Thames Estuary and Marshes which is designated as an internationally important Ramsar site and SSSI, and which is also a RSPB reserve. The route bisects a number of important habitats which will result in varying degrees of disturbance, habitat loss and habitat fragmentation. Specific comments on the potential design options for a new river crossing are outlined below:

The main impacts are associated with the construction phase. A completed tunnel would not impact the marine environment and the coastal/terrestrial impacts would be greatly reduced in comparison to the erection of a bridge (where permanent effects from loss of habitat and shading effects will occur) or immersed tube tunnel (with very large impacts on habitats and species during construction). The location of the tunnel entrance to the north of the crossing (and, in particular, the temporary works area associated with the tunnel portal) currently has a significant impact on an area of historic coastal grazing marsh and local wildlife site, which supports a diverse range of Red Data Book Invertebrates and may be also provide important functionally linked land for the SPA designated species (e.g. high tide roost). Micro-siting this entrance point to minimise impacts of habitat loss/deterioration and disturbance to SPA species is recommended. However there is potential for offset mitigation by enhancing land adjacent to the site which is currently agricultural land. Habitat loss and fragmentation of five areas of ancient woodland along the northern extent and one along the southern extent of the new road would involve a very large adverse effect on Ancient Woodland habitat that is irreplaceable (as discussed above).

Note the Summary Assessment Score is skewed by impacts on ancient woodland (six areas of ancient woodland affected) from the proposed route alignment.

# **Annex 5 – Historic Environment Worksheet**

# **Annex 5: Historic Environment Impacts Worksheet**

# Route 4 WSL Bored

	Step 2		Step 4		
Feature	Description	Scale it matters	Significance	Rarity	Impact
Form	The historic landscape within the study area is predominantly rural in character and the result of post-medieval farming activity. The study area also contains portions of settlements such as West Horndon, Horndon on the Hill, West Tilbury and Gravesend.  The study area contains a number of listed buildings (designated heritage assets), largely in rural settings, although there are small clusters in settlements such as East Tilbury. In total there are 45 Grade II, six Grade II* and one Grade I listed buildings within the study area (Grade II*: Little Warley Hall, Little Warley; Church of All Saints, East Hornden; Old Plough House, Bulphan; Marshall's Cottages and Church of St James, West Tilbury; Church of St Mary, East Court Manor. Grade I: Church of St Peter. Little Warley). The study area contains four conservation areas (designated assets): Thorndon Park, Thong, West Tilbury and East Tilbury. Thorndon Park is also a Grade II* registered park and garden. Cobham Park is a Grade II registered park and garden.  Known archaeological remains within the study area date from the prehistoric to post-medieval periods. There are five scheduled monuments (designated heritage assets) within the study area: a former parish church and churchyard of St Nicholas; Thorndon Old Hall and gardens; earthworks at West Tilbury and a Second World War anti-aircraft battery at Bowaters Farm.	a national level under the Planning (Listed Buildings and Conservation Areas) Act 1990 and are a material consideration at national level in the NPPF and NN-NPS.  The scheduled monuments are also designated heritage assets and are afforded protection at a national level under the Ancient Monuments and Archaeological Areas Act 1979. They are also a material consideration at national level in the NPPF and NN-NPS.  Whilst registered parks and gardens do not have statutory protection, they area a material consideration in the planning process and are considered at a national level in the NPPF and NN-NPS.  The treatment of non-designated archaeological remains within the planning process is also considered at a national level in the NPPF and NN-NPS even though they may be of lesser value than designated heritage assets.	the non-designated archaeological remains range in value from low to medium.	and are of moderate rarity. East Tilbury conservation area is a rare example of a planned modernist factory town. The other four conservation areas are relatively well represented regionally and nationally.  Thorndon Park and Cobham Park registered park and gardens contains considerable time depth and incorporates or is associated with a number of other high value assets and is rare on a national level.	The Scheme will have a direct physical impact on the Grade II listed Dunton Hills Farm, which will be removed. The scheme may impact on the settings of the listed buildings along the route. The scheme will have direct physical impact on the Thorndon Park conservation area and registered park and garden. The scheme may also impact on the settings of the Thong, West Tilbury and East Tilbury conservation areas and Cobham Park registered park and garden. The setting impacts may arise as a result of the introduction of a new linear element, the road, in a currently open rural landscape  The scheme may also impact on the settings of the scheduled monuments at Thorndon Old Hall, former parish church and churchyard of St Nicholas, West Tilbury and Bowaters Farm. The impacts may arise as a result of the introduction of a new linear element, the road, in a currently open rural landscape.  Construction excavations associated with the prosed road and tunnel portals may impact on non-designated archaeological remains within the scheme footprint via their complete or partial removal.
Survival	The survival of the listed buildings and the conservations areas is comparable with others in the region and is generally good.  The survival of Thorndon Park registered park and garden is generally good.  The survival of the scheduled monuments is generally good. The survival of the archaeological remains has not yet been fully determined.	The NPPF and NN-NPS takes the survival of heritage assets into account at a national level.	Survival of the designated heritage assets is of moderate to high significance as they contribute to the character of the area.  Survival of the non-designated archaeological remains is of low to moderate significance as surviving remains of these types are important in terms of our understanding of the human past.	With the exception of the former parish church and churchyard of St Nicholas and the Bowaters Farm anti-aircraft battery, the survival of which is rare at both regional and national levels, the survival of the scheduled monuments is of moderate rarity value.  Surviving non-designated archaeological remains are not rare regionally.	The scheme would not impact on the survival of designated assets within the study area, with the exception of Thorndon Park registered park and garden and conservation area, which would be subject to the direct physical impacts as the result of road construction within the designated area.  The scheme would not impact on the survival of non-designated assets within the study area as a whole, but would have impact within the scheme footprint.
Condition	The condition of the listed buildings and conservation areas is generally good.  The condition of Thorndon Park and Cobham Park registered park and garden are generally good.  The condition of the scheduled monuments is generally good, with the exception of the Bowaters Farm anti-aircraft battery, the condition of which is poor. The condition of the non-designated archaeological remains is currently unknown.	The NPPF and NN-NPS takes the condition of heritage assets into account at a national level.	The condition of the listed buildings, conservation areas and registered park and gardens is of moderate significance as they have they have a beneficial effect on the character and amenity value of the study area.  The condition of scheduled monuments and non-designated archaeological remains is of high and moderate significance respectively, as in good condition they can inform our understanding of the human past.	have low rarity value. Registered parks and gardens in good condition are also relatively common, but have moderate rarity due to their relative scarcity  Scheduled monuments of the nature and condition of those within the study area have a	The scheme would not impact on the condition of designated assets within the study area, with the exception of Thorndon Park registered park and garden and conservation area, which would be subject to the direct physical impacts as the result of road construction within the scheduled area.  The scheme would have not impact on the condition of non-designated assets within the study area as a whole, but would have some impact within the scheme footprint.
Complexity	The listed buildings and conservation areas are not unusually complex and represents a standard mix of agricultural, residential, ecclesiastical and commercial buildings. Thorndon Park and Cobham Parkl are relatively complex as it represents several phases of development.  Archaeological remains, both scheduled monuments and non-designated, represent activity from a number of periods and in relation to a number of industrial, settlement, funerary and agricultural processes. They are moderately complex but not unusual in a regional context.	The NPPF and NN-NPS takes the complexity of heritage assets into account at a national level.	The complexity of the historic environment resource has moderate significance as it represents both time-depth and potential to provide positive benefits to the character and amenity value and is also indicative of potential value in terms of our understanding of the human past.	The level of complexity within the historic environment resource is common on a regional level and as such is of low rarity.	The scheme would not impact on the complexity of designated assets within the study area.  The scheme would not impact on the complexity of non-designated assets within the study area as a whole and the scheme footprint.
Context	The study area lies within the Greater London / Thames Estuary areas and the historic environment resource within the study area reflect this wider context.	The NPPF and NN-NPS takes the context of heritage assets into account at a national level.	The context of the historic environment resource within the study area informs their settings and as such is of moderate to high significance.	The context of the historic environment resource within the study area is relatively common and as such is of low rarity.	The scheme would not impact on the context of the historic environment resource within the study area.

	Step 2		Step 3		Step 4		
Feature	Description	Scale it matters	Significance	Rarity	Impact		
renou	The listed buildings and conservation areas date from the medieval to modern periods.  Thorndon Park and Cobham Park registered park and garden dates from the early medieval to modern periods.  The scheduled monuments date from the Neolithic to the modern period, whilst the non-designated archaeological remains date from the prehistoric period onwards.		•	The range of periods represented by the historic environment resource within the study is common to the region and as such is of low rarity.	1 ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' '		

TAG Unit A3 (November 2014); DMRB Volume11, Section 3, Part 2 (2007); National Heritage List for England; Greater London Historic Environment Record; Essex Historic Environment Record, Thames Estuary Partnership Archaeological Research Framework (1999); Thames Estuary Partnership Greater Thames Research Framework (2010)

#### Step 5 - Summary Assessment Score

Large Adverse

### **Qualitative Comments**

The scheme covers an area that is largely open and rural in character but containing urban areas that expanded during the 19th and 20th centuries. One Grade II listed building (Dunton Hills Farm) will suffer a direct physical impact through its removal, the effect of which is predicted to be Large Adverse. Potential impacts to the settings of the following designated heritage assets have been identified as a result of scheme: scheduled monuments at Thorndon Old Hall, former parish church and churchyard of St Nicholas, West Tilbury and Bowaters Farm, listed buildings along the route; Thong, West Tilbury and East Tilbury conservation areas; Cobham Park registered park and garden. These effects are predicted to be Slight Adverse with regard to the listed buildings and Moderate Adverse with regard to the conservation areas, registered park and garden and scheduled monuments. Road construction within the registered area of the Thorndon Park registered park and garden and conservation area will cause a direct physical impact to this designated asset. Due to the high value of the assets, the effects are predicted to be Large Adverse. Construction excavations associated the proposed road and tunnel may have a physical impact on any non-designated archaeological remains within the scheme footprint are predicted.

# **Annex 6 – Landscape / Townscape Worksheet**

### Annex 6: Landscape Impacts Worksheet

### Route 4 WSL Bored

	Step 2		Step 3			Step 4		
Features	Description	Scale it matters	Rarity	Importance	Substitutability	Impact		
		Local	Rare in a local context	Varies, farmland is medium in	Varies along the route.	Moderate adverse. Route 4 WSL would have a direct and indirect impact on the pattern of the existing landscape. In places the route would cut through the gently		
	open arable fields and few hedgerows, which are mainly along the roads			a local context, Shorne woods	,			
	and around the small settlements. The land rises up to the wooded ridge of			rare and the urban edge common.	recreation land is medium while the woodland is low.	which would create a visual barrier. Fields which create a distinct pattern on the landscape would be bisected by the road, although these are larger in size than		
	Shorne Woods Country Park, with the A2 and high speed rail transport corridor to the south. To the west is the suburban edge of Gravesend with			common.	write the woodland is low.	they would have been historically, with most hedges removed or poorly maintained.		
	housing and recreational facilities such as a golf course and leisure centre.							
	The Thames river corridor consists of flood embankments along the river	Local	Rare in a local context	High in a local context	Low	Neutral. The tunnel portals would be located to the north and south of the Thames corridor.		
Pattern	edge backed by expansive marshlands with rough grazing and sparse							
	scrub. On the north side there are extensive areas of old mineral workings							
	some of which have been backfilled as landfill.							
	From the junction of the A127 with the M25 Route 4 WSL would pass	Local	Common	Medium	High	Moderate Adverse. Route 4 WSL would impose a linear transport corridor through a largely rural area and break up the existing scale of the field pattern. Where it		
	through open gently rolling countryside of medium sized, enclosed fields and	Local	Common	Wediam	i ligii	follows the line of the existing A127 the impact would be <b>slight adverse</b> .		
	small settlements. Further south the settlements become larger as do the					load to the side of the original to the side of the si		
	size of the fields. Power lines become a more prominent feature.							
	South of the Thames corridor the level of tranquillity varies considerably with	Local	Locally rare.	Varies, medium for most of the	Low	Moderate adverse in the vicinity of Route 4 WSL. Whilst there is some road noise in most areas at present this would increase considerably in most locations. The		
	location. There are peaceful country lanes and small villages, although			route while the country lanes		presence of road infrastructure would also have an impact on visual tranquillity. For residents of Thong, Riverview Park, and Chalk the route change the view and		
	nowhere is it completely tranquil due to distant road noise and the visual			and villages are high.		increase noise, having a detrimental impact on tranquillity.		
	intrusion of urban settlements, roads and pylons.							
	Within the Thames corridor there are expansive views over the river and	Local	Common	High in local context	Low	Slight adverse. A tunnel would pass below the Thames corridor the portal being located to the south of the Lower Higham Road. Noise levels and visual intrusion		
	surrounding marshland from the riverside paths which are often some	Loodi	Common	I light in local context	2011	would be much the same as they are at present, with the exception of locations closest to the portal and ventilation building.		
	distance from the nearest road. There is always the visual intrusion of man							
	made structures such as jetties, river traffic and Tilbury power station.							
Tranquillity								
	North of the Thames corridor the level of tranquillity varies considerably with	Local	Common	Low	High	Moderate adverse in the vicinity of Route 4 WSL. While there is some road noise in most areas at present this would increase considerably in the majority of		
	location. There are large roads such as the M25, A13 and A127 which					locations. The presence of road infrastructure would also have an impact on the rural character of the area. For some residents of East Tilbury, West Tilbury,		
	generate traffic noise and disrupt tranquillity whilst there are open areas of countryside between that are broken only by the occasional small road.					Linford, Southfield, Horndon on the Hill and west Horndon the route change the view and increase noise, having a detrimental impact on tranquillity.		
	Nowhere is it completely tranquil due to distant road noise and the visual							
	intrusion of small settlements, roads and pylons.							
	M + (B + 4)(0) + + + + (1) + 0 + B +	D : 1	D : " "					
	Most of Route 4 WSL is located within Green Belt.	Regional	Regionally medium	High in regional context	Low	Moderate adverse. The Green Belt is a valued rural separation between settlements. In this location Route 4 WSL would introduce a new urban element into the Green Belt that has been planned to separate Basildon, Grays, Tilbury and Gravesend from nearby villages.		
	South of the A2 is Cobham Hall which is included in the register of parks	National	Rare	High in a national context	Low	Neutral. A slip road at the junction with the A2 would be located within the registered park, however in reality it is outside of the current park boundary. The		
	and gardens comprising intact 18C parkland, gardens, estate woodlands					registered park boundary should be altered to accommodate current transport infrastructure.		
	and golf course.							
	Kent Downs Area of Outstanding Natural Beauty (AONB) and Shorne	National	Rare nationally	High in national context	Low	Slight adverse. Route 4 WSL and the junction with the A2 would mostly be located outside of AONB with a slip road located within it. This would have little impact		
	Woods Country Park.					due to the existing A2 and infrastructure. There would be views from parts of the AONB at Shorne Woods of new road infrastructure to the north and west. There would be an impact on the setting of the AONB from the north west.		
						would be all impact of the setting of the AOND Holline Hollin west.		
	Conservation Area at Thong.	Regional	Medium	High in regional context	Low	Slight adverse. Route 4 WSL would be close enough to the northern part of the conservation area to have an adverse impact on it.		
	Southern Valley Golf Course and driving range and land associated with	Local	Medium	Medium in local context	High	Slight adverse. Route 4 WSL would pass through the golf course which would have to be partly re-located.		
	Cascades Leisure Centre. Included in Gravesham Local Plan 2nd review as							
	an area for Green Grid Site Protection.							
	National Cycle Routes 1 and 13 and other public rights of way.	National/local	Rare/common	High/low	High as easily relocated	Moderate adverse for rights of way and national cycle routes located close Route 4 WSL due to the visual impact of road infrastructure and increased noise		
						levels.		
	Thames and Medway canal route (no longer navigable). Not designated.	Local	Rare locally	Medium in a local context	Low	Neutral The portal and road would be located some distance to the south.		
	Saxon Shore Way leisure route along the Thames and public right of way on	Regional/local	Rare regionally	High in a local context	Low	Neutral. The tunnel would pass below the paths.		
	northern side of the Thames.							
	Listed buildings located close to Route 4 south of the Thames: Filborough	National/regional	Nationally/ regionally rare	High in national/regional	Low	There would be a slight adverse impact on the setting of the listed buildings in Chalk and a neutral impact on the listed building in Thong which would be further		
	Farmhouse, Barn to the north west of Filborough Farmhouse, the granary		,,	context		from the proposed route.		
	at Little Filborough Farm East Court Manor, Church of St Mary in Chalk							
	(grade II*) and White Horse Cottage in Thong.							
	Scheduled monument. Coalhouse Fort battery and artillery defences.	National	Rare	High at a national level	Low	Neutral. A tunnel will have no impact on the setting to the monument.		
	, ,			9				
Cultural			<u> </u>					
Juiturai	Scheduled monument at Bowaters Farm WWII anti aircraft battery.	National	Rare	High at a national level	Low	The monument is largely hidden from view by scrub and despite the closeness of Route 4 WSL it would only have a <b>slight adverse</b> impact on the setting.		
		D : 1		10.1				
	Grade II listed building at Bucklands Farm.	Regional	Rare	High	Low	The building is surrounded by trees and the road would have only a <b>slight adverse</b> impact on its setting.		
	Fact Tilbury Conconvation area and listed buildings	Pagional	Paro	High	Low	Some distance away from the concentration area which is an unusual modernist development of housing and factories. For most of the area the invested by		
	East Tilbury Conservation area and listed buildings.	Regional	Rare	High	Low	Some distance away from the conservation area which is an unusual modernist development of housing and factories. For most of the area the impact would be <b>neutral</b> with <b>slight adverse</b> on the setting of the western edge.		
	Orada II listed buildings in the visitive of Handay and the 199 white 500	Pagianal	Para	High	Low			
	Grade II listed buildings in the vicinity of Hordon on the Hill within 500m of Route 4 WSL. 2 at Ongar Hall Farm, 2 at Wyfields Farm, Linsteads Farm,	Regional	Rare	High	Low	Generally a <b>slight adverse</b> impact on the setting of the buildings due to the distance from Route 4 WSL. At Chorleys farm the impact will be <b>moderate adverse</b> as the route is close to the building and would considerable change the setting from arable field to the east.		
	Chorleys farm, 2 at Saffron Gardens.					and react to discount the bulloting and mound constructable origing the Setting Hoth draute field to the east.		
			1					
	Bulphan WWII bombing decoy scheduled monument, south of Doesgate	National	Rare	High at a national level	Low	Large adverse impact on the setting of the scheduled monument due to the closeness of the road to an extremely rare example of a bombing decoy.		
	Lane.							
	Dunton Halls Golf Course.	Local	Medium	Low	Medium	Moderate adverse. Route 4 WSL would run through part of the golf course which would have to be relocated.		
		<u></u>						
		<del></del>						

	Step 2		1	Step 3		Step 4
Features	Description	Scale it matters	Rarity	Importance	Substitutability	Impact
	All saints Church grade II*, Freman Monument grade II & Stabling at Church of all Saints grade II, listed buildings.	National/regional	Rare	High	Low	Slight adverse The new junction with the distributer road would have an impact on the setting of the buildings.
	Grade II listed buildings at East Horndon Hall, Dunton Hills Farm & 2 at Dunton Hall.	Regional	Rare	High	Low	Moderate adverse to East Horndon Hall as the building would become surrounded by roads severely affecting its setting. Dunton Hills Farm would be demolished and the impacts will be addressed as part of the heritage worksheet. The other listed buildings are further from the route which would only have a slight adverse impact on their setting.
	Thordon Hall scheduled monument.	National	Rare	High	Low	Slight adverse. The slip roads connecting Route 4 WSL with the A127 and the new distributer road would have some impact on the setting of the monument although it will be largely hidden by vegetation.
	Thordon park registered park and conservation area.	National	Rare	High	Low	Moderate adverse. The southern part of the registered park and the conservation area will be affected by the 2 new slip roads to linking route 4 with the A127 and a new distributer road will cut through the southern part of the conservation area and the registered park. This will isolate small sections of both from the remainder.
	A grade I & II* listed buildings at Little Warley.	Regional/national	Rare	High	Low	Slight beneficial. The removal of the junction with the A127 and the demolition of the exiting service station would have a small improvement on the setting of the listed buildings.
	2 grade II Listed buildings, Hulmers and The Kilns Hotel on the B186 north of the A127.	Regional/national	Rare	High	Low	Neutral. The removal of the junction between the B186 and the A127 would have an advantages impact on the setting of the buildings. The proposed slip road between the A127 and the M25 and the junction of the distributer road with the B186 would have a slight adverse impact on the setting of the buildings. Overall the impact would be neutral.
	South of the A2 the grounds of Cobham Hall are a Registered Park and Garden comprising an intact 18th century parkland, gardens, estate woodlands and golf course.	National	Rare	High in National context	Low	Neutral. Part of the Route 4 WSL / A2 junction would be located inside of the registered park, although in reality this is outside of the of the current park boundary.
	Shorne Woods Country Park is made up of ancient woodland, woodland and heathland. The park has a visitor centre, car park, leisure facilities and walks.	Local	Rare	High in local context	Low	Neutral. None of Route 4 WSL would pass through the woodland.
	South of the Thames river corridor the landcover consists of arable farmland with hedgerows and trees grouped around small settlements. To the west is the suburban edge of Gravesend with associated recreational land uses such as a leisure centre, golf course and driving range.	Local	Common	Low in local context	Medium	Moderate adverse. The current agricultural landcover would change along Route 4 WSL to one dominated by transport infrastructure. There would probably be a change in the use of the land between the road and the edge of Gravesend as many of the fields would be too small to farm.
Landcover	The characteristic landcover of the Thames river corridor consists of open flat grazing marsh with sparse scrub and trees cover with emergent plants along ditches. The Thames is lined with inter tidal mud flats and gravel foreshore. On the north side there are extensive former mineral workings some of which have been backfilled with landfill.	Regional	Rare	High in regional context	Low	A bored tunnel would have <b>neutral</b> impact immediacy adjacent to the river. Above the current agricultural landcover would change along the route to one dominated by transport infrastructure, in the long term there would be the potential for Route 4 WSL to create changes to the surrounding agricultural land which would be bisected and would become less viable to farm.
	South of the A13 there are more settlements. Arable fields are still a feature but this are mixed with rough grassland, golf courses and gravel extraction. Overhead power lines become a common feature.	Local	Medium	Medium in local context	High	Moderate adverse. Despite the urban fringe character the introduction of Route 4 WSL would significantly change the land use in the immediate vicinity of the road and some arable fields would no longer be viable.
	From the M25 junction with the A127 to the A13 the landcover is mostly of arable fields, with hedges and boundary trees, with settlements some distance away. There is a golf course at Dunton. Areas of woodland at the junction with the M25 including a small area of ancient woodland would be destroyed by the new slip roads.	Local	Medium	Medium in local context	High. The most important features the trees and hedges can easily be replaced. Ancien woodland low.	
Summary of character	The Thames river corridor has a strong identity with large expansive horizontal visits dominated by the interplay of water and sky. The area to the north along Route 4 WSL consists of open arable farmland north of the A13, with settlements and urban fringe areas becoming more dominant to the south. South of the Thames corridor consists of large arable fields with hedgerows and trees grouped in association with small settlements. Recreational facilities such as a golf course and leisure centre fringe the suburban edge of Gravesend to the west. The land rises up to the south and the AONB with areas of woodland and heathland beyond which is the A2, HS1 transport corridor.	Regional	Medium regionally	Medium regionally	Medium	A bored tunnel would have a <b>neutral impact</b> in the Thames corridor. For the remainder of the route, in more rural areas the route would have a moderate adverse impact as it would change the character of the surrounding area. Closer to urban settlements it would have a slight adverse impact due to the presence of existing large roads.

Department of Transport TAG Unit A3 Environmental Impact Appraisal May 2014, Magic.gov.uk, Google Maps satellite photography, OS Maps, Thurrock UDP deposit draft 2003 (unadopted). National Character Area 111 Northern Thames Basin, National Character Area 81 Greater Thames Estuary, National Character Area 113 North Kent Plain, The Landscape Assessment of Kent 2004, Essex Landscape Character Assessment, Gravesham Local Plan 2nd review

#### Step 5 - Summary Assessment Score

#### Moderate adverse

#### Qualitative Comments

Route 4 WSL would create a new road corridor and introduce a significant change to the existing landscape character which is designated as Green Belt. Route 4 WSL would introduce a significant change to the existing landscape character for much of the route, which is designated as Green Belt. Route 4 WSL would introduce a significant change to the existing landscape character for much of the route, which is designated as Green Belt, due to the introduction of a major new transport corridor with its associated infrastructure such as signage, lighting, bridges and embankments, into a largely rural area. The new road corridor and junction infrastructure associated with Route 4 WSL would impact on locally, regionally and nationally valued features including scheduled monuments and listed buildings.

# **Annex 7 – Water Worksheet**

### Annex 7: Water Environment Impacts Worksheet

#### Route 4 WSL Bored

Route 4 WSL Bored  Description of study area/	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
summary of potential impacts	rey chilifornia resource	reutites	quanty	Oddie	nunty	Substitute - ubinty	Importance	magnitude	oigiiiioanee
Study area: River Thames	•								
Potential Impacts: Morphological and hydrodynamic changes to the River Thames due to river crossing	River Thames Estuarine/ transitional waters (WFD Water Body Thames Middle) ID No: GB530603911402	products / recreation / aesthetics / cultural heritage /	High Recommended Marine Conservation Zone. Heavily modified water body at Moderate Ecological Potential and failing Chemical Status. Important river of national significance with commercial and social value,	Regional / National (excludes biodiversity considerations)	Rare	Not feasible	Very High	Negligible	Lowsignificance
Potential Impacts: Routine runoff and spillage risk during operation of the new road		value to economy / navigation	including depository for effluent discharges, abstraction of water supply, recreation and, navigation. South Thames Estuary and Marshes SSSI and Ramsar site to south					Negligible Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant
Study Area: Mardyke									
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	WFD Water body ID GB106037028030	Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Moderate Ecological Potential. Target Good Ecological Potential by 2027 Water available for abstraction licensing, subject to limitations ( Roding Beam Ingrebourne and Mardyke CAMS)	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	Slight adverse Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								(Moderate adverse)  Negligible (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke (East Tributary- R8) WFD water body ID GB106037028070	Water supply / biodiversity / transport & dilution waste products / recreation	Low Waterbody currently at Poor Ecological Potential. Target Good Ecological Potential by 2027 Water available for abstraction licensing, subject to limitations ( Roding Beam Ingrebourne and Mardyke CAMS)	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	(Moderate adverse) (Larger tributary crossing) Slight adverse Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant (Low significance)
Potential Impacts: Routine runoff and spillage risk during operation of the new road								(Moderate adverse)  Negligible (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke (West Tributary) R9 WFD water Body ID GB106037028080	Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Moderate Ecological Status. Target Good Ecological Status by 2027 Water available for abstraction licensing, subject to limitations ( Roding Beam Ingrebourne and	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	Slight adverse Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road			Mardyke CAMS)					(Moderate adverse) Negligible (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke and Fobbing (R11) WFD water Body ID GB106037027970 Includes East Tilbury main drains	Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Moderate Ecological Potential. Target Good Ecological Potential by 2027 Water available for abstraction licensing, subject to limitations ( Roding Beam Ingrebourne and Mardyke CAMS)	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	Slight adverse Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								(Moderate adverse)  Negligible (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Study Area: Thames and Medway	Canal	I	I	1	<u> </u>	1	1		-
Potential Impacts: Morphological and hydrodynamic changes to the River Thames due to river crossing	Thames and Medway Canal (Ca18) (GB70610011)	Biodiversity / transport & dilution waste products /recreation / navigation (potential)	Medium (biodiversity evaluated separately) Thames and Medway Canal good potential, no other water quality data available at this stage. Could support protected ecological species. It is not known whether these water bodies have any intrinsic social or economic value. Not currently used for navigation. Appraisal on water environment not biodiversity	water body status)	Moderate	Limited feasibility	Medium	Negligible Assumes bored tunnel section has no impact on surface water courses	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								Negligible Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted. Note: Best practice drainage design precludes discharge to canals	Insignificant
Study Area: Minor watercourses a	and drainage ditches at South T	names Estuary and Marshes	(excluding Thames and Medway cana	ai)					
Potential Impacts: Morphological changes to minor watercourses and drainage networks	Minor water courses and drains of Shorne, Eastcourt, Great Clane Lane and Filborough Marshes. South Thames Estuary and Marshes SSSI and Ramsar site.	Biodiversity / recreation / amenity	Medium Could support protected ecological species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity	Local	Common	Limited feasibility	Medium	Negligible Assumes bored tunnel section has no impact on surface water courses	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								Negligible Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant
Study Area: Minor watercourses	and drainage ditches north of the	he River Thames (see also Ma	ardyke water body)						
Potential Impacts: Morphological changes to drainage networks	Minor watercourses and drainage ditches at East Tilbury Marshes	Biodiversity / recreation / amenity	Medium Could support protected ecological species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity	Local	Common	Limited feasibility	Medium	Slight adverse Assumes watercourse crossings and or displacement includes appropriate mitigation	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road								(Moderate adverse) Negligible Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant Low significance
Study Area: Lakes and ponds	<u> </u>	T	Γ	I	T	1	1	T	
Loss of or other physical impact on standing water bodies  Potential Impacts: Routine runoff	Standing water features (natural and man made) on land to N and S of River Thames including ponds and lakes and standing water in marsh areas	Biodiversity / recreation / amenity / water supply (small reservoirs and dams)	Low - Medium Could support protected ecological species. Some reservoirs and local (largely) agricultural water supplies	Local	Common	Limited feasibility	Low	Negligible: No significant standing waters crossed or intercepted.  Negligible:	Insignificant
and spillage risk during operation of the new road								Assumes no drainage to standing water in accordance with best practice	Insignificant

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
Study Area: Groundwater north of	of River Thames	<u> </u>	<u> </u>		<u> </u>		<u> </u>		
	South Essex Thurrock Chalk (GB40601G401100)	WFD water body status; water supply / resources; groundwater dependent ecosystems; groundwater flow / quality	(Linford / East Tilbury)	Regional (ref WFD water body status)	Rare (CAMS shows restricted water availability)	Not feasible	High (based on resource availability, WFD target)	(Moderate adverse) Depends on whether permanent structures and or permanent dewatering (including at portal) impact groundwater flow Slight adverse with mitigation. Assumes any drainage to ground managed in accordance with best practice	Low significance (significant)
Potential Impact: Impact on groundwater quality from potentially polluting surface activities / highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels and tunnel portals (if required) or disruption to natural groundwater	Essex gravels (GB40503G000400)	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Local commercial /industrial/agricultural licenced supplies	Regional (ref WFD water body status	Moderate	Not feasible	Medium	Negligible - slight adverse Assumes at grade road would not significantly impact groundwater and cuttings have minor impact on shallow groundwater. Drainage to ground managed in accordance with best practice. No exposure of this formation at Thames crossing	Insignificant
flow by underground structures. Long term impacts from mobilisation of leachates from contaminated land / old landfill	South Essex Lower London Tertiaries (G16) (GB40602G401000)	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium - low WFD water body status (current poor, target good)	Regional (ref WFD water body status	Moderate	Not feasible	Medium	Negligible: Little exposure of this formation Assumes any drainage to ground managed in accordance with best practice	Insignificant
	Shallow groundwater in alluvium, gravels and other superficial deposits (non WFD water bodies)	Groundwater dependant ecosystems (biodiversity); local water supply (agriculture)	Low	Local	Common	Not feasible	Low	Slight to moderate adverse. Depends on whether permanent structures and or permanent dewatering (including at portal) impact shallow groundwater flow Assumes any drainage to ground managed in accordance with best practice. Also assumes any landfill leachate appropriately managed	Insignificant
Study Area: Groundwater south	of River Thames			1	1	<b>r</b>	1		_
Potential Impact: Impact on groundwater quality from potentially polluting surface activities/ highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels and tunnel portals (if required) or disruption to natural groundwater flow by underground structures	North Kent Medway Chalk WFD Water body ID GB40601G500300	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Local commercial /industrial / agricultural licenced supplies	Regional (ref WFD water body status	Rare (CAMS shows restricted water availability)	Not feasible	High (based on resource availability, WFD target)	(Moderate adverse) Depends on whether permanent structures and or permanent dewatering (including at portal) impact groundwater flow Slight adverse with mitigation. Assumes any drainage to ground managed in accordance with best practice	Low significance (significant)
Potential Impact: Impact on groundwater quality from potentially polluting surface activities / highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels (if required) or disruption to natural groundwater flow by underground structures. Derogation of water in SSSI	Shallow groundwater (terrace gravels/ alluvium) feeding South Thames Estuary and Marshes SSSI	Groundwater dependant ecosystems (biodiversity); local water supply (agriculture)	Low (Ramsar / SSSI covered by blodiversity)	Local (National / International value covered by biodiversity)	Common	Not feasible	Low	Slight adverse Bored tunnel would pass beneath any shallow aquifer north of portal but may be impacted by long term dewatering at portal. Assumes any drainage to ground managed in accordance with best practice	Insignificant
Study Area: River Thames Flood 2	Zone 2/3 and associated defence	es	Т	1	I	I	I		I
Potential Impacts: Direct risk of flooding to highway from watercourse or tidal source (Thames)	River Thames crossing route	Transport link - improves efficiency of existing network	High	Regional	Moderate	Feasible (alternative crossing locations)	High	Slight adverse - portals and approaches off (defended floodplain) crossing closures due to flood conditions unlikely, further mitigation through design and integrated defences	Low significance
Potential impacts: Impedance of flood flows in River Thames channel due to crossing resulting in obstruction to flow	River Thames channel	Conveyance of flood flows	High - managed watercourse draining large upstream catchment	Local (immediate vicinity of crossing and City of London upstream)	Moderate	Not feasible	High	Negligible (bored tunnel would not interact with Thames channel flows)	Insignificant
Potential Impacts: Loss of flood storage volume (including loss through impedance of flood flows) due to the development (e.g. embankments, cuttings) or permanent spoil disposal sites leading to increased flood risk	River Thames floodplain	Conveyance and storage of flood flows: Mostly defended floodplain at present in vicinity of proposed route.  TE2100 Policy P4 implies improved defences in the future will ensure route remains in the defended floodplain	Medium - significant potential storage volume but not currently used for flood storage as the natural floodplain is defended	Local	Moderate	Feasible: Loss of (defended) floodplain storage substitutable	Medium (not currently used for flood storage)	Slight adverse: Assumes minimal loss of floodplain storage within defended River Thames floodplain	Insignificant
Potential impacts: Increase in flood risk by affecting existing flood defence or by preventing future flood defence development (e.g. actions under Thames Estuary TE 2100 planning)	River Thames flood defences	Protection of property/assets from flooding	High - provides protection for large urban area	Local	Moderate	Not feasible: Unlikely to be substitutable	High	Slight adverse: Assumes minimal loss of floodplain storage within defended River Thames floodplain	Insignificant
Study Area: Mardyke Flood Zone	2/ 3 and associated defences			•	•	•	•		•
Potential Impacts: Direct risk of flooding to highway from watercourse or tidal source (Mar Dyke)	River Thames crossing route	Transport link - improves efficiency of existing network	High	Regional	Common	Feasible (alternative crossing locations)	High	(Moderate Adverse) Slight adverse (mitigation available, design to manage flood risk - defended floodplain)	Low significance (Significant)
Potential Impacts: Loss of flood storage volume (including loss through impedance of flood flows) due to the development (e.g. embankments, cuttings) or permanent spoil disposal sites leading to increased flood risk	Mar Dyke floodplain	Conveyance and storage of flood flows: Defended floodplain at present in vicinity of proposed route.  TE2100 Policy P4 implies improved defences in the future will ensure route remains in the defended floodplain	Medium - potential flood storage shown in vicinity of route (EA flood Map) but shown as defended flood plain	Local	Common	Feasible: Loss of (defended) floodplain storage substitutable	Low	(Moderate adverse) -potential to increase flood risk upstream for mostly rural area.  Slight adverse with mitigation - where crossings span flood plain	Low significance (Significant)
Potential Impacts: Risk of afflux flooding (upstream) due to crossing of watercourse or land drain	Mar Dyke channel	Conveyance of flood flows	High - river channel shown (EA Flood Map) to convey flood flows at least up to 100-yr return period	Local	Moderate	Not feasible	High	(Moderate adverse) -potential to increase flood risk upstream for mostly rural area.  Slight adverse with mitigation - where crossings span flood plain	Low significance (Significant)
Potential impacts: Increase in flood risk by affecting existing flood defence or by preventing future flood defence development (e.g. actions under Thames Estuary TE 2100 planning)	Mar Dyke flood defences	Protection of property/assets from flooding	Low? - none shown on EA floodmap in vicinity of route	Local	Moderate	n/a - no defences shown (EA Flood map) in vicinity of proposed route	n/a	n/a - no defences shown (EA Flood map) in vicinity of proposed route	Insignificant - no defences shown (EA Flood map) in vicinity of proposed route

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance		
Study Area: Area surrounding Main Rivers, Ordinary Watercourses, land drains and ditches, including marshes											
Potential Impacts: Risk of afflux		Drainage of surface water,	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	Low	(Moderate adverse) (potential increase in flood risk). Slight adverse to negligible with mitigation	Insignificant Low significance		
Potential Impacts: Risk of increased runoff to watercourse or land drain causing increase in flood risk from watercourse			Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	Low	(Moderate adverse) (potential increase in flood risk). Slight adverse to negligible with mitigation	Insignificant Low significance		
Potential Impacts: Risk of flooding resulting from change in watercourse/drain flow regime due to morphological changes for development	As above	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	Low	(Moderate adverse) (potential increase in flood risk). Slight adverse to negligible with mitigation	Insignificant Low significance		
Study Area: Entire route.	•	1	•	•	•	•	•		•		
Potential Impacts: Risk of flooding from overland surface water flows (surface water "pluvial" flooding)	Various floodplains and surface water drainage areas		Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	(Moderate adverse) (potential increase in flood risk) Slight adverse after mitigation	Insignificant Low significance		
Potential Impacts: Risk of flooding from groundwater	Various floodplains and surface water drainage areas		Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	(Moderate adverse) (potential increase in flood risk) Slight adverse after mitigation	Insignificant Low significance		
Potential Impacts: Risk of flooding from drains, sewers, and water mains	Various floodplains and surface water drainage areas	Flood risk: People and property	Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	(Moderate adverse) (potential increase in flood risk) Slight adverse after mitigation	Insignificant Low significance		

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toding, Beam, Ingrebourne and Mardyke Abstraction Licensing Strategy (CAMS) Environment Environment Agency Website: "Whats is nyour backyard" Thames Estuary 2100. TE2100 Plan. Environment Agency. 2012 Thurrock Surface Water Management Plan (SWMP), URS. 2013. Trameside Surface Water Management Plan (SWMP), JBA. 2013. Srentwood Surface Water Management Plan (SWMP), JBA. 2015. South Essex Catchment Flood Management Plan (CFMP). Environment Agency. 2009. Horth Kent Rivers Catchment Flood Management Plan (CFMP). Environment Agency. 2009. Highways Agency Drainage Data Management System (HA DDMS)

#### **Summary Assessment Score**

(Post mitigation) Moderate Adverse impacts

# **Qualitative Comments**

Note 1: Risks from construction are only considered where they may have a permanent impact on the water environment once construction is completed.

Note 2: Impacts on biodiversity may occur as a result of changes in water courses, river morphology, sedimentation, water quality and/or flow. Impacts on habitats / ecosystems / flora / fauna are covered separately under biodiversity and not included here to avoid "double counting"

Note 3: For some features, the magnitude of impacts is shown without mitigation (bold red font in parentheses) and with mitigation (bold, the convention for webTAG assessment). In these cases significance of effect is shown both without (red font in parentheses) and with mitigation

Surface Water: The bridge crossing over the Thames will need to be developed to minimise impacts on river morphology from the bridge, although these are expected to be relatively localised with small increases inflow velocity within +/-2000m and there is little impact on HWL. Navigation will be affected by the obsiding of the piers and bank structures, but the design will ensure main navigable channels remain relatively unaltered. The bored tunnel would have little impact on the quality or morphology of the River Thames. Assuming the current bed profile is restored post construction, impacts from the immersed tunnel would have little impact on the quality or morphology of the River Thames. Assuming the current bed profile is restored post construction, impacts from the immersed tunnel would have little impact on the quality or morphology of the River Thames. Assuming the current bed profile is restored post construction, impacts from the immersed tunnel would have little impact on the quality or morphology of the River Thames. Assuming the current bed profile is restored post construction, impacts from the immersed under the quality or morphology of the River Thames. Assuming the current bed profile is restored post construction, impacts from the immersed under the quality or morphology of the River Thames. Assuming the current bed profile is restored post construction, impacts from the immersed under the quality or morphology of the River Thames. Assuming the current bed profile is restored post construction, impacts from the immersed under the quality or morphology of the River Thames. Assuming the current bed profile is restored post construction, impacts from the immersed under the quality or morphology of the River Thames. Assuming the current bed profile is restored post construction, impacts from the immersed under the quality or morphology of the River Thames. Assuming the current bed profile is restored post construction, impacts from the immersed the quality or morphology of the River Thames. Assuming the current bed profile is restored to the little impact on the quality of the quality or morphology of the River Thames. Assuming the current bed profile is restored to the quality of the River Thames. Assuming the current bed profile is restored to the quality of the River Thames. Assuming the current bed pr

mpacts on the Mardyke (WFD water body) will depend on the nature of the crossings adopted, fully spanning and viaduct crossings are likely to have only slight impacts, where smaller channel crossings are employed, mitigation is generally available to reduce impacts to slight adverse

mpacts on the Thames and Medway canal (WFD water body) depend on the construction methods adopted, a cut and cover tunnel through this area (immersed tunnel option) would lead to a loss of part of the water body and could impact its WFD status, however if mitigation in the form of full canal restoration post onstruction is adopted, these impacts could be reduced from moderate (or even large) adverse to slight adverse

red mostly slight adverse once mitigation is applied, although pending a full understanding of the impacts of the construction of the immersed tunnel, the impacts on the Tidal waters of the Thames remain moderate adverse

froundwater: Issues with rising groundwater levels have been identified regionally although it is understood these are less problematic in this immediate area. A tunnel crossing will require temporary dewatering during construction and may need longer term dewatering at portals. Larger groundwater resources an oublic supplies, primarily from the Chalk at depth are unlikely to be impacted, although there may be some impact on local licensed commercial/ industrial / agricultural supplies from shallow groundwater in the gravels, these are not thought to be significant. Impact at source protection zones may be mitigated by adopting appropriate construction and drainage practices. Through possible impacts on groundwater quality and flow from the construction of a long bored tunnel there may be residual slight adverse impacts on completion.

WFD status: A Water Framework Directive assessment will be required due to the potential for direct effects on biological, chemical and physical WFD parameters for both surface waters (Thames, Mardyke, Thames and Medway canal) and WFD groundwater bodies (north and south of the river). With appropriate nitigation, it is not anticipated that the River Thames crossing or impacts on the Mardyke or groundwaters will lead to a reduction on WFD status or will prevent these water bodies reaching good status or potential in the future. For the assessment, it is generally assumed that the target 2027 status of good applies ven though current status of most water bodies is poor.

# lood Risk

Tribus in lass.

The bridge option has some potential to increase flood risk in the River Thames channel upstream due to piers and other structures impeding channel conveyance. The bored and immersed tube tunnels would have no impact on channel conveyance. The impact of the bridge on channel conveyance is likely to be mitigated through design (adequate span, minimise pier dimensions).

Funnel options would be at higher risk of route closure due to high flood levels (i.e. through breach or overtopping of existing defences).

All bridge and tunnel options would require a design that integrates with (or does not compromise) TE2100 River Thames flood defence plans. At the River Thames flood defence locations the current Route 4 bridge design indicates the bridge would be significantly higher than the flood defences south of the River Thames which are located at the approximate transition between a raised viaduct and suspended bridge (no defences are shown on the north bank of the River Thames as here high ground forms the defence line). The Route 4 bored tunnel and immersed tunnel options have portals set back from the River Thames (south embankment) flood defences. However, there would still be a need to consider the impact of a tunnel on flood defences e.g. due to interference with flood defence piling by the tunnel.

TE2100 policies at the location of the Route 4 crossing are:

P4 for Policy Unit Purfleet, Grays and Tilbury, north of the River Thames (take further action to keep up with climate change and land use change so that flooding does not increase)
P3 for Policy Unit Purfleet, Grays and Tilbury, north of the River Thames (take further action to keep up with climate change and land use change so that flooding does not increase)
P3 for Policy Unit East Tilbury and Mucking Marshes, north of the river Thames (continue with existing or alternative actions to manage flood risk)
P3 for Policy Unit North Kent Marshes, south of the River Thames (continue with existing or alternative actions to manage flood risk). TE2100 includes an action to provide a secondary defence to Gravesend to protect from flooding from the tidal River Thames from the east. There is an opportunity for the Route 4 road embankment to provide this structural defence.

CFMP policies for Route 4 south of the River Thames (North Kent Rivers CFMP) are P3 for the North Kent Marshes Policy Unit (areas of low to moderate flood risk where we are generally managing existing flood risk effectively - i.e. no anticipated increase in FRM measures) and P1 for the North Kent Downs Policy Unit (areas of little or no flood risk where we will continue to monitor and advise).

CFMP policies for Route 4 north of the River Thames (South Essex CFMP - Thames Urban Tidal Policy Unit) are P4 for the Thames Urban Tidal Policy Unit (take further FRM actions to keep pace with climate change) and P6 for the Upper Mardyke Policy Unit (store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits). Route 4 crosses the Mardyke floodplain near the upstream extent of Mardyke catchment. Whilst this may present a flood risk to the proposed road and the potential for the road to increase flood risk upstream, there is also potential for the road embankment to be designed to hold back flood water and hence alleviate flood risk downstream (consistent with South Essex CFMP Policy).

Thurrock SWMP (URS 2013) identifies Critical Drainage Areas (CDAs). Route 4 passes through CDA\_010a and CDA\_010b (located west of Stanford-le-Hope) and CDA\_011 (located in the upper Mardyke catchment in and around Bulphan. For these areas there is potential for the road design to act to reduce local flood risk e.g. by providing attenuation of road drainage, providing flood storage directly upstream of the road. None of these CDAs are crossed by the proposed Route 4. Thameside SWMP (JBA 2013) is a Stage 1 SWMP and does not provide much detail in relation to the Route 4 route alignment and implications for local flood risk

The surface water drainage strategy / design (in accordance with HE guidance and standards) should be agreed with the relevant Lead Local Flood Risk Authorities. It is likely this will require that surface water runoff from the proposed crossing does not exceed existing rates (using SUDs where feasible)

# **Annex 8 - Noise Worksheet**

Annex 8: Noise Worksheet Route 4 WSL Bored Tunnel APPRAISAL - NOISE POLLUTION Present value base year: 2010 2015 Current year: 2025 Proposal Opening Year: Average Household Size: 2.36 Project (Road or Rail): Road No. of households experiencing 'without scheme' & 'with scheme' noise levels (given in dB<sub>Leq</sub>) in Opening Year With 45-47.9 | 48-50.9 | 51-53.9 | 54-56.9 | 57-59.9 | 60-62.9 | 63-65.9 | 66-68.9 | 69-71.9 | 72-74.9 | 75-77.9 | 78-80.9 Without scheme <45 45-47.9 146 174 9571 1210 331 4544 18 13 48-50.9 51-53.9 1351 5078 225 4652 89 39 17 1267 0 54-56.9 57-59.9 60-62.9 142 0 703 2498 146 29 0 711 154 0 63-65.9 17 2768 469 41 1751 69 245 837 72-74.9 75-77.9 0 0 0 49 No. of households experiencing 'without scheme' & 'with scheme' noise levels (given in dB<sub>Leq</sub>) in 15th Year After Opening 45-47.9 | 48-50.9 | 51-53.9 | 54-56.9 | 57-59.9 | 60-62.9 | 63-65.9 | 66-68.9 | 69-71.9 | 72-74.9 | 75-77.9 | 78-80.9 Without scheme <45 <45 45-47.9 48-50.9 51-53.9 54-56.9 57-59.9 1190 18 1266 86 39 204 3580 13 157 947 60-62.9 63-65.9 66-68.9 69-71.9 625 140 84 1807 61 72-74.9 75-77.9 90 33 78-80.9 81+ £13,358,865 Net Present Value of Noise of Proposal \*positive value reflects a net benefit (i.e. noise reduction) (60 Year Period) Estimated Population Annoyed (Do-Minimum): 12418 Estimated Population Annoyed (Do-Something): 12091 Net Noise Annoyance Change in 15th Year After -327 sitive value reflects an increase in people annoyed by noise Opening (no. of people):

# Appendix 7.4 Appraisal Summary Table Route 2 ESL (BT)

Appraisal Summary Table Route 2 ESL (BT)

Annex 1: TEE table

Annex 2: PA table

Annex 3: AMCB table

Annex 4: Biodiversity worksheet

Annex 5: Historic environment worksheet

Annex 6: Landscape/ townscape worksheet

Annex 7: Water worksheet

Annex 8: Noise worksheet

Appra	aisal Summary Table	Route 2, Eastern Southern Link, Bored Tunnel	Date produced:	22	Jan 2016	l	(	Contact:
	Name of scheme:	Route 2 Bored Tunnel with Eastern Southern Link - Core Growth, Central Case costs	, Current values o				Name	Chris Taylor
D	escription of scheme:	New Dual 2 lane trunk road (70mph) from M25 between J29 and J30, linking with A10	089, crossing the			itional lane for	Organisation	Highways England
		future proofing, 2km to the east of Gravesend with an easterly southern link to the M2	l				Role	Project Sponsor
	Impacts	Summary of key impacts		0	Asses	sment	Non-to-	Distributional
				Quantitative		Qualitative	Monetary £(NPV)	Distributional 7-pt scale/
							2()	vulnerable grp
m	Business users & transport providers	Large time savings estimated for business travellers, including freight, due to reduced congestion and improved connectivity. Small vehicle operating cost benefits would also occur due to reduced		ney time changes				
Economy	providers	congestion. Small user charge disbenefits as there will be charges on the new crossing.	0 to 2min	ourney time chang 2 to 5min	ges (£) > 5min	N/A	£3,257m	Not appraised yet
Eç			-£403m	£1,109m	£2,070m			
	Reliability impact on Business users	The option would improve journey time reliability for journeys across the Thames by providing a completely alternative route, and relieving congestion on the existing Dartford Crossing.		N/A		N/A	£107m	
	users	completely alternative route, and relieving congestion on the existing Dartiota Crossing.		IVA		IN/A	2107111	
	Regeneration	Not appraised using WebTAG, but see complementary wider economic modelling		N/A		N/A	N/A	
	Wider Impacts	Wider Impact (WI) benefits are more than double those for Route 1. 80% of WI benefits are from the agglomeration of business activities.	33 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -					
						N/A	£1,626m	
			Labour supply imp	oacts	£2m			
ntal	Noise	There is a small net benefit. Whilst there are reductions in noise along the M25/ A282 corridor, there are increases in noise for communities along the new route.	114 people would b	enefit based on an es	timated 12,418			
mer		there are increases in noise for communities along the new route.			nout scheme situation	N/A	£4m	Not appraised yet
Environmental			decreasing to 12,30	04 people in the with s	cneme situation.			
n <u>i</u>	Air Quality	All properties which are predicted to exceed or are at risk of exceeding the AQSO in the without Scheme situation would experience an improvement in air quality with the Scheme.	Two of the receptors	s modelled are predic	ted to exceed the			
ш		and the state of t		cheme (representing nese receptors experie		N/A	N/A	Not appraised yet
			compared to the wit	hout scheme. The sc	heme is not	IN/A	IN/A	Not appraised yet
			predicted to lead to	any new exceedence	S.			
	Greenhouse gases	The option is forecast to result in an increase in both non-traded and traded carbon emissions	Change in non-trade	ed carbon over 60y (C	6,213,068			
					tonnes 16,978	N/A	-£284m	
			Change in traded ca	arbon over 60y (CO2e	tonnes			
	Landscape	A new road would adversely affect the landscape character including in the vicinity of Tilbury, Grays and Chadwell St Mary, Shorne and Shorne Ridgeway, green belt and intrude into the						
		AONB. A bored tunnel would have limited impact on the character of the Thames corridor		N/A		Large Adverse	N/A	
		although new road infrastructure could potentially be visible from the AONB.						
	Townscape	See Landscape entry						
			N/A		N/A	N/A		
	Historic Environment	Direct physical impacts to two scheduled monuments, one conservation area and two Grade II						
		listed buildings. Potential impacts to the setting of a number of designated heritage assets and direct effects on non-designated archaeological remains within the scheme footprint.		N/A		Moderate Adverse	N/A	
		unect enects on non-designated archaeological remains within the scheme loophint.				Auverse		
	Biodiversity	Potential indirect effects on the Thames Estuary & Marshes SPA (loss of functionally linked land). Impacts on LWSs & areas of BAP Priority Habitat. Direct loss of ancient woodland at Great				Very large		
		Crabbles Wood SSSI and Court Wood.		N/A		Adverse	N/A	
	Water Environment	Impacts on Mardyke and crosses the Tilbury Flood Storage Area.						
				N/A		Slight Adverse	N/A	
Social	Commuting and Other users	Compared to business users, relatively small time savings arise for commuters and other users due to reduced congestion and improved connectivity. Vehicle operating cost disbenefits due to		ney time changes				
So		increased travel and lack of perception by non-business travellers. Small road user charge	0 to 2min	2 to 5min	yes (£) > 5min	N/A	£300m	Not appraised yet
		disbenefit as there will be charges on the new crossing	-£304m	£366m	£629m			
	Reliability impact on Commuting and Other users	The option would improve journey time reliability for journeys across the Thames by providing a completely alternative route, and relieving congestion on the existing Dartford Crossing.		N/A		N/A	£39m	
		g and garages and a second		IN/A		IN/A	23911	
	Physical activity	The option has no impact on walking and cycling		N/A		N/A	N/A	
	Journey quality	The route would provide a new high standard free-flowing solution and would relieve traffic from the existing crossing at Dartford and other routes including the A2. The ESL is the only option						
		which provides a motorway to motorway link, connecting the M2 with the M25. Route 2 uses the		N/A		Moderate	N/A	
		A1089 (the access to Tilbury Port) for part of the route, which will involve mixing of strategic traffic with local traffic which has a high percentage of HGVs				Beneficial	. 1// 1	
	Accidents	DfT's COBALT tool has been used to appraise accidents and shows a net increase in the number and value of accidents across the road network, as a result of this being a new route. However a						
		separate appraisal has also been undertaken using actual accident data across the road network,		new route 2,319 additi years, including 31 fa		N/A	-£118m	Not appraised yet
		which shows that the option will lead to a reduction in the rate of accidents (as measured by the Fatal and Weighted Injury rate per billion vehicle kilometres).		es and 3,259 slight car		,,,		
	Security	Lighting will be provided in accordance with Highways England's TA49/07 standard for new and replacement lighting on the strategic road network	N/A		Slight Adverse	N/A	Not appraised yet	
	Access to services	Not appraised because this criteria relates to public transport options	N/A		N/A	N/A	N/A	
	Affordability	The appraisal has assumed the same charges for the new crossing in real terms as those at Dartford Crossing today	N/A		Neutral	N/A	Not appraised yet	
	Severance	Safe re-provision will be made for all existing rights of way for pedestrians and cyclists that cross						
		the new trunk road. There will be permanent severance of some community facilities and public natural assets and mitigation options need to be developed		N/A		Slight Adverse	N/A	Not appraised yet
		Takana. accord and minganon opinons mood to be developed						
()	Option and non-use values	Not appraised because this criteria relates to public transport options		N/A		N/A	N/A	
Public counts	Cost to Broad Transport Budget (2010 Present Values)	The impacts on the transport budget would be twofold; the capital cost of construction and the subsequent maintenance and operating cost of the infrastructure offset by revenue collected from	Investment costs: £ Operating costs £28	*				
Pu		the additional user charges	Operator revenue £	816m (a benefit, offse	etting cost over the	N/A	£1,670m	
A	Indicat To: Down	A toy handii to control gay are most in formant and a second of the seco	longer term)					
	Indirect Tax Revenues	A tax benefit to central government is forecast as a result of additional traffic using the road network and particularly the Dartford Crossing		N/A		N/A	£585m	
	•	• • •				ı		

# Annex 1 - TEE Table

Annex 1: TEE Table

### Economic Efficiency of the Transport System (TEE): Route 2/ESL

Non-business: Commuting	ALL MODES		ROAD		BUS and COACH	RAIL		OTHER
User benefits	TOTAL		Private Cars and L	.GVs	Passengers	Passengers		
Travel time	£91,175,130			£91,175,130				
Vehicle operating costs	-£59,213,842			-£59,213,842				
User charges	£123,062			£123,062				
During Construction & Maintenance	£0							
COMMUTING	£32,084,350 (1a	a)		£32,084,350				
Non-business: Other	ALL MODES		ROAD		BUS and COACH	RAIL		OTHER
User benefits	TOTAL		Private Cars and L	.GVs	Passengers	Passengers		
Travel time	£600,605,538			£600,605,538				
Vehicle operating costs	-£330,703,841			-£330,703,841				
User charges	-£1,830,523			-£1,830,523				
During Construction & Maintenance	£0							
NET NON-BUSINESS BENEFITS: OTHER	£268,071,174 (1b	)		£268,071,174				
Business								
Business				Business Cars &				
<u>User benefits</u>			Goods Vehicles	LGVs	Passengers	Freight	Passengers	
Travel time	£2,776,293,744		£684,996,652	£2,091,297,092				
Vehicle operating costs	£602,235,975		£405,443,250	£196,792,725				
User charges	-£121,120,400		-£59,396,760	-£61,723,639				
During Construction & Maintenance	£0							
Subtotal	£3,257,409,319 (2)		£1,031,043,142	£2,226,366,178				
Private sector provider impacts						Freight	Passengers	
Revenue								
Operating costs								
Investment costs								
Grant/subsidy								
Subtotal	£0 (3)							
Other business impacts						-	-	
Developer contributions	(4)							
NET BUSINESS IMPACT	£3,257,409,319 (5)	= (2) +	(3) + (4)		•			
TOTAL								
Efficiency Benefits (TEE)	£3,557,564,844 (6) =	= (1a) -	+ (1b) + (5)					
	Notes: Benefits appear a			osts appear as neg	ative numbers.			
			ed present values, in					

# Annex 2 - PA Table

# Annex 2: Public Accounts (PA) Table

### **Route 2 ESL Bored Tunnel**

	ALL MODES	ROAD	BUS and COACH	RAIL	OTHER
Local Government Funding	TOTAL	INFRASTRUCTURE	_		
Revenue					
Operating Costs					
Investment Costs					
Developer and Other Contributions					
Grant/Subsidy Payments					
NET IMPACT	£0 (7)				
Central Government Funding: Transpo	<u>rt</u>				
Revenue	-£815,628,635	-£815,628,63	5		
Operating costs	£283,299,984	£283,299,984	4		
Investment Costs	£2,202,464,880	£2,202,464,880			
Developer and Other Contributions					
Grant/Subsidy Payments					
NET IMPACT	£1,670,136,229 (8)	£1,670,136,229	9		
Central Government Funding: Non-Trai	nsport				
Indirect Tax Revenues	-£584,916,674 <i>(9)</i>	-£584,916,674	4		
TOTALS					
Broad Transport Budget	£1,670,136,229 (10) =	(7) + (8)			
Wider Public Finances	-£584,916,674 (11) =	(9)			
	Notes: Costs appear as pos	itive numbers, while revenues and 'D	eveloper and Other Contributions' appear	as negative numbers.	
	All entries are discounted pr	resent values in 2010 prices and value	es.		

# Annex 3 - AMCB Table

## Annex 3: AMCB Table

### **Route 2 ESL Bored Tunnel**

Analysis of Monetised Costs and	Benefits	
	04.005.005	Luo
Noise	£4,205,925	[]`
Local Air Quality		(13)
Greenhouse Gases	-£284,000,920	Į
Journey Quality		(15)
Physical Activity		(16)
Accidents	-£118,064,600	
Economic Efficiency: Consumer Users (Commuting)	£32,084,350	(1a)
Economic Efficiency: Consumer Users (Other)	£268,071,174	(1b)
Economic Efficiency: Business Users and Providers	£3,257,409,319	(5)
Wider Public Finances (Indirect Taxation Revenues)	£584,916,674	- (11) - sign changed from PA table, as PA table represents costs, not benefits
Present Value of Benefits (see notes) (PVB)	£3,744,621,923	(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)
Broad Transport Budget	£1,670,136,229	(10)
Present Value of Costs (see notes) (PVC)	£1,670,136,229	(PVC) = (10)
OVERALL IMPACTS		_
Net Present Value (NPV)	£2,074,485,694	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	2.2	BCR=PVB/PVC
together with some where monetisation is in prospect.	re regularly or occasionally presented in monetised form in . There may also be other significant costs and benefits, so the analysis presented above does NOT provide a good ms.	ome of which cannot be

# **Annex 4 – Biodiversity Worksheet**

## Annex 4: TAG Biodiversity Impacts Worksheet

### Route 2 ESL Bored

Route 2 ESL Bored		ı						
Ste Area	ep 2  Description of feature/ attribute	Scale (at which	Importance (of attribute)	Step 3 Trend (in relation to target)	Substitution possibilities	Biodiversity and earth	Step 4 Magnitude of impact	Step 5 Assessment Score
Thames Estuary and Marshes Ramsar	Ramsar criterion 2 The site supports one endangered plant species and at least 14 nationally scarce plants of wetland habitats. The site also supports more than 20 British Red Data Book	attribute matters) International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	heritage value Very high - Ramsar Criterion 2	Minor Negative	Slight Adverse
Thames Estuary and Marshes	invertebrates.  Ramsar criterion 5 Assemblages of international importance: Species with peak counts in winter:	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 5	Minor Negative	Slight Adverse
Ramsar	45118 waterfowl (5 year peak mean 1998/99-2002/2003).  Ramsar criterion 6	International	Attribute a qualifying feature of	Unknown at present	Not possible to substitute	Very high - Ramsar	Minor Negative	Slight Adverse
Thames Estuary and Marshes Ramsar	species/populations occurring at levels of international importance (includes species with peak counts in autumn/winter and in spring).		Internationally designated site so very high importance.			Criterion 6		
Thames Estuary and Marshes SPA	Article 4.1 Qualification (79/409/EEC). Over winter the area regularly supports 1% of the population in GB of <i>Circus cyaneus</i> .	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.1 qualification	Minor Negative	Slight Adverse
Thames Estuary and Marshes SPA	Article 4.2 Qualification (79/409/EEC). Over winter the area regularly supports significant populations of a number of wading birds. On passage the area regularly supports 2.6% of the population of Charadrius hiaticula.  Article 4.2 Qualification	International	Attribute a qualifying feature of Internationally designated site so very high importance.  Attribute a qualifying feature of	Unknown at present  Unknown at present	Not possible to substitute  Not possible to substitute	Very high - Article 4.2 qualification  Very high - Article 4.2	Minor Negative  Minor Negative	Slight Adverse Slight Adverse
Thames Estuary and Marshes SPA	(79/409/EEC): An internationally important assemblage of birds. Over winter the area regularly supports 75019 waterfowl (5 year peak mean 21/03/2000).		Internationally designated site so very high importance.	·	·	qualification	Š	Š
Mucking Flats and Marshes SSSI	Botanical interest: Mudifats and Saltmarsh.	National	Attribute a qualifying feature of Nationally designated site so high importance.	Majority Favourable with small area Unfavourable Recovering status.	Not possible to substitute	High - nationally important habitats	Neutral	Neutral
Mucking Flats and Marshes SSSI	Wintering wildfowl and waders.	National	Attribute a qualifying feature of Nationally designated site so high importance.	Majority Favourable with small area Unfavourable Recovering status.	Not possible to substitute	High - nationally important species	Minor Negative	Slight Adverse
South Thames Estuary and Marshes SSSI	Wading birds and other overwintering species (such as short-eared owl).	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining.	Not possible to substitute	High - nationally important birds	Intermediate Negative	Large Adverse
South Thames Estuary and Marshes SSSI	Botanical importance (saltmarsh, freshwater habitats and grazing marshes).	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining.	Not possible to substitute	High - nationally important botany	Minor Negative	Slight Adverse
South Thames Estuary and Marshes SSSI	Invertebrate interest (saltmarsh, freshwater habitats and grazing marshes).	National	Attribute a qualifying feature of Nationally designated site - High importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining.	Not possible to substitute	High - nationally important invertebrates	Minor Negative	Slight Adverse
Shorne and Ashenbank Woods SSSI	Designated Ancient Woodland.	National	Attribute a qualifying feature of Nationally designated site so high importance.	Favourable to Unfavourable Recovering Status.	Not possible to substitute	High - nationally important ancient woodland	Minor Negative	Slight Adverse
Shorne and Ashenbank Woods SSSI	Woodland invertebrates.	National	Attribute a qualifying feature of Nationally designated site so high importance.	Favourable to Unfavourable Recovering Status.	Not possible to substitute	High - nationally important invertebrates	Minor Negative	Slight Adverse
Hangman's Wood and Deneholes SSSI	Remains of medieval chalk mines, provide the most important underground hibernation site for bats in Essex. Brown long eared, Natterer's and Daubenton's.	National	Attribute a qualifying feature of Nationally designated site - High importance.	Favourable	Not possible to substitute, medieval chalk and ancient woodland	High - nationally important for bats and ancient woodland	Neutral	Neutral
Hangman's Wood and Deneholes SSSI	Area of semi-natural habitat in which bats can feed. A relict fragment of ancient woodland, dominated by Pedunculate Oak Ash, Sycamore with occasional Wild Cherry and Elm.	National	Attribute a qualifying feature of Nationally designated site - High importance.	Favourable	Not possible to substitute, medieval chalk and ancient woodland	High - nationally important for bats and ancient woodland	Neutral	Neutral
Great Crabbles Wood SSSI	Botanical importance - broadleaved mixed and yew lowland woodland - designated Ancient Woodland.	National	Attribute a qualifying feature of Nationally designated site - High importance.	Unfavourable - Recovering. The whole area is classified as being in a 'no change' condition due to the lack of forestry and woodland management.	Not possible to substitute ancient woodland	High - nationally important ancient woodland	Major Negative	Very Large Adverse
Cobham Woods SSSI (includes Great Wood - ancient woodland)	Botanical importance - designated Ancient Woodland.	National	Attribute a qualifying feature of Nationally designated site - High importance.	Over 81% of the area is in a 'favourable' or 'recovering' condition. The remaining area is classified as 'no change' as the area is neglected and subject to multiple ownership.	Not possible to substitute ancient woodland plant species without ancient woodland.	High - nationally important botany	Minor Negative	Slight Adverse
Cobham Woods SSSI (includes Great Wood - ancient woodland)	Botanical importance - woodland edge/ arable land plant species.	National	Attribute a qualifying feature of Nationally designated site - High importance.	Over 81% of the area is in a 'favourable' or 'recovering' condition. The remaining area is classified as 'no change' as the area is neglected and subject to multiple ownership.	Not possible to substitute	High - nationally important botany	Minor Negative	Slight Adverse
Cobham Woods SSSI (includes Great Wood - ancient woodland)	Marine and estuarine habitats and	National National	Attribute a qualifying feature of Nationally designated site - High importance.  Attribute a qualifying feature of Nationally	Favourable to Unfavourable Recovering Status.  Marine and estuarine habitats	Not possible to substitute  Not possible to substitute	High - nationally important birds  Very High -	Minor Negative  Neutral	Slight Adverse
Thames Estuary recommended MCZ (on hold)	species.		designated site so high importance.	in the Thames are being degraded through issues such as pollution and climate change.		undesignated site hosting habitats/species of (European) Community interest (annexes 1 & 2, Habitats Directive, 1992).		
	1	1	L	l .	l	1	t	·

Ste Area	ep 2  Description of feature/ attribute	Coole (et which	Importance (of attribute)	Step 3 Trend (in relation to target)	Substitution possibilities	Biodiversity and earth	Step 4 Magnitude of impact	Step 5 Assessment Score
Area	Complex of habitats of value for	Scale (at which attribute matters) Regional	Importance (of attribute)  Attribute of value to local communities, of	Some goals are being	Not possible to substitute	heritage value  Medium - community	Minor Negative	Slight Adverse
Greater Thames Marshes Nature Improvement Area	biodiversity and as a community resource.	riegional	Medium importance.	achieved.	rot possible to substitute	value and extensive area.	Nillioi Negalive	Silgiit Auverse
Court Wood, Shorne (GR01) - includes Starmore Wood and Peartree Wood (ancient woodlands)	Local Wildlife Site Ancient and Ancient Semi-natural Woodland; derelict orchard and semi- improved neutral grassland.	Local	Area of degraded ancient woodland, high importance with a derelict orchard and area of unmanaged semi-improved neutral grassland of limited botanical interest that supports invertebrates.	Much of this woodland has been converted to chestnut but still retains a good diversity of flowering plants, including many ancient woodland indicator species.	Not possible to substitute ancient woodland	High - ancient woodland	Major Negative	Very Large Adverse
Shorne Pasture (GR18)	Local Wildlife Site Grassland, scrub.	Local	Area of unimproved pasture on acid, dry pebbly soils. Supports a herb-rich flora - Low importance.	Unknown - not indicated on Kent Local Wildlife Site schedule.	Soil translocation a possibility	Low - local value grassland and scrub	Neutral	Neutral
Un-named ancient woodland (at centre of M2 J1 interchange)	Ancient Woodland	National	Area of degraded ancient woodland of Low to Medium importance.	Unknown, but likely to be declining due to isolation and impact of poor air quality.	Not possible to substitute ancient woodland	High - ancient woodland	Minor Negative	Moderate Adverse
Un-named ancient woodland (south of M2 J1 interchange, to the west of the M2)	Ancient Woodland	National	Area of degraded ancient woodland of Low to Medium importance.	Unknown - but likely to be declining due to impact of poor air quality given proximity to M2.	Not possible to substitute ancient woodland	High - ancient woodland	Minor Negative	Moderate Adverse
Hangman's Wood and Deneholes - Ancient Woodland	Ancient Woodland	National	Ancient woodland habitat, likely to be of Low to Medium Importance for biodiversity due to small size.	Nationally ancient woodland is being lost or degraded due to habitat loss and environmental factors such as climate change and imported tree pathogens.	Not possible to substitute	High - important ancient woodland	Neutral	Neutral
Priority Habitat - Deciduous Woodland (Disrupted in several places to various degrees - see individual Local Wildlife Sites (below)). Impacts on woodland around Buckland and Brook Farm (north of the East Tilbury Marshes), A126 roundabout near Bretts farm (north of Tilbury), and a small section on A226 south east of Chalk	Priority BAP habitat. Some will be lost/severely impacted.	Local	Medium importance, BAP habitat	Nationally lowland mixed deciduous woodland is declining due to clearance, over grazing, and replanting with non-native species.	Replacement planting and/translocation of habitats a possibility.	Medium - BAP priority habitat	Intermediate Negative	Moderate Adverse
Priority habitat - Coastal Saltmarshes (south of river, as part of Shorne Marshes and Eastcourt Marshes)	Important for cohesion between designated sites and for sustaining populations of wading birds.	National (contiguous with similar habitat of international importance within designated sites).	Importance will be dependant on functioning within who wider network of habitats, likely to be Medium to High Importance.	Likely to be decreasing due to coastal erosion, climate change and development.	Creation of replacement habitat through managed realignment a possibility, but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Neutral	Neutral
Priority Habitat - Intertidal mudflats (particularly northern bank of the river at crossing, down stream of the Thames Estuary and Marshes (Ramsar))	Important for cohesion between designated sites and for sustaining populations of wading birds.	National (contiguous with similar habitat of international importance within designated sites).	Likely to be Medium to High Importance.	Likely to be decreasing due to coastal erosion, climate change and development.	Creation of replacement habitat through managed realignment a possibility, but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Minor Negative	Slight Adverse
Priority Habitat - Coastal and Floodplain Grazing Marsh including freshwater ditches/ponds	Of importance for cohesion between designated sites and for sustaining populations of waterfowl and of value for notable invertebrates and plants.	National (contiguous with similar habitat of international importance within designated sites).	Low to High, dependant on functioning within the wider network of habitats.	Likely to be decreasing due to agricultural improvement, drainage and development.	Replacement habitat creation potentially possible (e.g. managed realignment or creation of freshwater wetland habitats), but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Minor Negative	Slight Adverse
Priority habitat - Traditional Orchards (north of A1089 and east of Orsett - small patch of orchard lining green lane. Also running along M25 east of Upminster where M25 will be widened)	Priority BAP habitat	Local	Traditional Orchards BAP habitat - Medium importance.	Declining due to a loss of sites only partially compensated for by improved management and restoration.	Not possible to recreate mature habitats, replanting and (if possible) translocation of habitats and/or soils a possibility.	Medium - BAP priority habitat	Major Negative	Moderate Adverse
Priority habitat - Wood-pasture and Parkland (adjacent to M2 J1 interchange)	Priority BAP habitat	Local	Wood-pasture and Parkland BAP habitat - Medium importance	Generally believed to be declining nationally. However, there are no reliable statistics on the extent of the overall resource, nor on historical and current rates of loss or degradation of this type of habitat.	Not possible to recreate mature habitats	Medium - BAP priority habitat	Minor Negative	Slight Adverse
Priority habitat - Traditional Orchards (adjacent to the A289 at MZ J1 interchange; on Church Lane and adjacent to the A226 north of Shorne)	Priority BAP habitat	Local	Traditional Orchards BAP habitat - Medium importance	Declining due to a loss of sites only partially compensated for by improved management and restoration.	Not possible to recreate mature habitats, replanting and (if possible) translocation of habitats and/or soils a possibility	Medium - BAP priority habitat	Major Negative	Moderate Adverse
Priority habitat - Deciduous Woodland (adjacent to M2 J1 interchange; Great Crabbles Wood; and along northern edge of the A226 near Church Lane)	Priority BAP habitat	Local	Deciduous Woodland BAP habitat - Medium importance	Nationally lowland mixed deciduous woodland is declining due to clearance, over grazing and replanting with nonnative species.	translocation of habitats	Medium - BAP priority habitat	Minor Negative	Slight Adverse
Blackshots Nature Area (Th34 )	Local wildlife Site - rough grassland and deciduous woodland.	Local	Large area of rough grassland and important invertebrate population, as well as providing potential nesting habitats for birds such as skylark. UK BAP fly species Dorycera graminum found here.	Species rich grasslands are decreasing, unmanaged grassland is likely to be increasing. Nationally deciduous woodland is declining.	Replacement planting a possibility but limited space available.	Medium - BAP priority habitat	Minor Negative	Slight Adverse
Little Thurrock Reedbeds (Th35)	Local wildlife Site. Of importance for cohesion between designated sites and for sustaining populations of birds such as bearded reedling.	Local	BAP habitat. Low to Medium, dependant on functioning within the wider network of habitats.	Increasing nationally	Not possible to substitute	Medium - BAP Habitat of Principal Importance in England.	Minor Negative	Slight Adverse
Terrels Heath (Th36 ) - incudes Chadwell Wood (ancient woodland)	Local wildlife Site with Ancient Woodland.	Local	Terrels Heath is a forest structure dominated by pendunculate Oak ( <i>Quercus robar</i> ). High importance - ancient woodland.	Nationally deciduous woodland is declining due to clearance, over-grazing, and replanting with non-native species.	Not possible to substitute	High - important ancient woodland.	Minor Negative	Moderate Adverse

Ste	ep 2			Step 3			Step 4	Step 5
Area	Description of feature/ attribute	Scale (at which	Importance (of attribute)	Trend (in relation to target)	Substitution possibilities	Biodiversity and earth	Magnitude of impact	Assessment Score
Broom Hill (Th38 )	Local wildlife Site	attribute matters) Local	Hilltop site, developed partly on shallow sand/gravel workings, of interest for its ancient acid-grassland flora. Significant populations of invertebrate species associated including 7 Red Data Book invertebrate specioles such as; the ant Myrmica specioidesand Great Green Buscricket (Tettigonia viridissima).	7 Red Data Book invertebrate species and a number of UK BAP species. Condition unknown.	Not possible to substitute.	heritade value High - undesignated site hosts Red Data Book species.	Minor negative	Slight Adverse
-ytag Brownfield (Th39)	Local Wildlife site	Local	Low to medium importance. Survey work by independent ecological consultants has revealed populations of all four Essex reptiles(Adder, Grass snake, Common Lizard, and Slow-worm) making this one of the more important reptile sites in the borough.	Reptile species in decline in some areas. It is also likely that this site has UK BAP invertebrates given the presence of them on similar habitats in the area. No data currently.	Lytag Brownfield will be temporarily disturbed. Reptile translocation required. Habitat reinstatement a possibility but requires suitable substrate to maintain required pH for habitats to establish.	Low to Medium - Local Wildlife Site.	Minor Negative	Slight adverse
West Tilbury Hall (Th42)	Local wildlife Site	Local	Area of interesting acidic grassland flora. Low importance.	Unknown	Soil translocation a possibility but requires suitable substrate to maintain the required pH for habitats to establish.	Low - Local Wildlife Site	Major Negative	Slight Adverse
West Tilbury Church (Th43)	Local wildlife Site	Local	Area behind the now privately owned church. Ancient grassland. Low to medium importance depending on species present.	Maintenance of the botanical interest relies on keeping soil nutrient levels low and removing the cuttings arising from grassland management (as now in private, residential ownership).	Not possible to substitute	Low to Medium - Local Wildlife Site	Intermediate Negative	Slight Adverse
ow Street Pit (Th47 )	Local wildlife Site	Local	Lies on the regionally important Thames terrace gravels. Deciduous woodland as well as old grassland. Supports the UK BAP species Hornet Robber fly (Asilus crabroniformis).	Deciduous woodland is declining. The Hornet Robber fly relies on the presence of animal dung that is relatively free from insecticides and worming agents for the development of its larvae. A grazing regime would also be the most appropriate way of maintaining the floristic interest of the site.	Not possible to substitute	Medium - UK BAP species and Thames Terrace habitats/species	Minor negative	Slight Adverse
Goshems Farm (Th49)	Local wildlife Site - deciduous woodland.	Local	This old landfill area supports two important species populations: the nationally rare Red Data plant Stinking Goosefoot and the UK BAP species Hornet Robber fly. Also made up of a large of deciduous woodland. Medium imp	Red Data species but unknown at present.	Not possible to substitute	High - UK BAP species and Red Data Book plant species.	Intermediate Negative	Large Adverse
Canal and grazing Marsh, Higham Gr17)	Local Wildlife Site Restored Higham Canal and coastal grazing marsh (UK BAP habitat).	Local	Recently established reedbeds, damp disturbed grassland and a dyke system.	Unknown	Not possible to substitute	Medium - BAP priority habitat.	Neutral	Neutral
Fentacled lagoon worm ( <i>Alkmaria</i> romijni)	Tentacled lagoon worm is protected under Schedule 5 of the Wildlife and Countryside Act 1981.		High importance (protected under Schedule 5 of the Wildlife and Countryside Act). Nationally scarce marine animal.	Considered scarce within the UK; vulnerable to changes to, or loss of, the habitats in which they live.	Not possible to substitute	High	Neutral	Neutral
European eel ( <i>Anguilla anguilla</i> )	European eel is a UK BAP Priority Species (BAP species are now Species of Principal Importance/Priority Species).	National	Medium importance, BAP species.	Listed as Critically Endangered on the IUCN Red List; on the OSPAR list of threatened and/or declining species and habitats.	Not possible to substitute	Medium	Neutral	Neutral
Smelt (Osmerus eperlanus)	Smelt is a UK BAP Priority Species (BAP species are now Species of Principal Importance/Priority Species).	National	Medium importance, BAP species	Declining, most of the recorded populations in Scotland are now extinct, as are a third of those from estuaries in England and Wales.	·	Medium	Neutral	Neutral
Harbour Porpoise ( <i>Phocoena</i> ohocoena)	Annex II of the European Commission's Habitats Directive (92/43/EEC); Schedule 5 of the Wildlife and Countryside Act.	National	High importance	Common to all UK waters 'favourable conservation status', but due to incidental fisheries by-catch, the species has been assessed as under threat/in decline in the Greater North Sea and Celtic Sea.	Not possible to substitute	High	Neutral	Neutral

MAGIC website for designated site locations; ancient woodland locations; priority habitat locations

JNCC website for Ramsar, SPA, SAC and SSSI site designations

JNCC website for Hamsar, SPA, SAC and SSS site designations
Natural England website for Local Nature Reserve designations
Thurrock Biodiversity Study 2006-2011
Essex Wildlife Trust website for locations of Local Wildlife Sites (http://www.essexwtrecords.org.uk/lowsfinder)
Kent Wildlife Trust website for locations of Local Wildlife Sites (https://cms.esriuk.com/tunbridgewells/Sites/KWT\_External/#)
Green Infrastructure Asset Baseline Report, Gravesham Borough, December 2009 (http://docs.gravesham.gov.uk/WebDocs/Environment%20and%20Planning/LDF/Green\_Infrastructure\_Assets\_Baseline\_Report\_1\_Main.pdf)
Review of Lower Thames Crossing Options: Final Review Report Appendices, AECOM, 2013
UK Biodiversity Action Plan; Priority Habitat Descriptions. BRIG (ed. Ant Maddock) 2008 (Updated Dec 2011).

# Summary Assessment Score

Very Large Adverse\*

# **Qualitative Comments**

Route 2 bisects a number of designated and local wildlife sites and areas of Biodiversity Action Plan habitat. These include an area of the Thames Estuary and Marshes which is designated as an internationally important Ramsar site and SSSI, and which is also a RSPB reserve. The route bisects a number of important habitats which depending on the crossing type will result in varying degrees of disturbance, habitat loss and habitat fragmentation. Specific comments on the potential design options for a new river crossing are outlined below:

The main impacts are associated with the construction phase. A completed tunnel would not impact the marine environment and the coastal/terrestrial impacts would be greatly reduced in comparison to the erection of a bridge (where permanent effects from loss of habitat and shading effects will occur) or immersed tube tunnel (with very large impacts on habitats and species during construction). The location of the tunnel entrance to the north of the crossing (and, in particular, the temporary works area associated with the tunnel portal) currently has a fairly significant impact on an area of historic coastal grazing marsh and local wildlife site, which supports a diverse range of Red Data Book Invertebrates and may be also provide important functionally linked land for the SPA designated species (e.g. high tide roost). Micro-siting this entrance point to minimise impacts of habitat loss/deterioration and disturbance to SPA species is recommended. However there is potential for orfset mitigation by enhancing land adjacent to the site which is currently agricultural land. Habitat loss and fragmentation of areas of ancient woodland along the southern extents of the new road, where this links to the M2 in the south, would involve a very large adverse effect on Ancient Woodland habitat that is irreplaceable as discussed above.

Note the Summary Assessment Score is being skewed by impacts on Great Crabbles Wood SSSI and Court Wood where areas of ancient woodland will be lost to the route alignment.

# **Annex 5 – Historic Environment Worksheet**

# **Annex 5: Historic Environment Impacts Worksheet**

# Route 2 ESL Bored

	Step 2		Step 3	Step 4	
Feature	Description	Scale it matters	Significance	Rarity	Impact
Form	The historic landscape within the study area is predominantly rural in character and the result of post-medieval farming activity. The study area also contains portions of urban settlements such as South Ockendon, Grays, West Tilbury and Gravesend and smaller settlements such as Orsett.  The study area contains a number of listed buildings (designated heritage assets), either within settlements such as South Ockendon and Orsett or within a more rural context such as small groups of farm buildings. In total there are 64 Grade II, six Grade II* and three Grade I listed buildings within the study area (Grade II*: Orsett House, Orsett; Marshall's Cottages and Church of St James, West Tilbury; Church of St Mary, East Court Manor, Little St Katerines and Chuch of St Peter and St Paul, Shorne. Grade I: Church of St Mary Magdelene, North Ockendon; Church of St Nicholas, South Ockendon; Church of St Mary, Chadwell St Mary.). The study area also contains three conservation areas (designated assets): West Tilbury, Shorne Village and Chestnut Green, Shorne  Known archaeological remains within the study area date from the prehistoric to post-medieval periods. There are seven scheduled monuments (designated heritage assets) within the study area: a barrow at South Ockendon Hall; a medieval moated site at South Ockenden Old Hall; Orsett crop mark complex; the Springfield style enclosure at Orsett; Dene Holes in Hangmans Wood; earthworks at West Tilbury and a Second World War anti-aircraft battery at Bowaters Farm.	The listed buildings and conservation areas are designated heritage assets and are afforded protection at a national level under the Planning (Listed Buildings and Conservation Areas) Act 1990 and are a material consideration at national level in the NPPF and NN-NPS.  The scheduled monuments are also designated heritage assets and are afforded protection at a national level under the Ancient Monuments and Archaeological Areas Act 1979. They are also a material consideration at national level in the NPPF and NN-NPS. The treatment of non-designated archaeological remains within the planning process is also considered at a national level in the NPPF and NN-NPS even though they may be of lesser value than designated heritage assets.	The Grade I and Grade II* listed buildings are of high value, whilst the Grade II listed buildings are of medium value. The conservation areas are of medium value.  The scheduled monuments are of high value and the non-designated archaeological remains range in value from low to medium.	The Grade I and Grade II* listed buildings, churches and high-status houses, are relatively well represented types on a national and regional level and are of moderate rarity. Conservation areas are relatively well represented regionally and nationally.  The scheduled monuments at South Ockenden Old Hall, South Ockendon Hall, Orsett, West Tilbury and Bowater Farm are relatively well represented types of monument and are of moderate rarity. The Dene Holes flint mine complex and the Springfield style enclosure at Orsett are less well represented and are of high rarity. The non-designated archaeological remains are of types that are well represented on a regional level and are of low rarity.	The Scheme will have a direct phyical impact on two Grade II listed buildings: 1 and 2 Gray's Corner cottages and Thatched Cottage, both to the east of Thurrock. Both listed buildings will be removed. The Scheme will have a direct physical impact on West Tilbury Conservation Area through the construction of a new road within the southern portion of the designated area. The scheme may impact on the settings of the Grade II listed buildings to the south and west of Orsett and to the west of West Tilbury. The scheme may also impact on the settings of the West Tilbury and Shorne Village conservations areas. The impacts may arise as a result of the introduction of a new linear element, the road, in a currently open rural landscape.  The scheme would have a direct physical impact on the Orsett cropmark complex and the Earthworks at West Tilbury scheduled monuments through the construction of new roads within the scheduled areas. The scheme may also impact on the settings of the scheduled monuments at South Ockenden Old Hall, Ockendon Hall, Orsett, West Tilbury and Bowaters Farm. The impacts may arise as a result of the introduction of a new linear element, the road, in a currently open rural landscape.  Construction excavations associated with the new road and tunnel portals may impact on non-designated archaeological remains within the scheme footprint via their complete or partial removal.
Survival	The survival of the listed buildings and the conservations areas is comparable with others in the region and is generally good.  The survival of the scheduled monuments is generally good. The survival of the archaeological remains has not yet been fully determined.	The NPPF and NN-NPS takes the survival of heritage assets into account at a national level.	Survival of the designated heritage assets is of moderate to high significance as they contribute to the character of the area.  Survival of the non-designated archaeological remains is of low to moderate significance as surviving remains of these types are important in terms of our understanding of the human past.	Surviving listed Grade II listed buildings are not rare regionally or nationally, although surviving Grade I and Grade II* listed buildings are rare on both scales.  With the exception of the Springfield style enclosure at Orsett and the Bowater Farm antiaircraft battery, the survival of which is rare on both regional and national levels, the survival of the scheduled monuments is of moderate rarity value.  Surviving non-designated archaeological remains are not rare regionally.	The scheme would not impact on the survival of designated assets within the study area, with the exception of the Orsett cropmark complex and the Earthworks at West Tilbury scheduled monuments which would be subject to the direct physical impacts as the result of road construction within the scheduled areas.  The scheme would not impact on the survival of non-designated assets within the study area as a whole, but would have impact within the scheme footprint.
	The condition of the listed buildings and conservation areas is generally good.  The condition of the scheduled monuments is generally good, with the exception of the Orsett cropmark complex and Bowaters Farm anti-aircraft battery, the condition of which are poor. The condition of the non-designated archaeological remains is currently unknown.	The NPPF and NN-NPS takes the condition of heritage assets into account at a national level.	The condition of the listed buildings and conservation areas is of moderate significance as they have they have a beneficial effect on the character and amenity value of the study area.  The condition of scheduled monuments and non-designated archaeological remains is of high and moderate significance respectively, as in good condition they can inform our understanding of the human past.	have low rarity value.  Scheduled monuments of the nature and condition of those within the study area have a high rarity value.	complex and Earthworks at West Tilbury scheduled monuments which would be subject to the direct physical impacts as the result of road
Complexity	The listed buildings are not unusually complex and represent a standard mix of agricultural, residential, ecclesiastical and commercial buildings.  Archaeological remains, both scheduled monuments and non-designated, represent activity from a number of periods and in relation to a number of industrial, settlement, funerary and agricultural processes. They are moderately complex but not unusual in a regional context.	The NPPF and NN-NPS takes the complexity of heritage assets into account at a national level.	The complexity of the historic environment resource has moderate significance as it represents both time-depth and potential to provide positive benefits to the character and amenity value and is also indicative of potential value in terms of our understanding of the human past.	The level of complexity within the historic environment resource is common on a regional level and as such is of low rarity.	The scheme would not impact on the complexity of designated assets within the study area.  The scheme would not impact on the complexity of non-designated assets within the study area as a whole and the scheme footprint.
Context	The study area lies within the Greater London / Thames Estuary areas and the historic environment resource within the study area reflect this wider context.	The NPPF and NN-NPS takes the context of heritage assets into account at a national level.	The context of the historic environment resource within the study area informs their settings and as such is of moderate to high significance.	The context of the historic environment resource within the study area is relatively common and as such is of low rarity.	The scheme would not impact on the context of the historic environment resource within the study area.

	Step 2		Step 3		Step 4	
Feature	Description	Scale it matters	Significance	Rarity	Impact	
	'	The NPPF and NN-NPS takes the period of heritage assets into account at a national level.	significance due to the potential to aid		The scheme would not impact on the periods represented by the historic environment resource within the study area.	
Period	The scheduled monuments date from the Bronze Age to the modern period, whilst the non-designated archaeological remains date from the prehistoric period onwards.		understanding the development of the region.			

#### **Reference Sources**

TAG Unit A3 (November 2014); DMRB Volume11, Section 3, Part 2 (2007); National Heritage List for England; Greater London Historic Environment Record; Essex Historic Environment Record, Thames Estuary Partnership Archaeological Research Framework (1999); Thames Estuary Partnership Greater Thames Research Framework (2010)

#### Step 5 - Summary Assessment Score

#### Moderate Adverse

#### **Qualitative Comments**

The scheme covers an area that is largely open and rural in character but containing urban areas that expanded during the 19th and 20th centuries. Two Grade II listed buildings will experience direct physical impacts through their removal: 1 and 2 Gray's Corner Cottages and Thatched Cottage, both to the east of Thurrock. The effect of these impacts is predicted to be Large Adverse. Potential impacts to the settings of the following designated heritage assets have been identified as a result of scheme: scheduled monuments at South Ockendon Hall, Orsett, West Tilbury and Bowaters Farm, Grade II listed buildings to the south and west of Orsett and to the west of West Tilbury, West Tilbury and Shorne Village conservations areas. These effects are predicted to be Slight Adverse with regard to the listed buildings and Moderate Adverse with regard to the conservation areas and scheduled monuments. Road construction within the scheduled areas of the Orsett cropmark complex and the Earthworks at West Tilbury scheduled monument, the effects are predicted to be Large Adverse. However, due to the poor condition of the Orsett Cropmark complex scheduled monument, these effects are predicted to be Moderate Adverse. Construction excavations associated with the proposed road and the tunnel may have a physical impact on any non-designated archaeological remains within the scheme footprint. In addition, any dredging within the river channel to facilitate the construction of a bored tunnel may impact previously unknown archaeological remains. Overall, Slight Adverse Effects to any non-designated archaeological remains within the scheme footprint are predicted.

# **Annex 6 – Landscape / Townscape Worksheet**

## Route 2 ESL Bored

	Step 2	1	Q1	ep 3		Step 4
Features	Description	Scale it matters	Rarity	Importance	Substitutability	Impact
	Between the A2 corridor and the A226 the landform is undulating and rises towards the south. The higher land is well wooded, some of the woods are ancient woodlands, with the settlements of Shorne and Shorne Ridgeway running along ridges. Arable fields defined by hedges and trees fill the lower land close to the A226 and in the valleys either side of Shorne. Properties along Pear tree Lane have extensive gardens/grounds, some with horse paddocks.	Local	Rare	Medium	Low. It is not possible to replace ancient woodland.	Large adverse. Route 2 ESL would cut across the pattern of the landscape particularly to the east of Shorne where it would run across a valley and then through a hill requiring extensive earthworks. An area of ancient woodland in Great Crabbles Wood would be destroyed.
	Between the A226 and the Thames Corridor the landscape is gently undulating, with large open arable fields and few hedgerows. These are mainly along the roads and around the small settlements.	Local	Rare in a local context	Medium	Varies along the route. Substitutability of farmland and recreation land is medium while the woodland is low.	Moderate adverse. Route 2 ESL has a direct and indirect impact on the pattern of the existing landscape. In places the it cuts through the gently undulating landform.
Pattern	The Thames river corridor consists of flood embankments along the river edge backed by expansive marshland with rough grazing and sparse scrub. On the north side of the river there are extensive areas of former mineral workings some of which have been backfilled as landfill.	Local	Rare in a local context	High in a local context	Low	Neutral. The tunnel portals would be located to the north and south of the Thames corridor and have no impact.
	South of Baker Street Route 2 ESL passes through an urban fringe landscape, with areas of arable land, horse pasture, crossed by roads such as the A13 and A1089 and with areas of suburban housing and school playing fields.	Local	Common	9	8 High	Slight adverse. Where Route 2 ESL passes between existing settlements and follows the line of existing roads. Moderate adverse. Where the existing pattern is more rural, around Baker Street and to the north and north-east of Tilbury
	Between the proposed junction with the M25 at North Ockendon and Baker Street Route 2 ESL passes, through relatively flat open countryside of large arable fields and areas of historic clay pits now used for landfill.	Local	Common	Medium	High	Moderate adverse. Route 2 ESL would have a direct impact on the pattern of the existing landscape. Fields which create a distinct pattern on the landscape would be bisected by the road.
	South of Shorne and Shorne Ridgeway, noise from the A2 and M2 becomes increasing intrusive, although visually due to the screening effect of trees the area is rural in appearance. The immediate area around the M2, A2, A289 junction is dominated by the roads despite extensive planting.	Local	Medium	Medium	Low	Moderate adverse in the vicinity of Route 2 ESL. Whilst there is some road noise in most areas at present this would increase considerably. The presence of road infrastructure would also have an impact on visual tranquillity. For residents of Thong, Riverview Park, and Chalk the route will change the view and increase noise, having a detrimental impact on tranquillity.
	The area around Shorne and Shorne Ridgeway has an unspoilt rural feel considering its closeness to Gravesend and the Medway towns. It is relatively free from traffic noise and the visual intrusion of industry and power lines. There are distant views over the Thames corridor to Essex and Tilbury power station.	Local	Medium	Medium	Low.	Large adverse. Route 2 ESL would introduce high levels of traffic noise and transport infrastructure into a currently tranquil rural scene. Some residents of Pear Tree Lane, Shorne Ridgeway, Shorne and Lower Shorne would have a significantly reduced level of tranquillity.
Tranquillity	Within the Thames corridor there are expansive views over the river and surrounding marshland from riverside paths which are often some distance from the nearest road. There is always some visual intrusion of man made structures such as jetties, river traffic and Tilbury power station.	Local	Common	High in local context	Low	Slight adverse. The tunnel would pass below the Thames corridor the portal being located to the south of the Lower Higham Road. Noise levels and visual intrusion would be much the same as they are at present, with the exception of locations closest to the portal and ventilation building.
	North of the Thames corridor the level of tranquillity varies considerably with location. There are large roads such as the M25, A13 and A1089 which generate traffic noise und disrupt tranquitity while there are open areas of countryside between that are broken only by the occasional small lane. Nowhere is it completely tranquil due to distant road noise and the visual intrusion of small settlements and pylons.	Local	Common	Low	High	Large adverse away from the existing large roads a new road would introduce additional noise and visual clutter into a largely rural scene. For some residents of Tilbury, West Tilbury, Grays, Chadwell St Mary, Orsett Heath, Baker Street and South Ockendon the route will change the view and increase noise, having a detrimental impact on tranquillity.
	Most of the route is located within Green Belt	Regional	Regionally medium	High in regional context	Low	Large adverse. The Green Belt is a valued rural separation between the urban edge of large settlements such as Grays, Tilbury and Gravesend, nearby villages. A new road would introduce a new urban element into this landscape.
	Public rights of way and National Cycle Route no. 1	National / local	Rare / common	High / low	High as easily relocated	Impact depends on the right of way but some will be crossed by the route and this would have a <b>Moderate adverse</b> impact on the users of the paths.
	South of the A2 is Cobham Hall which is included in the register of parks and gardens comprising intact 18C parkland, gardens, estate woodlands and golf course.	National	Nationally rare	High nationally	Low	<b>Neutral.</b> Part of the Route 2 ESL/A2/M2 junction would be located within the registered park, however in reality it is outside of the current park boundary. The registered park boundary should be altered to accommodate current transport infrastructure.
	Kent Downs Area of Outstanding Natural Beauty (AONB).	National	Rare nationally	High nationally	Low. It would not be possible to replicate the features of the AONB elsewhere	The Route 2 ESL junction with the A2, A289 and M2 would affect an area on the edge of the AONB and an area immediately around it which is important in terms of its landscape character, although not designated. The new junction would totally destroy this area and part of Great Crabbles Woods having a <b>large adverse</b> impact despite the existing large roads nearby.
	Grade II listed building in Old Watling Street.	Regional	Regionally rare	High in regional context	Low	Slight adverse. The proposed changes to the existing junction would mean that roads are closer to the building.
	Well Tree Cottage & Bushylees grade II listed buildings off Pear Tree Lane.	Regional	Regionally rare	High in regional context	Low	There would be a <b>slight adverse</b> impact on the setting of the rear of the buildings.
	Shorne conservation area. Listed buildings in Shorne within 500m of Route 2 ESL: Front garden wall & gate piers to Pipes Place, Pipes place, Chapel of St Katherine, St Katherine's House, all grade II & Little St Katherine's grade II*.	Grade II * listed building national. Grade II listed buildings local. Conservation area regional	Grade II* listed building nationally rare, listed buildings and conservation area regionally rare	High in national / local context	Low	Slight adverse impact on the northern most part of Shorne conservation area. Neutral for the remainder of Shorne conservation area and the listed buildings
	Listed buildings located close to Route 2 ESL between the A226 and the Thames: Filborough Farmhouse, Barn to the north west of Filborough Farmhouse, the granary at Little Filborough Farm East Court Manor (all grade II & Church of St Mary in Chalk (grade II*).	National / regional	Nationally / regionally rare	High in national / regional context	Low	There would be a <b>moderate adverse</b> impact of Route 2 ESL on the setting of the listed buildings.
	Thames and Medway canal route (no longer navigable). Not designated.	Local	Rare locally	Medium in a local context	Low	Neutral The portal and road would be located some distance to the south.

	Step 2		Ste	p 3		Step 4
Features	Description	Scale it matters	Rarity	Importance	Substitutability	Impact
	Saxon Shore way leisure route along the Thames, and public right of way on northern side of the Thames.	Regional / local	Rare regionally	High in a local context	Low	Neutral. The tunnel would pass below the paths.
Cultural						
Cultural	Scheduled monument. Coalhouse Fort battery and artillery defences	National	Rare	High at a national level	Low	Neutral. A tunnel will have no impact on the setting to the monument.
	East Tilbury Battery Scheduled Monument	National	Rare	High at a national level	Low	Neutral. Little remains of the monument and Route 2 ESL is a considerable distance away and would have no impact.
	Second World War Battery at Bowaters Farm Scheduled Monument.	National	Rare	High at a national level	Low	Moderate adverse. Route 2 ESL runs close to the monument. Although this is largely hidden from view by scrub there would be an impact on its setting.
	West Tilbury Scheduled monument at Hall Hill (has potential to show development from pre-Saxon to the medieval period), West Tilbury conservation area & listed buildings (grade II).	National scheduled monument, regional conservation area, local listed buildings.	Nationally / regionally / locally rare	High in national / regional / local context	Low	Moderate adverse. The village of West Tilbury with its various designations is located on the top of hill which is an important landmark standing out from the flat areas of former marsh to the south. Route 2 ESL would have a considerably impact on the setting.
	Chadwell House listed building, Chadwell St. Mary (grade II).	Regional	Regionally rare	High in regional context	Low	Slight adverse. Route 2 ESL would have some impact on the setting of the house from the east and south.
	Listed buildings to the south of the Route 2 ESL / A13 junction: Heath Place, Heath Cottage both off Hornsby Lane; Whitecrofts Farmhouse; thatched cottage south of Nevilles Farm; 2 Baker Street. All are grade II.	Regional	Regionally rare	High in regional context	Low	Slight adverse. Route 2 ESL would follow the route of existing roads south of the A13. However the roads are likely to be increased in size, with more signage and an intensification in use, all of which would have an impact on the setting of the buildings.
	Grade II Listed buildings at Baker Street.	Regional	Regionally rare	High in regional context	Low	Moderate adverse. The junction is very close to a listed windmill which will adversely affect its setting. The remainder of the buildings are further away and there would only be a <b>slight adverse</b> impact on their setting.
	Crop mark complex, Orsett directly on Route 2 ESL its junction with the A13. Very little visible at surface level.	National	Rare	High in national context	Low	Neutral landscape impact as the monument is below ground
	Scheduled monument and grade II listed building – gatehouse and moat of South Ockendon Hall and Scheduled monument - Roman barrow.	Scheduled monument National / listed building regional	Scheduled monument rare nationally / listed building rare regionally	Scheduled monument high in national context / listed building high in regional context	Low	Moderate adverse - The current monuments are surrounded by a flat, broad expanse of arable fields. Route 2 ESL, which would be very close, would have a detrimental impact on the setting of the monuments from the north.
	2 grade II Listed buildings at Kemps Farm.	Regional	Regionally rare	High in regional context	Low	Slight adverse. The M25 has an impact on the setting of the buildings currently. A new road junction would increase the level of impact.
	3 grade II listed buildings, a grade 1 listed building and a conservation area at North Ockendon.	Regional / national for grade I listed building	Regionally rare	High in regional context	Low	Neutral - The proposed Route 2 ESL junctionwith the M25 would be a considerable distance from North Ockendon which is already impacted by the presence of the M25. Route 2 ESL would be largely screened by existing trees and hedges.
	South of the A2 the grounds of Cobham Hall are a Registered Park and Garden comprising an intact 18th century parkland, gardens, estate woodlands and golf course.	National	Rare	High in National context	Low	Neutral. Part of the Route 2 ESL junction with the A2 would be located inside of the registered park, although in reality this is outside of the of the current park boundary. The registered park boundary should be altered to accommodate current transport infrastructure.
	The A2 / M / HS1 transport corridor dominates the surrounding rural landscape.	Local	Common	Low	High	Slight adverse. A new road junction would have little impact on land use other than to remove areas of planting and increase the area of road surface.
	The villages of Shorne and Shorne Ridgeway are on the higher land which is also well wooded and includes Shorne and Great Crabbles Woods amongst others.	Local	Medium locally	Medium	Low	Large adverse. A road would change the current land cover next to Southern Alternative from a predominantly rural one to one dominated by transport infrastructure. Large earthworks would be necessary to cut through the high land at Pear Tree Land requiring an extensive footprint.
	South of the A226 the lower areas are predominantly of arable fields bounded by hedges and woodlands.	Local	Medium locally	Medium	Low	Moderate adverse. A road would change the current land cover next to Southern Alternative from a predominantly rural one of fields and woodlands to one dominated by transport infrastructure.
Landcover	Between the A226 and the Thames corridor landcover is of large arable fields and small groups of houses. To the west is the suburban edge of Chalk.	Local	Low	Medium	High	Moderate adverse. A road would change the current land cover next to Southern Alternative from a predominantly rural one of arable fields to one dominated by transport infrastructure.
	The characteristic landcover of the Thames river corridor consists of open flat grazing marshes, with sparse scrub and tree cover, with emergent plants along ditches. The Thames is lined with inter tidal mud flats and gravel foreshore. On the north side there are extensive former mineral workings some of which have been backfilled with landfill.	Regional	Rare	High in regional context	Low	A bored tunnel would have <b>neutral</b> impact immediately adjacent to the river. Above ground the current agricultural landcover would change along Route 2 ESL to one dominated by transport infrastructure. In the long term there would be the potential for the route to create changes as surrounding agricultural land would be bisected and would become less viable to farm.
	From the A13 to the north of Tilbury the landcover is of a mix of arable fields, horse pasture, roads and suburban settlements.	Local	Low	Low	High	Slight adverse. Most of the Route 2 ESL would follow the line of the existing A1089.
	From the M25 junction to the A13 junction with Route 2 ESL the landcover is mostly of arable fields, with hedges and boundary trees. There old clay pits to the west of South Ockendon that are now used as landfill.	Local	Medium		High. The most important features the trees and hedges can easily be replaced	Moderate adverse The current agricultural landcover would change along the route to one dominated by transport infrastructure.
Summary of character	The Thames river corridor has a strong identity with large expansive horizontal vistas dominated by the interplay of water and sky. The area to the north along Route 2 ESL consists of open arable farmland north of the A13, with large suburban settlements and urban fringe areas to the south. South of the Thames corridor consists of large arable fields with hedgerows and trees grouped in association with small settlements. The land rises south of the A226 with villages and woodland on the higher land. Further south still is the busy A2/M2 road corridor.		Medium regionally	Medium regionally	Medium	Large adverse. Although there are major roads running through the parts landscape, Route2 ESL would introduce a new transport corridor through areas that are largely rural in character. In places this would dramatically change the character of the landscape from a rural one to one dominated by transport infrastructure and have a wider effect on the surrounding area than the immediate footprint of the road.

#### Reference Sources

Department of Transport TAG Unit A3 Environmental Impact Appraisal May 2014, Magic.gov.uk, Google Maps satellite photography, OS Maps, Thurrock UDP deposit draft 2003 (unadopted). National Character Area 111 Northern Thames Basin, National Character Area 81 Greater Thames Estuary, National Character Area 113 North Kent Plain, The Landscape Assessment of Kent 2004, Essex Landscape Character Assessment, Gravesham Local Plan 2nd review

### Step 5 - Summary Assessment Score

Large Adverse

### **Qualitative Comments**

Route 2 ESL would create a new road corridor and introduce a significant change to the existing landscape character which is designated as Green Belt and part of which is an AONB. Infrastructure associated with the road such as embankments, retaining structures, bridges, signage and lighting, would be notable additional built elements within the open rural landscape. The new road corridor and junction infrastructure associated with Route 2 ESL would impact directly and indirectly and nationally valued features including scheduled monuments and listed buildings.

# **Annex 7 – Water Worksheet**

### Annex 7: Water Environment Impacts Worksheet

### Route 2 ESL Bored

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - Importance ability		Magnitude	Significance
Study area: River Thames									
Potential Impacts: Morphological, and hydrodynamic changes to the River Thames due to river crossing	Water Body Thames Middle)	Water supply / biodiversity / transport & dilution waste products / recreation / aesthetics / cultural heritage / value to	High Recommended Marine Conservation Zone. Heavily modified water body at Moderate Ecological Potential and failing Chemical Status. Important river of national significance with commercial and social value, including depository	Regional/ National (excludes biodiversity	Rare	Not feasible	Very High	Negligible	Low significance
Potential Impacts: Routine runoff and spillage risk during operation of the new road	GB530603911402	economy / navigation	for effluent discharges, abstraction of water supply, recreation and, navigation. South Thames Estuary and Marshes SSSI and Ramsar site to south	considerations)				Negligible Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant
Study Area: Mardyke				1	1		1		T
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke and Fobbing (R1) WFD Water body ID (8B106037027990	Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Moderate Ecological Status. Target Good Ecological Status by 2027 Water available for abstraction licensing, subject	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply	Not feasible	Medium	(Moderate adverse) Slight adverse Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant (Low significance)
Potential Impacts: Routine runoff and spillage risk during operation of the new road			to limitations ( Roding Beam Ingrebourne and Mardyke CAMS)		availability)		_	(Moderate adverse) Negligible (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain		Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Poor Ecological Potential. Target Good Ecological Potential by 2027 Water available for abstraction licensing, subject	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply	Not feasible	Medium	Slight adverse Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road			to limitations ( Roding Beam Ingrebourne and Mardyke CAMS)		availability)			(Moderate adverse) Negligible (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke and Fobbing (R11) WFD water Body ID GB106037027970 Includes West and East Tilbury	Water supply / biodiversity / transport & dilution waste products / recreation	Medium Waterbody currently at Moderate Ecological Potential. Target Good Ecological Potential by 2027 Water available for abstraction licensing, subject	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply	Not feasible	Medium	Slight adverse Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road	main drains		to limitations ( Roding Beam Ingrebourne and Mardyke CAMS)		availability)			(Moderate adverse) Negligible (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Study Area: Thames and Medway Canal		<b>.</b>	T	ı	T		T	T	T
Potential Impacts: Morphological and hydrodynamic changes to the River Thames due to river crossing			Medium (biodiversity evaluated separately) Thames and Medway Canal good potential, no other water quality data available at this stage. Could support protected ecological species. It is	Regional (ref WFD		Limited feasibility	Medium	Negligible Assumes bored tunnel section has no impact on surface water courses	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road	(Ca18) (GB70610011)	products / recreation / navigation (potential)	not known whether these water bodies have any intrinsic social or economic value. Not currently used for navigation. Appraisal on water environment not biodiversity	water body status)	Moderate			Negligible Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted. Note: Best practice drainage design precludes discharge to canals	Insignificant
Study Area: Minor watercourses and drain	age ditches at South Thames	Estuary and Marshes (excluding Tham	es and Medway canal)	1					T
Potential Impacts: Morphological changes to minor watercourses and drainage networks	Minor water courses and drains of Shorne, Eastcourt, Great Clane Lane and Filborough	Biodiversity / recreation / amenity	Medium Could support protected ecological species. Assumed interaction with shallow groundwater.	Local	Common	Limited feasibility	Medium	Negligible Assumes bored tunnel section has no impact on surface water courses	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road	Marshes. South Thames Estuary and Marshes SSSI and Ramsar site	•	Appraisal on water environment not biodiversity					Negligible Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant
Study Area: Minor watercourses and drain	nage ditches north of the River	Thames (see also Mardyke water bod	у)	_					
Potential Impacts: Morphological changes to drainage networks	Minor watercourses and		Medium			Limitod		Slight adverse Assumes watercourse crossings and or displacement includes appropriate mitigation	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road	drainage ditches at West / East Tilbury Marshes	Biodiversity / recreation / amenity	Could support protected ecological species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity	Local	Common	Limited feasibility	Medium	(Moderate adverse) Negligible Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant Low significance
Study Area: Lakes and ponds				T	T		1	T	T
Loss of or other physical impact on standing water bodies	Standing water features (natural and man made) on land to N and S of River Thames including ponds and	Biodiversity / recreation / amenity / water supply (small reservoirs and	Low - Medium  Could support protected ecological species.  Some reservoirs and local (largely) agricultural	Local	Common	Limited feasibility	Low	Negligible: No significant standing waters crossed or intercepted	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road	lakes and standing water in	dams)	water supplies			-		<b>Negligible:</b> Assumes no drainage to standing water in accordance with best practice	Insignificant
Study Area: Groundwater north of River	Thames						<u>.                                    </u>	<u> </u>	
	South Essex Thurrock Chalk (GB40601G401100)	WFD water body status; water supply / resources; groundwater dependent ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Source Protection Zone 3 (Nr J29) Local commercial/industrial/agricultural licenced supplies Roding Beam Ingrebourne and Mardyke CAMS - no water available for further abstraction	Regional (ref WFD water body status)	Rare (CAMS shows restricted water availability)	Not feasible	High (based on resource availability, WFD target)	(Moderate adverse) Depends on whether permanent structures and or permanent dewatering (including at portal) impact groundwater flow Slight adverse with mitigation. Assumes any drainage to ground managed in accordance with best practice	Low significance (significant)
Potential Impact: Impact on groundwater quality from potentially polluting surface activities / highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels and tunnel portals (if required) or disruption to natural groundwater flow by underground	Essex gravels (GB40503G000400)	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Local commercial /industrial/agricultural licenced supplies	Regional (ref WFD water body status	Moderate	Not feasible	Medium	Negligible - slight adverse Assumes at grade road would not significantly impact groundwater and cuttings have minor impact on shallow groundwater. Drainage to ground managed in accordance with best practice. No exposure of this formation at Thames crossing	Insignificant
structures. Long term impacts from mobilisation of leachates from contaminated land / old landfill	South Essex Lower London Tertiaries (G16) (GB40602G401000)	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good)	Regional (ref WFD water body status	Moderate	Not feasible	Medium	Negligible: Little exposure of this formation Assumes any drainage to ground managed in accordance with best practice	Insignificant
	Shallow groundwater in alluvium, gravels and other superficial deposits (non WFD water bodies)	Groundwater dependant ecosystems (biodiversity); local water supply (agriculture)	Low	Local	Common	Not feasible	Low	Slight to moderate adverse. Depends on whether permanent structures and or permanent dewatering (including at portal) impact shallow groundwater flow Assumes any drainage to ground managed in accordance with best practice. Also assumes any landfill leachate appropriately managed	Insignificant

Company	Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
March 1999		Thames					,			
Last Option and was all controls and statement of the control of t	Potential Impact: Impact on groundwater quality from potentially polluting surface activities / highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels and tunnel portals (if required) or disruption to natural groundwater flow by underground	North Kent Medway Chalk	resources; groundwater dependant	WFD water body status (current poor, target good). Source Protection Zones 1, 2 and 3 (SE of Shorne) Local commercial /industrial/agricultural licenced		shows restricted	Not feasible	resource availability, WFD	structures and or permanent dewatering (including at portal) impact groundwater flow Slight adverse with mitigation. Assumes any drainage to ground managed in	Low significance
Particul impose, from its official product from contract or the ratio of the product of the prod	quality from potentially polluting surface activities / highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels (if required) or disruption to natural groundwater flow by underground structures.	gravels / alluvium) feeding South Thames Estuary and	(biodiversity); local water supply	Low (Ramsar/ SSSI covered by biodiversity)	International value covered by	Common	Not feasible	Low	Bored tunnel would pass beneath any shallow aquifer north of portal but may be impacted by long term dewatering at portal. Assumes any drainage to ground managed in	Insignificant
The properties of the properti	Study Area: River Thames Flood Zone 2/3	and associated defences								
The Principle of Authority of Management (Authority of Management (Auth	highway from watercourse or tidal source	River Thames crossing route		High	Regional	Moderate	(alternative crossing	High	(defended floodplain) crossing closures due to flood conditions unlikely, further mitigation through design	Low significance
Notes to began before the company of	in River Thames channel due to crossing	River Thames channel	Conveyance of flood flows		vicinity of crossing and City of London	Moderate	Not feasible	High		Insignificant
Interior processing from an interior processing from the form on the processing from the form of the processing from the following the followi	volume (including loss through impedance of flood flows) due to the development (e.g. embankments, cuttings) or permanent spoil	River Thames floodplain	Mostly defended floodplain at present in vicinity of proposed route.  TE2100 Policy P4 implies improved defences in the future will ensure route	not currently used for flood storage as the natural	Local	Moderate	of (defended) floodplain storage	currently used		Insignificant
Protesti invaste. Diver die of tooley to Springer Springe	affecting existing flood defence or by preventing future flood defence development (e.g. actions under Thames Estuary TE 2100	River Thames flood defences		High - provides protection for large urban area	Regional	Moderate	Unlikely to be	High		Insignificant
Transport in companies and the largest control strains (Model and Section 1998). Model and states and strains of the largest control strains (Model and Section 1998). Model and strains (Model and Se	Study Area: Mardyke Flood Zone 2/3 and associated defences									<u>'</u>
Powerful impacts: Loss of level integrated and processes of the of insight and processes of the continued processes of the contin	highway from watercourse or tidal source	Mardyke crossing route		High	Regional	Common	(alternative crossing	High	available, design to manage flood risk - defended	Low significance (Significant)
Potential impacts: Risk of allow footing of potential control of the potential impacts: Risk of allow footing of potential impacts: Risk of flooding toward footing of potential impacts: Risk of flooding flooding footing flooding floodi	volume (including loss through impedance of flood flows) due to the development (e.g. embankments, cuttings) or permanent spoil	Mardyke floodplain	Defended floodplain at present in vicinity of proposed route.  TE2100 Policy P4 implies improved defences in the future will ensure route	of route (EA flood Map) but shown as defended	Local	Common	of (defended) floodplain storage	Low	upstream for mostly rural area.  Slight adverse with mitigation - viaduct spans flood	Low significance (Significant)
reference implaces required and management of the proposed register. The process of the process	(upstream) due to crossing of watercourse or	Mardyke channel		convey flood flows at least up to 100-yr return	Local	Moderate	Not feasible	High	upstream for mostly rural area.  Slight adverse with mitigation - viaduct spans flood	Low significance (Significant)
Robertial Impacts: Risk of afflux flooding (upstream) due to crossing of watercourse or land drain  Potential Impacts: Risk of increased runoff to watercourse or land drain  Potential Impacts: Risk of increased runoff to watercourse or land drain  Potential Impacts: Risk of increased runoff to watercourse or land drain accusing increase in flood risk from watercourse or land drain accusing increase in flood risk from watercourse or land drain causing increase in flood risk from watercourse or land drain causing increase in flood risk from watercourse or land drain causing increase in flood risk from watercourse or land drain causing increase in flood risk from watercourse or land drain causing increase in flood risk from watercourse or land drain causing increase in flood risk from watercourse or land drain causing increase in flood risk from watercourse or land drain causing increase in flood risk from watercourse or land drain causing increase in flood risk from watercourse or land drain causing increase in flood risk from watercourse or land drain causing increase in flood risk from watercourse or land drain causing increase in flood risk from watercourse or land drain causing increase in flood risk from watercourse or land drain causing increase in flood risk from watercourse or land drain causing increase in flood risk from watercourse or land drain causing increase in flood risk from watercourse or land drain causing increase in flood risk from watercourse or land drain causing increase in flood risk from watercourse or land drain causing increase in flood risk.  Potential Impacts: Risk of flooding resulting from water floors (with a flooding from water floors) flooding from water floors (with a flooding from water floor) flooding from water floor flooding floor wat	affecting existing flood defence or by preventing future flood defence development (e.g. actions under Thames Estuary TE 2100	Mardyke flood defences			Local	Moderate	defences shown (EA Flood map) in vicinity of	n/a		vicinity of proposed
Potential Impacts: Risk of Influent flooding (upstream) due to crossing of watercourse of land from watercourse of land land land land land land land land	Study Area: Area surrounding Main Rivers	, Ordinary Watercourses, land	drains and ditches, including marshes	5			•			•
It is watercourse or land drain causing increase in flood risk from watercourse  Potential Impacts: Risk of flooding from change in watercourse/drain flow regime due to morphological changes for development  Study Area: Entire route.  Potential Impacts: Risk of flooding from vertand surface water flood risk.  Various floodplains and surface water flood risk. People and property water drainage areas  Various floodplains and surface water mitigation  Various floodplains and surface water flood risk. People and property water drainage areas  Various floodplains and surface water flood risk. People and property water drainage areas  Various floodplains and surface water flood risk. People and property water drainage areas  Various floodplains and surface water flood risk. People and property water drainage areas  Various floodplains and surface flood risk. People and property water drainage areas  Various floodplains and surface flood risk. People and property water drainage areas  Various floodplains and surface flood risk. People and property water drainage areas  Various floodplains and surface flood risk. People and property water drainage areas  Various floodplains and surface flood risk. People and property water drainage areas  Various floodplains and surface flood risk. People and property water drainage areas  Various floodplains and surface flood risk. People and property water drainage areas  Various floodplains and surface flood risk. People and property water drainage areas  Various floodplains and surface flood risk. People and property water drainage areas  Various floodplains and surface flood risk. People and property water drainage areas  Various floodplains and surface flood risk. People and property water drainage areas  Various floodplains and surface flood risk. People and property water drainage areas  Various floodplains and surface flood risk. People and property water drainage areas  Various floodplains and surface flood risk. People and property water drainage areas  Various floodplains a	(upstream) due to crossing of watercourse or	the land to N and S of River Thames, including drainage of Stone, Purfleet and West Thurrock Marshes ("West			Local	Common		Low		Insignificant Low significance
from change in watercourse/drain flow regime due to morphological changes for development  Study Area: Entire route.  Study Area: Entire route.  Potential Impacts: Risk of flooding)  Potential Impacts: Risk of flooding from overland surface water drainage areas  Various floodplains and surface areas  Water drainage areas  Water drainage areas  Potential Impacts: Risk of flooding from groundwater  Potential Impacts: Risk of flooding from groundwater  Various floodplains and surface flood risk: People and property water drainage areas  Water drainage areas  Water drainage areas  Various floodplains and surface water flows (surface water mitigation  Water drainage areas  Various floodplains and surface flood risk: People and property water drainage areas  Water drainage areas  Various floodplains and surface flood risk: People and property water drainage areas  Water drainage areas  Various floodplains and surface flood risk: People and property  Water drainage areas  Various floodplains and surface flood risk: People and property  Water drainage areas  Various floodplains and surface flood risk: People and property  Water drainage areas  Various floodplains and surface flood risk: People and property  Water drainage areas  Various floodplains and surface flood risk: People and property  Water drainage areas  Various floodplains and surface flood risk: People and property  Water drainage areas  Various floodplains and surface flood risk: People and property  Water drainage areas  Various floodplains and surface flood risk: People and property  Water drainage areas  Various floodplains and surface flood risk: People and property  Water drainage areas  Various floodplains and surface flood risk: People and property  Water drainage areas  Various floodplains and surface flood risk: People and property  Water drainage areas  Various floodplains and surface flood risk: People and property  Water drainage areas  Various floodplains and surface flood risk: People and property  Water drainage areas  Various floodplains an	to watercourse or land drain causing	As above			Local	Common		low		Insignificant Low significance
Various floodplains and surface Water drainage areas  Various floodplains and surface Flood risk: People and property water drainage areas  Various floodplains and surface Flood risk: People and property water drainage areas  Various floodplains and surface Flood risk: People and property water drainage areas  Various floodplains and surface Flood risk: People and property water drainage areas  Various floodplains and surface Flood risk: People and property water drainage areas  Various floodplains and surface Flood risk: People and property water drainage areas  Various floodplains and surface Flood risk: People and property water drainage areas  Various floodplains and surface Flood risk: People and property water drainage areas  Various floodplains and surface Flood risk: People and property water drainage areas  Various floodplains and surface Flood risk: People and property water drainage areas  Various floodplains and surface Flood risk: People and property water drainage areas  Various floodplains and surface Flood risk: People and property water drainage areas  Various floodplains and surface Flood risk: People and property water drainage areas  Various floodplains and surface Flood risk: People and property water drainage areas  Various floodplains and surface Flood risk: People and property water drainage areas  Various floodplains and surface Flood risk: People and property water drainage areas  Various floodplains and surface Flood risk: People and property water drainage areas  Various floodplains and surface Flood risk: People and property water drainage areas  Various floodplains and surface Flood risk: People and property water drainage areas  Various floodplains and surface Flood risk: People and property water drainage areas  Various floodplains and surface Flood risk: People and property water drainage areas  Various floodplains and surface Flood risk: People and property water drainage areas  Various floodplains and surface Flood risk: People and property water drainage areas  Various floodp	from change in watercourse/drain flow regime due to morphological changes for	As above			Local	Common		Low		Insignificant Low significance
Potential Impacts: Risk of flooding from overland surface water flows (surface water flowd risk) Slight adverse after mitigation  Various floodplains and surface Flood risk: People and property water drainage areas  Various floodplains and surface Flood risk: People and property Water drainage areas  Various floodplains and surface Flood risk: People and property Water drainage areas  Various floodplains and surface Flood risk: People and property Water drainage areas  Various floodplains and surface Flood risk: People and property Water drainage areas  Various floodplains and surface Flood risk: People and property Water drainage areas  Various floodplains and surface Flood risk: People and property Water drainage areas  Various floodplains and surface Flood risk: People and property Water drainage areas  Various floodplains and surface Flood risk: People and property Water drainage areas  Various floodplains and surface Flood risk: People and property Water drainage areas  Various floodplains and surface Flood risk: People and property Water drainage areas  Various floodplains and surface Flood risk: People and property Water drainage areas  Various floodplains and surface Flood risk: People and property Water drainage areas  Various floodplains and surface Flood risk: People and property Water drainage areas  Various floodplains and surface Flood risk: People and property Water drainage areas  Various floodplains and surface Flood risk: People and property Water drainage areas  Various floodplains and surface Flood risk: People and property Water drainage areas  Various floodplains and surface Fl	Study Area: Entire route.	Various floodals in a re-	Flood rick: Passia and array	Modium	l ood	Commer	Limitad	Low		· I
Potential Impacts: Risk of flooding from groundwater  Located across multiple flood zones	overland surface water flows (surface water	water drainage areas	,	Located across multiple flood zones			feasibility			Insignificant Low significance
Potential Impacts: Risk of flooding from Potential Impacts: Risk of flooding f	,	water drainage areas	,	Located across multiple flood zones			feasibility			Insignificant Low significance
Reference Sources	drains, sewers and water mains.							-		Insignificant Low significance

# Reference Sources

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Thameside Surface Water Management Plan (SWMP). JBA. 2013.
Havering Flood Risk Management Strategy (FRMS). London Borough of Havering. 2015.
South Essex Catchment Flood Management Plan (CFMP). Environment Agency. 2009.
North Kent Rivers Catchment Flood Management Plan (CFMP). Environment Agency. 2009.
Highways Agency Drainage Data Management System (HA DDMS)

**Summary Assessment Score** 

#### **Qualitative Comments**

Note 1: Risks from construction are only considered where they may have a permanent impact on the water environment once construction is completed

Note 2: Impacts on biodiversity may occur as a result of changes in water courses, river morphology, sedimentation, water quality and/or flow. Impacts on habitats / ecosystems / flora / fauna are covered separately under biodiversity and not included here to avoid "double counting"

Note 3: For some features, the magnitude of impacts is shown without mitigation (bold red font in parentheses) and with mitigation (bold, the convention for webTAG assessment). In these cases significance of effect is shown both without (red font in parentheses) and with mitigation.

Surface Water: The bridge crossing over the Thames will need to be developed to minimise impacts on river morphology from the bridge, although these are expected to be relatively localised with small increases inflow velocity within +/-2000m and there is little impact on HWL. Navigation will be affected by the position of the piers and bank structures, but the design will ensure main navigable channels remain relatively unaltered. The bored tunnel would have little impact on the quality or morphology of the River Thames. Assuming the current bed profile is restored post construction, impacts from the immersed tunnel depend primarily on the scale of any permanent effects (if any) that arise through the construction process (morphology, sedimentation, water quality, fisheries, navigational channels). Whilst these may have local impact, within the context of the Thames Middle water body overall, these are considered to be likely to be at worst moderate adverse. The long term impacts of sedimentation change (brought about during construction) are mostly related to tidal and inter tidal habitats, assessed under biodiversity.

npacts on the Mardyke (WFD water body) will depend on the nature of the crossings adopted, fully spanning and viaduct crossings are likely to have only slight impacts, where smaller channel crossings are employed, mitigation is generally available to reduce impacts to slight adverse

npacts are considered mostly slight adverse once mitigation is applied, although pending a full understanding of the impacts of the construction of the immersed tunnel, the impacts on the Tidal waters of the Thames remain moderate a

Groundwater: Issues with rising groundwater levels have been identified regionally although it is understood these are less problematic in this immediate area. A tunnel crossing will require temporary dewatering during construction and may need longer term dewatering at portals. Larger groundwater resources and public supplies, primarily from the Chalk at depth are unlikely to be impacted, although the manufactural supplies are provided by adopting appropriate construction and drainage practices. Through possible impacts on groundwater unlikely to be some impact on local licensed commercial/ industrial / agricultural supplies form shallow groundwater in the gravels, these are not thought to be significant. Impact at source protection zones may be mitigated by adopting appropriate construction and drainage practices. Through possible impacts on groundwater quality and flow from the construction of a long bored tunnel there may be residual slight adverse impacts on completion. Impact at source protection zones (especially SPZ 1 near Shorne) may be mitigated by adopting

WFD status: A Water Framework Directive assessment will be required due to the potential for direct effects on biological, chemical and physical WFD parameters for both surface waters (Thames, Mardyke, Thames and Medway canal ) and WFD groundwater bodies (north and south of the river). With appropriate militigation, it is not anticipated that the River Thames crossing or impacts on the Mardyke or groundwaters will lead to a reduction on WFD status or will prevent these water bodies reaching good status or potential in the future. For the assessment, it is generally assumed that the target 2027 status of good applies, even though current status of most water bodies is poor.

#### Flood Risk:

The bridge option has some potential to increase flood risk in the River Thames channel upstream due to piers and other structures impeding channel conveyance. The bored and immersed tube tunnels would have no impact on channel conveyance. The impact of the bridge on channel conveyance is likely to be mitigated through design (adequate span, minimise pier dimensions).

unnel options would be at higher risk of route closure due to high flood levels (i.e. through breach or overtopping of existing defences).

All bridge and tunnel options would require a design that integrates with (or does not compromise) TE2100 River Thames flood defence plans. At the River Thames flood defence locations the current Route 2 bridge design indicates the bridge would be significantly higher than the flood defences south of the River Thames which are located at the approximate transition between a raised viaduct and suspended bridge (no defences are shown on the north bank of the River Thames as here high ground forms the defence line). The Route 2 bored tunnel and immersed tunnel options have portals set back from the River Thames (south embankment) flood defences. However, there would still be a need to consider the impact of a tunnel on flood defences e.g. due to interference with flood defence piling by the tunnel.

TE2100 policies at the location of the Route 2 crossing are:

P4 for Policy Unit Purfleet, Grays and Tilbury, north of the River Thames (take further action to keep up with climate change and land use change so that flooding does not increase)
P3 for Policy Unit North Kent Marshes, south of the River Thames (continue with existing or alternative actions to manage flood risk). TE2100 includes an action to provide a secondary defence to Gravesend to protect from flooding from the tidal River Thames from the east. There is an opportunity for the Route 2 road embankment to provide this structural defence.

CFMP policies for Route 2 south of the River Thames (North Kent Rivers CFMP) are P3 for the North Kent Marshes Policy Unit (areas of low to moderate flood risk where we are generally managing existing flood risk effectively - i.e. no anticipated increase in FRM measures) and P1 for the North Kent Downs Policy Unit (areas of little or no flood risk where we will continue to monitor and advise)

CFMP policies for Route 2 north of the River Thames (South Essex CFMP - Thames Urban Tidal Policy Unit (ake further FRM actions to keep pace with climate change) and P6 for the Upper Mardyke Policy Unit (store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits). Where Route 2 crosses the Mardyke floodplain there may be opportunities to increase flood storage upstream of the road to provide benefits downstream.

Route 2 crosses the Mardyke flood plain. Whilst this may present a flood risk to the proposed road and the potential for the road to increase flood risk upstream, there is also potential for the road embankment to be designed to hold back flood water and hence alleviate flood risk downstream (consistent with South Essex CFMP policy).

Thurrock SWMP (URS 2013) identifies Critical Drainage Areas (CDAs). Route 2 crosses the identified CDA\_008, which includes Tilbury Flood Storage Area, designed to store surface water and so protect Tilbury from flooding. The Environment Agency has stated that no net reduction in available storage within the scheme would be considered acceptable. For Route 2 to be considered further, principles for mitigating any displaced storage within Tilbury FSA would need to be agreed with the EA and / or Thurrock Council.

Thameside SWMP (JBA 2013) is a Stage 1 SWMP and does not provide much detail in relation to the Route 2 alignment and implications for local flood risk.

The surface water drainage strategy / design (in accordance with HE guidance and standards) should be agreed with the relevant Lead Local Flood Risk Authorities. It is likely this will require that surface water runoff from the proposed crossing does not exceed existing rates (using SUDs where feasible).

# **Annex 8 - Noise Worksheet**

Annex 8: Noise Worksheet Route 2 ESL Bored Tunnel

APPRAISAL - NOISE POLLUTION

Present value base year: 2010

Current year: 2015

Proposal Opening Year: 2025

Average Household Size: 2.36

Project (Road or Rail): Road

No. of households experiencing 'without scheme' & 'with scheme' noise levels (given in dB<sub>Leq</sub>) in Opening Year

	With scheme	<45	45-47.9	48-50.9	51-53.9	54-56.9	57-59.9	60-62.9	63-65.9	66-68.9	69-71.9	72-74.9	75-77.9	78-80.9	81+
Without															
scheme															
<45		9589	321	169	85	54	34	25	9	12	1	1	0	0	0
45-47.9		1064	4338	330	249	23	7	46	16	3	0	0	0	0	0
48-50.9		9	1369	4915	306	168	27	21	5	3	0	0	0	0	0
51-53.9		0	13	1226	4564	254	113	35	10	1	0	0	0	0	0
54-56.9		0	0	5	902	3367	182	108	23	6	2	0	0	0	0
57-59.9		0	0	0	44	694	2444	152	86	11	0	0	0	0	0
60-62.9		0	0	0	0	13	711	2637	147	100	6	1	0	0	0
63-65.9		0	0	0	0	0	6	523	2734	106	30	0	0	0	0
66-68.9		0	0	0	0	0	0	9	481	1729	67	20	0	0	0
69-71.9		0	0	0	0	0	0	0	18	241	854	21	5	1	0
72-74.9		0	0	0	0	0	0	0	0	12	74	198	3	0	0
75-77.9		0	0	0	0	0	0	0	0	0	1	53	49	1	0
78-80.9		0	0	0	0	0	0	0	0	0	0	2	9	3	0
81+		0	0	0	0	0	0	0	0	0	0	0	0	0	0

No. of households experiencing 'without scheme' & 'with scheme' noise levels (given in dB<sub>Leq</sub>) in 15th Year After Opening

	With scheme	<45	45-47.9	48-50.9	51-53.9	54-56.9	57-59.9	60-62.9	63-65.9	66-68.9	69-71.9	72-74.9	75-77.9	78-80.9	81+
Without															
scheme															
<45		9218	307	154	95	53	36	25	10	13	1	1	0	0	0
45-47.9		1029	4290	357	240	16	11	42	15	3	0	0	0	0	0
48-50.9		13	1200	5107	356	181	23	26	7	3	0	0	0	0	0
51-53.9		0	7	1086	4696	243	108	27	17	1	0	0	0	0	0
54-56.9		0	0	0	862	3553	201	123	14	9	2	0	0	0	0
57-59.9		0	0	0	7	680	2504	178	82	5	0	0	0	0	0
60-62.9		0	0	0	0	7	645	2662	167	111	13	1	0	0	0
63-65.9		0	0	0	0	0	9	469	2786	136	31	0	0	0	0
66-68.9		0	0	0	0	0	0	7	430	1814	63	7	1	0	0
69-71.9		0	0	0	0	0	0	0	37	231	959	31	9	1	0
72-74.9		0	0	0	0	0	0	0	0	7	94	214	7	0	0
75-77.9		0	0	0	0	0	0	0	0	0	1	37	69	1	0
78-80.9		0	0	0	0	0	0	0	0	0	0	2	7	3	0
81+		0	0	0	0	0	0	0	0	0	0	0	0	0	0

Net Present Value of Noise of Proposal (60 Year Period)

£4,205,925 sitive value reflects a net benefit (i.e. noise reduction)

Estimated Population Annoyed (Do-Minimum): Estimated Population Annoyed (Do-Something):

12418 12304

Net Noise Annoyance Change in 15th Year After

-114

Opening (no. of people):

# Appendix 7.5 Appraisal Summary Table Route 3 ESL (BT)

Appraisal Summary Table Route 3 ESL (BT)

Annex 1: TEE table

Annex 2: PA table

Annex 3: AMCB table

Annex 4: Biodiversity worksheet

Annex 5: Historic environment worksheet

Annex 6: Landscape/ townscape worksheet

Annex 7: Water worksheet

Annex 8: Noise worksheet

Appraisal Summary Table		Route 3, Eastern Southern Link, Bored Tunnel	Date produced: 22 Jan 2016				Contact:	
	Name of scheme:	Route 3 Bored Tunnel with Eastern Southern Link - Core Growth, Central Case costs					Name	Chris Taylor
De	escription of scheme:	New Dual 2 lane trunk road (70mph) from M25 between J29 and J30, crossing the Th	names in a bored to	unnel, with an addition	nal lane for futur	e proofing, 2km		Highways England
		to the east of Gravesend with an easterly southern link to the M2.					Role	Project Sponsor
	Impacts	Summary of key impacts		Quantitative	Asses	sment Qualitative	Monetary	Distributional
				Quantitative		Qualitative	£(NPV)	7-pt scale/
							, i	vulnerable grp
my	Business users & transport providers	Large time savings estimated for business travellers, including freight, due to reduced congestion and improved connectivity. Small vehicle operating cost benefits would also occur due to reduced		ney time changes(£ ourney time change				
Economy	p	congestion. Small user charge disbenefits as there will be charges on the new crossing.	0 to 2min	2 to 5min	> 5 (£)	N/A	£3,374m	Not appraised yet
Ec			-£437m	£1,096m	£2,154m			
		The option would improve journey time reliability for journeys across the Thames by providing a completely alternative route, and relieving congestion on the existing Dartford Crossing.		N/A		N/A	C100m	
	users	completely alternative route, and relieving congestion on the existing Dartford Grossing.		IN/A		IN/A	£108m	
	Regeneration	Not appraised using WebTAG, but see complementary wider economic modelling		N/A		N/A	N/A	
	Wider Impacts	Wider Impact (WI) benefits are more than double those for Route 1. 80% of WI benefits are from the agglomeration of business activities.	Agglomeration		£1,337m			
		and aggionnolation of sections determined.	Output in imperfec	tly competitive marke	£339m	N/A	£1,677m	
			Labour supply imp	pacts	£1m			
tal	Noise	There is a small net benefit. Whilst there are reductions in noise along the M25/ A282 corridor,		enefit based on an estin				
ien		there are increases in noise for communities along the new route.		ed by noise in the withou 9 people in the with sch		N/A	£10m	Not appraised yet
nr			decreasing to 12,10	o people in the with son	one situation.			,
Environmental	Air Quality	All properties which are predicted to exceed or are at risk of exceeding the AQSO in the without	T (1)					
Ē		Scheme situation would experience an improvement in air quality with the Scheme.		s modelled are predicted cheme (representing up				
				ese receptors experien	•	N/A	N/A	Not appraised yet
				hout scheme. The sche any new exceedences.	me is not			
	Greenhouse gases	The option is forecast to result in an increase in both non-traded and traded carbon emissions		•	6,297,821	<del>                                     </del>		
	areermouse gases	The option is isleaded to result in an insteade in south for traded and traded surson emissions	Change in non-trade	ed carbon over 60y (CO	tonnes	N/A	-£288m	
			Change in traded ca	urbon over 60y (CO2e)	17,256		-1200111	
	Landscape	A new road corridor would adversely affect the landscape character including in the vicinity of			tonnes			
		Shorne and Shorne Ridgeway, green belt and intrude into the AONB. A bored tunnel would have		N/A		Large Adverse	N/A	
		limited impact on the character of the Thames corridor although new road infrastructure could potentially be visible from the AONB.				24.907.470.00		
	Townscape	See Landscape entry						
				N/A		N/A	N/A	
	Historic Environment	Direct physical impacts to one scheduled monument and two Grade II listed buildings. Potential						
		impacts to the setting of a number of designated heritage assets and direct effects on non-		N/A		Moderate Adverse	N/A	
	Biodiversity	designated archaeological remains within the scheme footprint.  Potential indirect effects on the Thames Estuary & Marshes SPA (loss of functionally linked land)				1.0.00	<del> </del>	
		and Cobham Woods SSSI. Potential impacts on ancient woodlands, LWSs & areas of BAP		N/A		Very Large	N1/A	
		Priority Habitat. Direct loss of ancient woodland at Great Crabbles Wood SSSI and Court Wood.		IN/A		Adverse	N/A	
	Water Environment	Impacts on Mardyke and on flood plain.						
				N/A		Slight Adverse	N/A	
Social	Commuting and Other users	Compared to business users, relatively small time savings arise for commuters and other users due to reduced congestion and improved connectivity. Vehicle operating cost disbenefits due to		ney time changes(£	•			
Soc		increased travel and lack of perception by non-business travellers. Small road user charge	0 to 2min	ourney time change 2 to 5min	s (£) > 5min	N/A	£291m	Not appraised yet
		disbenefit as there will be charges on the new crossing	-£325m	£360m	£641m			
	Reliability impact on Commuting and Other users	The option would improve journey time reliability for journeys across the Thames by providing a		NI/A		N/A	000	
	Communing and Other users	completely alternative route, and relieving congestion on the existing Dartford Crossing.		N/A		IN/A	£39m	
	Physical activity	The option has no impact on walking and cycling		N/A		Neutral	N/A	
	Journey quality	The route would provide a new high standard free-flowing solution and would relieve traffic from the existing crossing at Dartford and other routes including the A2. The ESL is the only option				Moderate		
		which provides a motorway to motorway link, connecting the M2 with the M25.		N/A		beneficial	N/A	
	Accidents	DfTs COBALT tool has been used to appraise accidents and shows a net increase in the number						
		and value of accidents across the road network, as a result of this being a new route. However a	Recause it is s	ew route 2,313 addition	al accidente ere			
		separate appraisal has also been undertaken using actual accident data across the road network, which shows that the option will lead to a reduction in the rate of accidents (as measured by the		years, including 33 fata		N/A	-£120m	Not appraised yet
		Fatal and Weighted Injury rate per billion vehicle kilometres).	injurie	s and 3,239 slight casu	alties			
	0	lishtis will be any ideal in a second and with Highway Factor II 10007 should be a second						
	Security	Lighting will be provided in accordance with Highways England's TA49/07 standard for new and replacement lighting on the strategic road network		N/A		Slight Adverse	N/A	Not appraised yet
	Access to services	Not appraised because this criteria relates to public transport options		N/A		N/A	N/A	N/A
	Affordability	The appraisal has assumed the same charges for the new crossing in real terms as those at Dartford Crossing today		N/A		Neutral	N/A	Not appraised yet
	Dartford Crossing today  Severance Safe re-provision will be made for all existing rights of way for pedestrians and cyclists that cross							
		the new trunk road. There will be permanent severance of some community facilities and public natural assets and mitigation options need to be developed		N/A		Slight Adverse	N/A	Not appraised yet
						- 32.0.00	17/1	<u>                                     </u>
	Option and non-use values	Not appraised because this criteria relates to public transport options		N/A		N/A	N/A	
Public counts	Cost to Broad Transport Budget (2010 Present Values)	The impacts on the transport budget would be twofold; the capital cost of construction and the subsequent maintenance and operating cost of the infrastructure offset by revenue collected from	Investment costs: £2 Operating costs £30	,				
Pu cou		the additional user charges	Operator revenue £8	343m (a benefit, offsetti	ng cost over the	N/A	£1,656m	
Ac			longer term)					
	Indirect Tax Revenues	A tax benefit to central government is forecast as a result of additional traffic using the road network and particularly the Dartford Crossing		N/A		N/A	£589m	
			<u> </u>				l	

# Annex 1 - TEE Table

Annex 1: TEE Table

### Economic Efficiency of the Transport System (TEE): Route 3/ESL

Non-business: Commuting	ALL MODES		ROAD		BUS and COACH	RAIL		OTHER
User benefits	TOTAL		Private Cars and L	.GVs	Passengers	Passengers		
Travel time	£85,904,201			£85,904,201				
Vehicle operating costs	-£56,409,250			-£56,409,250				
User charges	£120,641			£120,641				
During Construction & Maintenance	-£1,256,454			-£1,256,454		1		
COMMUTING	£28,359,139 (1a	1)		£28,359,139				
Non-business: Other	ALL MODES		ROAD		BUS and COACH	RAIL		OTHER
User benefits	TOTAL		Private Cars and L	.GVs	Passengers	Passengers		
Travel time	£589,641,853			£589,641,853				
Vehicle operating costs	-£317,478,831			-£317,478,831				
User charges	-£2,012,471			-£2,012,471				
During Construction & Maintenance	-£7,773,652			-£7,773,652		1		
NET NON-BUSINESS BENEFITS: OTHER	£262,376,898 (1b	)		£262,376,898		1		
<u>User benefits</u> Travel time	£2,813,255,443		£715,366,233	Business Cars & LGVs £2,097,889,210	Passengers	Freight	Passengers	
Vehicle operating costs	£707,086,970		£482,670,830	£224,416,140				
User charges	-£128,714,212		-£63,510,391	-£65,203,822				
During Construction & Maintenance	-£17,179,049					1		
Subtotal	£3,374,449,152 <i>(2)</i>		£1,134,526,673	£2,257,101,528				
Private sector provider impacts						Freight	Passengers	
Revenue								
Operating costs								
Investment costs								
Grant/subsidy								
Subtotal	£0 (3)							
Other business impacts								
Developer contributions	(4)							
NET BUSINESS IMPACT	£3,374,449,152 (5)	= (2) +	(3) + (4)					
TOTAL								
Efficiency Benefits (TEE)	£3,665,185,189 (6)	= (1a) -	- (1b) + (5)					
	Notes: Benefits appear a	as posit	ive numbers, while c	osts appear as nega	ative numbers.			
	All entries are dis	scounte	ed present values, in	2010 prices and va	lues			

# Annex 2 - PA Table

## Annex 2: Public Accounts (PA) Table

### **Route 3 ESL Bored Tunnel**

	ALL MODES	ROAD	BUS and COACH	RAIL	OTHER					
Local Government Funding	TOTAL	INFRASTRUCTUR	E							
Revenue										
Operating Costs										
Investment Costs										
Developer and Other Contributions										
Grant/Subsidy Payments										
NET IMPACT	£0 (7)									
Central Government Funding: Trans	sport									
Revenue	-£843,093,903	-£	843,093,903							
Operating costs	£300,025,957	£	300,025,957							
Investment Costs	£2,199,437,719	£2,	199,437,719							
Developer and Other Contributions										
Grant/Subsidy Payments										
NET IMPACT	£1,656,369,773 (8)	£1,	656,369,773							
Central Government Funding: Non-	Fransport									
Indirect Tax Revenues	-£588,995,607 <i>(9)</i>	-£	588,995,607							
<u>TOTALS</u>										
Broad Transport Budget	£1,656,369,773 (10)	(7) = (7) + (8)								
Wider Public Finances		) = (9)								
	Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.  All entries are discounted present values in 2010 prices and values.									

# Annex 3 - AMCB Table

## Annex 3: AMCB Table

## **Route 3 ESL Bored Tunnel**

and should not be used as the sole basis for decisions.

Analysis of Monetised Costs and Benefits	
Noise	£9,958,130 <i>(12)</i>
Local Air Quality	(13)
Greenhouse Gases	-£287,927,026
Journey Quality	(15)
Physical Activity	(16)
Accidents	-£119,925,000 <i>(17)</i>
Economic Efficiency: Consumer Users (Commuting)	£28,359,139 (1a)
Economic Efficiency: Consumer Users (Other)	£262,376,898 (1b)
Economic Efficiency: Business Users and Providers	£3,374,449,152 (5)
Wider Public Finances (Indirect Taxation Revenues)	£588,995,607 - (11) - sign changed from PA table, as PA table represents costs, not benefits
Present Value of Benefits (see notes) (PVB)	£3,856,286,900 $(PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)$
Broad Transport Budget	£1,656,369,773 (10)
Present Value of Costs (see notes) (PVC)	£1,656,369,773 (PVC) = (10)
OVERALL IMPACTS	
Net Present Value (NPV)	£2,199,917,128 NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	2.3 BCR=PVB/PVC
Note: This table includes costs and benefits which are regularly or together with some where monetisation is in prospect. There may a	

## **Annex 4 – Biodiversity Worksheet**

## Annex 4: TAG Biodiversity Impacts Worksheet

## Route 3 ESL Bored

Ste Area	Description of feature/ attribute	attribute matters)	Importance (of attribute)	Step 3 Trend (in relation to target)	,	Biodiversity and earth heritage value	Step 4 Magnitude of impact	Step 5 Assessment Score
Thames Estuary and Marshes Ramsar	Ramsar criterion 2 The site supports one endangered plant species and at least 14 nationally scarce plants of wetland habitats. The site also supports more than 20 British Red Data Book invertebrates.	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 2	Minor Negative	Slight Adverse
Thames Estuary and Marshes Ramsar	Ramsar criterion 5 Assemblages of international importance: Species with peak counts in winter: 45118 waterfowl (5 year peak mean 1998/99-2002/2003).	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 5	Minor Negative	Slight Adverse
Thames Estuary and Marshes Ramsar	Ramsar criterion 6 species/populations occurring at levels of international importance (includes species with peak counts in autumn/winter and in spring).	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 6	Minor Negative	Slight Adverse
Thames Estuary and Marshes SPA	Article 4.1 Qualification (79/409/EEC). Over winter the area regularly supports 1% of the population in GB of Circus cyaneus.	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.1 qualification	Minor Negative	Slight Adverse
Thames Estuary and Marshes SPA	Article 4.2 Qualification (79/409/EEC). Over winter the area regularly supports significant populations of a number of wading birds. On passage the area regularly supports 2.6% of the population of Charadrius hiaticula.	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.2 qualification	Minor Negative	Slight Adverse
Thames Estuary and Marshes SPA	Article 4.2 Qualification (79/409/EEC): An internationally important assemblage of birds. Over winter the area regularly supports 75019 waterfowl (5 year peak mean 21/03/2000).	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.2 qualification	Minor Negative	Slight Adverse
Mucking Flats and Marshes SSSI	Botanical interest: Mudifats and Saltmarsh	National	Attribute a qualifying feature of Nationally designated site so high importance.	Majority Favourable with small area Unfavourable Recovering status.	Not possible to substitute	High - nationally important habitats	Neutral	Neutral
Mucking Flats and Marshes SSSI	Wintering wildfowl and waders	National	Attribute a qualifying feature of Nationally designated site so high importance.	Majority Favourable with small area Unfavourable Recovering status.	Not possible to substitute	High - nationally important species	Minor Negative	Slight Adverse
South Thames Estuary and Marshes SSSI	Wading birds and other overwintering species (such as short-eared owl).	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining.	Not possible to substitute	High - nationally important birds	Intermediate Negative	Large Adverse
South Thames Estuary and Marshes SSSI	Botanical importance (saltmarsh, freshwater habitats and grazing marshes).	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining.	Not possible to substitute	High - nationally important botany	Minor Negative	Slight Adverse
South Thames Estuary and Marshes SSSI	Invertebrate interest (saltmarsh, freshwater habitats and grazing marshes).	National	Attribute a qualifying feature of Nationally designated site - High importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining.	Not possible to substitute	High - nationally important invertebrates	Minor Negative	Slight Adverse
Shorne and Ashenbank Woods SSSI	Designated Ancient Woodland	National	Attribute a qualifying feature of Nationally designated site so high importance.	Favourable to Unfavourable Recovering Status.	Not possible to substitute	High - nationally important ancient woodland	Minor Negative	Slight Adverse
Shorne and Ashenbank Woods SSSI	Woodland invertebrates	National	Attribute a qualifying feature of Nationally designated site so high importance.	Favourable to Unfavourable Recovering Status	Not possible to substitute	High - nationally important invertebrates	Minor Negative	Slight Adverse
Great Crabbles Wood SSSI	Botanical importance - broadleaved mixed and yew lowland woodland - designated Ancient Woodland.	National	Attribute a qualifying feature of Nationally designated site - High importance.	Unfavourable - Recovering. The whole area is classified as being in a 'no change' condition due to the lack of forestry and woodland management.	Not possible to substitute ancient woodland	High - nationally important ancient woodland	Major Negative	Very Large Adverse
Cobham Woods SSSI (includes Great Wood - ancient woodland)	Botanical importance - designated Ancient Woodland	National	Attribute a qualifying feature of Nationally designated site - High importance.	Over 81% of the area is in a 'favourable' or 'recovering' condition. The remaining area is classified as 'no change' as the area is neglected and subject to multiple ownership.	Not possible to substitute ancient woodland plant species without ancient woodland.	High - nationally important botany	Minor Negative	Slight Adverse

Ste	n 2	1		Step 3			Step 4	Step 5
Area	Description of feature/ attribute		Importance (of attribute)	Trend (in relation to target)	Substitution possibilities	Biodiversity and earth	Magnitude of impact	Assessment Score
	Botanical importance - woodland	attribute matters) National	Attribute a qualifying feature of	Over 81% of the area is in a	Not possible to substitute	heritage value High - nationally	Minor Negative	Slight Adverse
	edge/ arable land plant species		Nationally designated site - High	'favourable' or 'recovering'		important botany	3	3
O-l-l Wd- 0001 /:ld			importance.	condition. The remaining area is classified as 'no				
Cobham Woods SSSI (includes Great Wood - ancient woodland)				change' as the area is neglected and subject to				
				multiple ownership.				
	Woodland birds	National	Attribute a qualifying feature of	Favourable to Unfavourable	Not possible to substitute	High - nationally	Minor Negative	Slight Adverse
			Nationally designated site - High importance.	Recovering Status		important birds		
Cobham Woods SSSI (includes								
Great Wood - ancient woodland)								
	Marine and estuarine habitats and species	National	Attribute a qualifying feature of Nationally designated site so high	Marine and estuarine habitats in the Thames are being	Not possible to substitute	Very High - undesignated site	Neutral	Neutral
	and species		importance.	degraded through issues		hosting		
Thames Estuary recommended				such as pollution and climate change.		habitats/species of (European) Community		
MCZ (on hold)				onango.		interest (annexes 1 & 2,		
						Habitats Directive, 1992).		
	Complex of habitats of value for	Regional	Attribute of value to local communities,	Some goals are being	Not possible to substitute	Medium - community	Minor Negative	Slight Adverse
	biodiversity and as a community resource		of Medium importance.	achieved.		value and extensive area		
Greater Thames Marshes Nature								
Improvement Area								
	Local Wildlife Site	Local	Area of degraded ancient woodland,	Much of this woodland has	Not possible to substitute	High - ancient	Major Negative	Very Large Adverse
	Ancient and Ancient Semi-natural		high importance with a derelict orchard	been converted to chestnut	ancient woodland	woodland	,	, _u.go Auterse
Court Wood, Shorne (GR1) - includes Starmore Wood and	Woodland; derelict orchard and semi-improved neutral grassland		and area of unmanaged semi-improved neutral grassland of limited botanical	but still retains a good diversity of flowering plants,				
Peartree Wood (ancient	, i i i i gracolaria		interest that supports invertebrates.	including many ancient				
woodlands)				woodland indicator species.				
		Land		lunder aven	O-literary 1 11 11 11 11 11 11 11 11 11 11 11 11	l and the state of	Navitus!	No. at a 1
	Local Wildlife Site Grassland, scrub	Local	Area of unimproved pasture on acid, dry pebbly soils. Supports a herb-rich	unknown - not indicated on Kent Local Wildlife Site	Soil translocation a possibility	Low - local value grassland and scrub	Neutral	Neutral
			flora - Low importance.	schedule.				
Shorne Pasture (GR18)								
	Ancient Woodland	National	Area of degraded ancient woodland of	unknown, but likely to be	Not possible to substitute	High - ancient	Minor Negative	Moderate Adverse
			Low to Medium importance.	declining due to isolation and impact of poor air quality.	ancient woodland	woodland		
Un-named ancient woodland (at								
centre of M2 J1 interchange)								
	Ancient Woodland	National	Area of degraded ancient woodland of	unknown - but likely to be	Not possible to substitute	High - ancient	Minor Negative	Moderate Adverse
			Low to Medium importance.	declining due to impact of poor air quality given	ancient woodland	woodland		
Un-named ancient woodland				proximity to M2.				
(south of M2 J1 interchange, to the west of the M2)								
	Priority BAP habitat	Local	Medium importance, BAP habitat	Nationally lowland mixed	Replacement planting	Medium - BAP priority	Intermediate Negative	Moderate Adverse
	Thomy DAI Habitat	Local	Mediam importance, DAI Habitat	deciduous woodland is	and/translocation of habitats a		intermediate regative	Moderate Adverse
Priority Habitat - Deciduous				declining due to clearance, over-grazing, and replanting	possibility.			
Woodland around Buckland, Brook				with non-native species.				
Farm (north of the East Tilbury Marshes), small section on A226								
south east of Chalk. See also local wildlife sites (below).								
wildlife sites (below).								
	Important for cohesion between	National (contiguous	Importance will be dependant on	Likely to be decreasing due	Creation of replacement	Medium to High, BAP	Neutral	Neutral
Priority habitat - Coastal	designated sites and for sustaining populations of wading	with similar habitat of international	functioning within who wider network of habitats, likely to be Medium to High	to coastal erosion, climate change and development.	habitat through managed realignment a possibility, but	priority habitat which is likely to support SPA		
Saltmarshes (south of river, as part	birds.	importance within designated sites).	Importance.		very limited opportunities locally due to lack of available	qualifying species.		
of Shorne Marshes and Eastcourt Marshes)		designated sites).			land.			
	Important for cohesion between	National (contiguous	Likely to be Medium to High	Likely to be decreasing due	Creation of replacement	Medium to High, BAP	Minor Negative	Slight Adverse
Priority Hobitat Intentional	designated sites and for	with similar habitat of	Importance.	to coastal erosion, climate	habitat through managed	priority habitat which is	J	
Priority Habitat - Intertidal mudflats (particularly northern bank of the	sustaining populations of wading birds.	international importance within		change and development.	realignment a possibility, but very limited opportunities	likely to support SPA qualifying species.		
river at crossing, down stream of the Thames Estuary and Marshes		designated sites).			locally due to lack of available			
(Ramsar))					land.			
	Of importance for cohesion	National (contiguous	Low to High, dependant on functioning	Likely to be decreasing due	Replacement habitat creation		Minor Negative	Slight Adverse
	between designated sites and for sustaining populations of	with similar habitat of international	within the wider network of habitats.	to agricultural improvement, drainage and development.	potentially possible (e.g. managed realignment or	priority habitat which is likely to support SPA		
Priority Habitat - Coastal and	waterfowl and of value for	importance within			creation of freshwater wetland habitats), but very	qualifying species.		
Floodplain Grazing Marsh including freshwater ditches/ponds.	notable invertebrates and plants.	designated sites).			limited opportunities locally			
, , , , , ,					due to lack of available land.			
	Priority BAP habitat	Local	Traditional Orchards BAP habitat -	Declining due to a loss of	Not possible to recreate	Medium - BAP priority	Major Negative	Moderate Adverse
Priority habitat - Traditional			Medium importance.	sites only partially compensated for by	mature habitats, replanting and (if possible) translocation	habitat		
				improved management and	of habitats and/or soils a			
Orchards (north of A1089 and east				restoration.	possibility.			
Orchards (north of A1089 and east of Orsett - small patch of orchard lining green lane. Also running		I						
Orchards (north of A1089 and east of Orsett - small patch of orchard lining green lane. Also running along M25 east of Upminster				i e	İ	Ì	1	
Orchards (north of A1089 and east of Orsett - small patch of orchard lining green lane. Also running								
Orchards (north of A1089 and east of Orsett - small patch of orchard lining green lane. Also running along M25 east of Upminster	Priority BAP habitat	Local	Wood-pasture and Parkland BAP	Generally believed to be	Not possible to recreate	Medium - BAP priority	Minor Negative	Slight Adverse
Orchards (north of A1089 and east of Orsett - small patch of orchard lining green lane. Also running along M25 east of Upminster	Priority BAP habitat	Local	Wood-pasture and Parkland BAP habitat - Medium importance.	declining nationally.	Not possible to recreate mature habitats	Medium - BAP priority habitat	Minor Negative	Slight Adverse
Orchards (north of A1089 and east of Orsett - small patch of orchard lining green lane. Also running along M25 east of Upminster	Priority BAP habitat	Local	· ·	declining nationally. However, there are no reliable statistics on the			Minor Negative	Slight Adverse
Orchards (north of A1089 and east of Orsett - small patch of orchard lining green lane. Also running along M25 east of Upminster where M25 will be widened)  Priority habitat - Wood-pasture	Priority BAP habitat	Local	· ·	declining nationally. However, there are no reliable statistics on the extent of the overall			Minor Negative	Slight Adverse
Orchards (north of A1089 and east of Orsett - small patch of orchard lining green lane. Also running along M25 east of Upminster where M25 will be widened)  Priority habitat - Wood-pasture and Parkland (adjacent to M2 J1	Priority BAP habitat	Local	· ·	declining nationally. However, there are no reliable statistics on the			Minor Negative	Slight Adverse
Orchards (north of A1089 and east of Orsett - small patch of orchard lining green lane. Also running along M25 east of Upminster where M25 will be widened)  Priority habitat - Wood-pasture	Priority BAP habitat	Local	· ·	declining nationally. However, there are no reliable statistics on the extent of the overall resource, nor on historical and current rates of loss or			Minor Negative	Slight Adverse
Orchards (north of A1089 and east of Orsett - small patch of orchard lining green lane. Also running along M25 east of Upminster where M25 will be widened)  Priority habitat - Wood-pasture and Parkland (adjacent to M2 J1	Priority BAP habitat	Local	· ·	declining nationally. However, there are no reliable statistics on the extent of the overall resource, nor on historical and			Minor Negative	Slight Adverse

Ste	p 2			Step 3			Step 4	Step 5
Area	Description of feature/ attribute		Importance (of attribute)	Trend (in relation to target)	Substitution possibilities	Biodiversity and earth	Magnitude of impact	Assessment Score
	Priority BAP habitat	attribute matters) Local	Traditional Orchards BAP habitat -	Declining due to a loss of	Not possible to recreate	heritage value Medium - BAP priority	Major Negative	Moderate Adverse
			Medium importance	sites only partially	mature habitats, replanting	habitat		
Priority habitat - Traditional				compensated for by improved management and	and (if possible) translocation of habitats and/or soils a			
Orchards (adjacent to the A289 at				restoration.	possibility			
M2 J1 interchange; on Church								
Lane and adjacent to the A226 north of Shorne)								
<del>-</del> /							1	
	Priority BAP habitat	Local	Deciduous Woodland BAP habitat -	Nationally lowland mixed	Replacement planting and/or	Medium - BAP priority	Minor Negative	Slight Adverse
			Medium importance	deciduous woodland is	translocation of habitats	habitat		og / lavoiso
				declining due to clearance,	and/or soils a possibility			
Priority habitat - Deciduous Woodland (adjacent to M2 J1				over-grazing and replanting with non-native species.				
interchange; Great Crabbles								
Wood; and along northern edge of								
the A226 near Church Lane)								
	- -  -	11		On a sing with an analysis and	Dealers and alertics a	Maraticus DAD and auto	Main Nonethia	
	Local wildlife Site - rough grassland and deciduous	Local	Large area of rough grassland and important invertebrate population, as	Species rich grasslands are decreasing, unmanaged	Replacement planting a possibility but limited space	Medium - BAP priority habitat and species	Major Negative	Moderate Adverse
	woodland.		well as providing potential nesting	grassland is likely to be	available.	·		
Blackshots Nature Area (Th34)			habitats for birds such as skylark. UK BAP fly species <i>Dorycera graminum</i>	increasing. Nationally deciduous woodland is				
			found here.	declining				
	Local Wildlife site and Ancient	Local	Terrels Heath is a forest structure	Nationally deciduous	Not possible to substitute	High - important ancient	Minor Negative	Neutral
	Woodland.		dominated by pendunculate Oak (Quercus robar) High importance.	woodland is declining due to clearance, over-grazing, and		woodland		
Terrels Heath (Th36 ) - incudes			(Querous robar) riigir importance.	replanting with non-native				
Chadwell Wood (ancient				species.				
woodland)								
	Local Wildlife Site	Local	HCr19; SCr4. Brownfield site with acid	Believed to be favourable,	Lytag Brownfield will be	Medium - BAP priority	Minor Negative	Slight adverse
	Acid grassland; reptiles	Local	grassland that supports all four	but identified as a site a risk	temporarily disturbed. Reptile		inno inegative	Singrit adverse
			common species of reptile (adder,	from development.	translocation required.		1	
			grass snake, common lizard and slow worm). Medium importance		Habitat reinstatement a possibility but requires		1	
Lytag Brownfield (Th39)					suitable substrate to maintain		1	
					required pH for habitats to			
					establish.		1	
	Local Wildlife Site Flora; invertebrates	Local	Thames Terrace grasslands and ancient heathland. Site supports 4	Unknown at present, but a rare grassland habitat and	Not possible to substitute	Medium importance Thames Terrace	Intermediate negative	Moderate Adverse
	i iora, invertebrates		nationally rare and 50 nationally scarce			grassland and		
M 1: 11 (1/71/44)			invertebrate species. Medium	fauna, associated with		invertebrates		
Mucking Heath (Th41)			importance.	Thames Terrace soils.				
	Local wildlife Site	Local	Rainbow Shaw is thought to be a small	Unknown at present	Creation of replacement	Low - Local Wildlife Site	Minor negative	Slight adverse
			ancient woodland fragment. Low to		habitat possible.		l	J
			medium importance.					
Rainbow Shaw (Th45)								
Trainbow onaw (TH+0)								
							1	
							1	
	Local wildlife Site	Local	This brownfield site supports an	This Site has a number of	Creation of replacement	High - Red Data Bok	Neutral	Neutral
			important invertebrate fauna and lies	Red Data Book (Endangered)		species		
			within a very significant cluster of such sites.	invertebrates, including the bees <i>Andrena florea</i> and				
			Sites.	Nomada fulvicornis (both				
				RDB3) and the wasps				
				Cerceris quinquefasciata (RDB3 and a national BAP				
				species) and Hedychrum				
Linford Pit (Th46)				niemelai (also RDB3), as				
Limora Fit (Th40)				well as several nationally				
				scarce spiders and the nationally rare fly Myopa				
				polystigma (RDB3).				
	Local wildlife Site	Local	Lies on the regionally important	Deciduous woodland is	Not possible to substitute	Medium - UK BAP	Major Negative	Moderate Adverse
			Thames terrace gravels. Deciduous	declining. The Hornet Robber		species and Thames	1 .,.	
			woodland as well as old grassland. Supports the UK BAP species Hornet	fly relies on the presence of animal dung that is relatively		Terrace habitats/species		
			Robber fly (Asilus crabroniformis)	free from insecticides and		nabitats/species		
				worming agents for the				
Low Street Pit (Th/17 )				development of its larvae. A				
Low Street Pit (Th47)				grazing regime would also be the most appropriate way of				
				maintaining the floristic				
				interest of the site				
							1	
							1	
	Local wildlife Site - deciduous	Local	This old landfill area supports two	Red Data species but	Not possible to substitute	High - UK BAP species	Intermediate Negative	Large Adverse
	woodland.		important species populations: the	unknown at present.		and Red Data Book		
			nationally rare Red Data plant Stinking Goosefoot and the UK BAP species			plant species.	1	
Goshems Farm (Th49)			Hornet Robber fly. Also made up of a				1	
. ,			large of deciduous woodland. Medium				1	
			importance.				1	
	111200000		D #		N	NA 11	l .	
	Local Wildlife Site Restored Higham Canal and	Local	Recently established reedbeds, damp	Unknown	Not possible to substitute	Medium - BAP priority	Neutral	Neutral
Canal and grazing Marsh, Higham	Restored Higham Canal and coastal grazing marsh (UK BAP		disturbed grassland and a dyke system			habitat	1	
(Gr17)	habitat)						1	
	Tentacled lagoon worm is	National	High importance (protected under	Considered scarce wihtin the	Not possible to substitute	High	Neutral	Neutral
	protected under Schedule 5 of		Schedule 5 of the Wildlife and	UK; vulnerable to changes to,		_	1	1
Tentacled lagoon worm (Alkmaria	the Wildlife and Countryside Act 1981		Countryside Act). Nationally scarce marine animal	or loss of, the habitats in which they live			1	
romijni)	1501		maine amilai	writer trey live				
							1	
	Furances colin a LIV DAD	National	Modium importance BAD accessor	Listed as Critically	Not possible to substitute	Modium	Noutral	Noutral
	European eel is a UK BAP Priority Species (BAP species	National	Medium importance, BAP species	Listed as Critically Endangered on the IUCN	Not possible to substitute	Medium	Neutral	Neutral
	are now Species of Principal			Red List; on the OSPAR list			1	
European col / Amerille "	Importance/Priority Species)			of threatened and/or			1	
European eel (Anguilla anguilla)				declining species and habitats.			1	
							1	
							1	]

Ste	Step 2 Step 3							Step 5
Area	Description of feature/ attribute	Scale (at which attribute matters)	Importance (of attribute)	Trend (in relation to target)	Substitution possibilities	Biodiversity and earth heritage value	Magnitude of impact	Assessment Score
Smelt (Osmerus eperlanus)	Smelt is a UK BAP Priority Species (BAP species are now Species of Principal Importance/Priority Species)	National		Declining, most of the recorded populations in Scotland are now extinct, as are a third of those from estuaries in England and Wales	Not possible to substitute	Medium	Neutral	Neutral
Harbour Porpoise ( <i>Phocoena</i> phocoena)	Annex II of the European Commission's Habitats Directive (92/43/EEC); Schedule 5 of the Wildlife and Countryside Act	National		Common to all UK waters 'favourable conservation status', but due to incidental fisheries by-catch, the species has been assessed as under threat/in decline in the Greater North Sea and Celtic Sea.	Not possible to substitute	High	Neutral	Neutral

#### Reference Sources

MAGIC website for designated site locations; ancient woodland locations; priority habitat locations JNCC website for Ramsar, SPA, SAC and SSSI site designations Natural England website for Local Nature Reserve designations

Thurrock Biodiversity Study 2006-2011

Essex Wildlife Trust website for locations of Local Wildlife Sites (http://www.essexwtrecords.org.uk/lowsfinder)

Kent Wildlife Trust website for locations of Local Wildlife Sites (https://cms.esriuk.com/tunbridgewells/Sites/KWT\_External/#)

Green Infrastructure Asset Baseline Report, Gravesham Borough, December 2009 (http://docs.gravesham.gov.uk/WebDocs/Environment%20and%20Planning/LDF/Green\_Infrastructure\_Assets\_Baseline\_Report\_1\_Main.pdf)
Review of Lower Thames Crossing Options: Final Review Report Appendices, AECOM, 2013

UK Biodiversity Action Plan; Priority Habitat Descriptions. BRIG (ed. Ant Maddock) 2008 (Updated Dec 2011).

## **Summary Assessment Score**

Very Large Adverse\*

#### Qualitative Comments

Route 3 bisects four designated, seven local wildlife sites and 12 areas of Biodiversity Action Plan habitat. These include an area of the Thames Estuary and Marshes which is designated as an internationally important Ramsar site and SSSI, and which is also a RSPB reserve. The route bisects a number of important habitats which will result in varying degrees of disturbance, habitat loss and habitat fragmentation. Specific comments on the potential design options for a new river crossing are outlined below:

The main impacts are associated with the construction phase. A completed tunnel would not impact the marine environment and the coastal/terrestrial impacts would be greatly reduced in comparison to the erection of a bridge (where permanent effects from loss of habita and shading effects will occur) or immersed tube tunnel (with very large impacts on habitats and species during construction). The location of the tunnel entrance to the north of the crossing (and, in particular, the temporary works area associated with the tunnel portal) currently has a fairly significant impact on an area of historic coastal grazing marsh and local wildlife site, which supports a diverse range of Red Data Book Invertebrates and may be also provide important functionally linked land for the SPA designated species (e.g. high tide roost). Micro-siting this entrance point to minimise impacts of habitat loss/deterioration and disturbance to SPA species is recommended. However there is potential for offset mitigation by enhancing land adjacent to the site which is currently agricultural land. Habitat loss and fragmentation of ancient woodland along the southern extents of the new road, where this links the M2, would involve a very large adverse effect on Great Crabbies Wood SSSI and large adverse effect on Shorne and Ashenbank Wood SSSI ancient woodlands and large adverse effect on a number of Ancient Woodland habitats that are irreplaceable (see detail below). While not legally protected, planning policy is very clear that such sites should only be developed as a last resort.

Impacts on woodlands, specifically Ancient Woodland, is greater for all crossing options if the ESL is adopted as this would directly impact on part of Court Wood (Shorne Local Wildlife Site) and Great Crabbles SSSI, which would be affected by direct habitat loss and fragmentation as part of the connection with the M2 involving a large adverse effect on Ancient Woodland that is replaceable. UK BAP Habitat (Traditional Orchards) will also be affected by habitat loss and fragmentation of the orchard at the connection with the M2 involving a moderate adverse effect on a UK BAP Habitat. While not legally protected, planning policy is very clear that such sites should only be developed as a last resort. There are als potential impacts on Cobham Woods SSSI, 5 areas of ancient woodland (often part of local wildlife sites) and 2 UK BAP Habitats (Wood-pasture and Parkland; Deciduous Woodland) from impacts associated with increased air pollution/nitrogen deposition

Note the Summary Assessment Score is being skewed by impacts on Great Crabbles Wood SSSI and Court Wood where ancient woodland will be lost to the route alignment.

## **Annex 5 – Historic Environment Worksheet**

## **Annex 5: Historic Environment Impacts Worksheet**

## Route 3 ESL Bored

	Step 2		Step 3		Step 4
Feature	Description	Scale it matters	Significance	Rarity	Impact
Form	also contains portions of urban settlements such as South Ockendon, Grays, West Tilbury, Gravesend and smaller settlements such as Orsett.  The study area contains a number of listed buildings (designated heritage assets), either within settlements such as South Ockendon and Orsett or within a more rural context such as small groups of farm buildings. In total there are 58 Grade II, five Grade II* and two Grade I listed buildings within the study area (Grade II*: Marshalls Cottages and Chruch of St James,	and NN-NPS. The treatment of non-designated archaeological remains within the planning process is also considered at a national level in the NPPF and NN-NPS even though they may be of lesser value than designated heritage assets.	The Grade I and Grade II* listed buildings are of high value, whilst the Grade II listed buildings are of medium value. The East Tilbury conservation area is of high value whilst the other three conservation areas are of medium value.  The scheduled monuments are of high value and the non-designated archaeological remains range in value from low to medium.	represented types on a national and regional level and are of moderate rarity. East Tilbury conservation area is a rare example of a planned modernist factory town. The other three conservation areas are relatively well represented regionally and nationally.  The scheduled monuments at South Ockenden Old Hall, South Ockendon Hall, Orsett, West Tilbury and Bowaters Farm are relatively well represented types of monument and are of moderate rarity. The Dene Holes flint mine complex, Springfield style enclosure at Orsett and causewayed enclosure south of Thurrock are less well represented and are of high rarity. The non-designated archaeological remains are of types that are well represented on a regional level and	The Scheme will have a direct physical impact on two Grade II listed buildings: 1 and 2 Gray's Corner Cottages and Thatched Cottage, both to the west of Thurrock. The scheme may impact on the settings of the Grade II listed buildings to the south and west of Thurrock and to the west of West Tilbury. The scheme may also impact on the settings of the West Tilbury, East Tilbury and Shorne Village conservations areas. The impacts may arise as a result of the introduction of a new linear element, the road, in a currently open rural landscape.  The scheme may also impact on the settings of the scheduled monuments at South Ockenden Old Hall, South Ockendon Hall, Orsett, south of Orsett, West Tilbury and Bowaters Farm. The impacts may arise as a result of the introduction of a new linear element, the road, in a currently open rural landscape. In addition, the scheme would have a direct physical impact on the Orsett cropmark complex scheduled monument through the construction of a new road within the scheduled area.  Construction excavations associated with the new road and tunnel portals may impact on non-designated archaeological remains within the scheme footprint via their complete or partial removal.
	The survival of the listed buildings and the conservations areas is comparable with others in the region and is generally good.  The survival of the scheduled monuments is generally good. The survival of the archaeological remains has not yet been fully determined.	The NPPF and NN-NPS takes the survival of heritage assets into account at a national level.	Survival of the designated heritage assets is of moderate to high significance as they contribute to the character of the area.  Survival of the non-designated archaeological remains is of low to moderate significance as surviving remains of these types are important in terms of our understanding of the human past.	Grade I and Grade II* listed buildings are rare on both scales.  With the exception of the Springfield style enclosure at Orsett and the Bowaters Farm anti-	The scheme would not impact on the survival of designated assets within the study area, with the exception of the Orsett cropmark complex which would be subject to the direct physical impacts as the result of road construction within the scheduled area.  The scheme would not impact on the survival of non-designated assets within the study area as a whole, but would have impact within the scheme footprint.
Condition	The historic landscape is in constantly evolving, the condition of landscape features is considered to be good.  The condition of the listed buildings and conservation areas is generally good.  The condition of the scheduled monuments is generally good, with the exception of the Orsett cropmark complex and Bowaters Farm anti-aircraft battery, the condition of which are poor. The condition of the non-designated archaeological remains is currently unknown.	The NPPF and NN-NPS takes the condition of heritage assets into account at a national level.	The condition of the listed buildings and conservation areas is of moderate significance as they have a beneficial effect on the character and amenity value of the study area.  The condition of scheduled monuments and non-designated archaeological remains is of high and moderate significance respectively, as in good condition they can inform our understanding of the human past.	condition are relatively common in this region and have low rarity value.  Scheduled monuments of the nature and condition of those within the study area have a high rarity value.  Non-designated archaeological remains in good	The scheme would impact on the condition of three designated assets within the study area: two Grade II listed buildings to the west of Thurrock (1 and 2 Gray's Corner Cottages and Thatched Cottage), which would be removed and the Orsett cropmark complex scheduled monument, which would be subject to the direct physical impacts as the result of road construction within the scheduled area.  The scheme would have no impact on the condition of non-designated assets within the study area as a whole, but would have some impact within the scheme footprint.
	The listed buildings are not unusually complex and represents a standard mix of agricultural, residential, ecclesiastical and commercial buildings.  Archaeological remains, both scheduled monuments and non-designated, represent activity from a number of periods and in relation to a number of industrial, settlement, funerary and agricultural processes. They are moderately complex but not unusual in a regional context.	The NPPF and NN-NPS takes the complexity of heritage assets into account at a national level.	The complexity of the historic environment resource has moderate significance as it represents both time-depth and potential to provide positive benefits to the character and amenity value and is also indicative of potential value in terms of our understanding of the human past.	level and as such is of low rarity.	The scheme would not impact on the complexity of designated assets within the study area.  The scheme would not impact on the complexity of non-designated assets within the study area as a whole and the scheme footprint.
	The study area lies within the Greater London / Thames Estuary areas and the historic environment resource within the study area reflects this wider context.	The NPPF and NN-NPS takes the context of heritage assets into account at a national level.	The context of the historic environment resource within the study area informs their settings and as such is of moderate to high significance.	The context of the historic environment resource within the study area is relatively common and as such is of low rarity.	The scheme would not impact on the context of the historic environment resource within the study area.

	Step 2		Step 3		Step 4
Feature	Description	Scale it matters	Significance	Rarity	Impact
Period	The listed buildings and conservation areas date from the post-medieval to modern periods.  The scheduled monuments date from the Neolithic to the modern period, whilst the non-designated archaeological remains date from the prehistoric period onwards.	heritage assets into account at a national level.	_		The scheme would not impact on the periods represented by the historic environment resource within the study area.

#### Reference Sources

TAG Unit A3 (November 2014); DMRB Volume11, Section 3, Part 2 (2007); National Heritage List for England; Greater London Historic Environment Record; Essex Historic Environment Record, Thames Estuary Partnership Archaeological Research Framework (1999); Thames Estuary Partnership Greater Thames Research Framework (2010)

## Step 5 - Summary Assessment Score

#### Moderate Adverse

## **Qualitative Comments**

The scheme covers an area that is largely open and rural in character but containing urban areas that expanded during the 19th and 20th centuries. Two Grade II listed buildings (1 and 2 Gray's Corner Cottages and Thatched Cottage, both to the west of Thurrock) would exprience direct physical impacts through their removal. The effect of these impacts is predicted to be Large Adverse. Potential impacts to the settings of the following designated heritage assets have been identified as a result of the scheme: scheduled monuments at South Ockenden Old Hall, South Ockendon Hall, Orsett, south of Thurrock, West Tilbury and Bowaters Farm, Grade II listed buildings to the south and west of Thurrock and to the west of West Tilbury; West Tilbury, East Tilbury and Shorne Village conservations areas. These effects are predicted to be Slight Adverse with regard to the listed buildings and Moderate Adverse with regard to the conservation areas and scheduled monuments. Road construction within the scheduled area of the Orsett cropmark complex will cause a direct physical impact to this designated asset. However, due to the poor condition of the scheduled monument, the effects are predicted to be Moderate Adverse. Construction excavations associated with the proposed road and tunnel may have a physical impact on any non-designated archaeological remains within the scheme footprint are predicted.

## **Annex 6 – Landscape / Townscape Worksheet**

## Annex 6: Landscape Impacts Worksheet

## **Route 3 ESL Bored**

	Step 2			ep 3	_	Step 4
Features	Description	Scale it matters	Rarity	Importance	Substitutability	Impact
	Between the A2 corridor and the A226 the landform is undulating and rises towards the south. The higher land is well wooded, some of the woods are ancient woodlands, with the settlements of Shorne and Shorne Ridgeway running along ridges. Arable fields defined by hedges and trees fill the lower land close to the A226 and in the valleys either side of Shorne. Properties along Pear tree Lane have extensive gardens/grounds, some with horse paddocks.	Local	Rare	Medium	Low. It is not possible to replace ancient woodland.	Large adverse. Route 3 ESL would cut across the pattern of the landscape particularly to the east of Shorne where would run across a valley and then through a hill requiring extensive earthworks. An area of ancient woodland in Great Crabbles Wood would be destroyed.
	Between the A226 and the Thames Corridor the landscape is gently undulating, with large open arable fields and few hedgerows. These are mainly along the roads and around the small settlements.	Local	Rare in a local context	Medium	Varies along the route. Substitutability of farmland and recreation land is medium while the woodland is low.	<b>Moderate adverse.</b> Route 3 ESL would have a direct and indirect impact on the pattern of the existing landscape. In places the it would cut through the gently undulating landform.
Pattern	The Thames river corridor consists of flood embankments along the river edge, backed by expansive marshlands with rough grazing and sparse scrub. On the north side of the river there are extensive areas of old mineral workings, some of which have been backfilled as landfill.	Local	Rare in a local context	High in a local context	Low	Neutral. The tunnel portals would be located to the north and south of the Thames corridor.
	From the North of the Thames corridor to Orsett, Route 3 ESL passes, through gently undulating countryside of medium and large fields, with occasional farm buildings. The area is crossed by a number of overhead electric power lines.	Local	Common	Medium locally	High	Moderate adverse. The road would break up the existing pattern of the landscape in particular at the A13 junction.
	Adjacent to Orsett the route cuts through a historic parkland landscape that forms the setting of the village.	Local	Locally rare	High in a local context	Medium	Moderate adverse. Route 3 ESL would run along the edge of the parkland and would fundamentally change its character.
	Between the proposed junction with the M25 at North Ockendon and Orsett Route 3 passes, through relatively flat open countryside of large arable fields, and close to areas of historic clay pits, now used for landfill.	Local	Common	Medium locally	High	<b>Moderate adverse.</b> Route 3 would have a direct impact on the pattern of the existing landscape. Fields which create a distinct pattern on the landscape would be bisected by the road.
	South of Shorne and Shorne Ridgeway, noise from the A2 and M2 becomes increasing intrusive, although visually due to the screening effect of trees the area is rural in appearance. The immediate area around the M2, A2, A289 junction is dominated by the roads despite extensive planting.	Local	Medium	Medium	Low	Moderate adverse away from the existing A2/M2 transport corridor. Route 3 ESL would introduce high levels of traffinoise and transport infrastructure into the currently rural scene. Closer to the existing roads the impact would be less Some residents on the western edge of Strood would experience an increase in noise and increased visual impact of road infrastructure.
T fe is aı E	The area around Shorne and Shorne Ridgeway has an unspoilt rural feel considering its closeness to Gravesend and the Medway towns. It is relatively free from traffic noise and the visual intrusion of industry and power lines. There are distant views over the Thames corridor to Essex and Tilbury power station.	Local	Medium	Medium	Low.	Large adverse. Route 3 ESL would introduce high levels of traffic noise and transport infrastructure into a currently tranquil rural scene. Some residents of Pear Tree Lane, Shorne Ridgeway, Shorne and Lower Shorne would have a significantly reduced level of tranquillity.
Tranquillity	Between the Thames corridor to the A226 there is visual intrusion on the landscape of urban settlements, roads and pylons. There is constant, although mostly distant, road noise. The sweeping views across the Thames are dominated by Tilbury power station.	Local	Common	Medium	Medium	<b>Moderate adverse.</b> A new road would increase the levels of road noise considerably and introduce transport infrastructure into the view. Some residents of Chalk and Church Lane would have a significantly reduced level of tranquillity.
	Within the Thames corridor there are expansive views over the river and surrounding marshland from the riverside paths which are often some distance from the nearest road. There is always the visual intrusion of man made structures such as jetties, river traffic and Tilbury power station.	Local	Common	High in local context	Low	Slight adverse. A tunnel would pass below the Thames corridor the portal being located to the south of the Lower Higham Road. Noise levels and visual intrusion would be much the same as they are at present, with the exception of locations closest to the portal and ventilation building.
	The level of tranquillity north of the Thames corridor varies considerably with location. There are major arterial roads such as the M25 and A13 which generate traffic noise and disrupt visual tranquillity, while there are open areas of countryside between, that are broken only by the occasional small road. Nowhere is it completely tranquil due to distant road noise and the visual intrusion of urban settlements and pylons.	Local	Common	Medium	High	Moderate adverse Away from the existing large roads Route 3 ESL would introduce additional noise and intrusive visual clutter into the scene. For some residents of East Tilbury, West Tilbury, Linford, east of Chadwell St Mary, Baker Street Orsett and South Ockendon the route will change the view and increase noise, having a detrimental impact on tranquillity.
	Most of the route is located within Green Belt.	Regional	Regionally medium	High in regional context	Low	Moderate adverse. The Green Belt is a valued rural separation between the urban edge of large settlements such as Grays, Tilbury and Gravesend nearby villages. A new road would introduce a new urban element into this landscape.
	Public rights of way.	Local	Common	Medium	High	Impact depends on the right of way but some would be crossed by the route and this would have a <b>Moderate</b> adverse impact on the users of the paths.
	South of the A2 is Cobham Hall which is included in the register of parks and gardens comprising intact 18C parkland, gardens, estate woodlands and golf course.	National	Nationally rare	High nationally	low	<b>Neutral.</b> Part of the Route 3 ESL/ A2/M2 junction would be located within the registered park, however in reality it is outside of the current park boundary. The registered park boundary should be altered to accommodate current transport infrastructure.
	Kent Downs Area of Outstanding Natural Beauty (AONB).	National	Rare nationally	High nationally	Low. It would not be possible to replicate the features of the AONB elsewhere.	The route 3 ESL junction with the A2, A289 and M2 would affect an area on the edge of the AONB and an area immediately around it which is important in terms of its landscape character, although not designated. The new junction would totally destroy this area and part of Great Crabbles Woods having a <b>large adverse</b> impact despite the existing large roads nearby.
	Grade II listed building in Old Watling Street.	Regional	Regionally rare	High in regional context	Low	Slight adverse. The proposed changes to the existing junction will mean that roads are closer to the building.

Features	Description	Scale it matters	Rarity	Importance	Substitutability	Impact
	Well Tree Cottage & Bushylees grade II listed buildings off Pear Tree Lane.	Regional	Regionally rare	High in regional context	Low	There would be a <b>slight adverse</b> impact on the setting of the rear of the buildings.
	Edito.					
	Shorne conservation area. Listed buildings in Shorne within 500m of Route 3 ESL: Front garden wall & gate piers to Pipes Place, Pipes place, Chapel of St Katherine, St Katherine's House, all grade II & Little St Katherine's grade II*.	Grade II * listed building national. Grade II listed buildings local. Conservation area regional.	Grade II* listed building nationally rare, listed buildings and conservation area regionally rare.	High in national/local context	Low	Slight adverse impact on the northern most part of Shorne conservation area. Neutral for the remainder of St conservation area and the listed buildings.
	Listed buildings located close to Route 3 ESL between the A226 and the Thames: Filborough Farmhouse, Barn to the north west of Filborough Farmhouse, the granary at Little Filborough Farm East	National/regional	Nationally/ regionally rare	High in national/regional context	Low	There would be a <b>moderate adverse</b> impact of Route 3 ESL on the setting of the listed buildings.
	Court Manor (all grade II & Church of St Mary in Chalk (grade II*).  Thames and Medway canal route (no longer navigable). Not designated.	Local	Rare locally	Medium in a local	Low	Neutral The portal and road would be located some distance to the south.
	designated.			Context		
	National Cycle Routes 1 and 13.	National	Rare	Medium	High as easily relocated	Moderate adverse where cycle routes would be close Route 3 ESL due to the visual impact of road infrastruct increased noise levels.
Cultural	Saxon Shore Way leisure route along the Thames and public right of way on northern side of the Thames.	Regional/local	Rare regionally	High in a local context	Low	Neutral. The tunnel would pass below the paths.
	Scheduled monument. Coalhouse Fort battery and artillery defences.	National	Rare	High at a national level	Low	Neutral. A tunnel will have no impact on the setting to the monument.
	Tilbury Fort Scheduled monument.	National	Rare	High at a national level	Low	Neutral. A tunnel will have no impact on the setting to the monument.
	Scheduled monument at Bowaters Farm WWII anti aircraft battery.	National	Rare	High at a national level	Low	The monument is largely hidden from view by scrub and despite the closeness of Route 3 ESL it would only ha
	Screduled monument at bowaters I aim wwwi aim aird air battery.	Ivational	Tidle	riigii at a national level	Low	slight adverse impact on the setting.
	Grade II listed building at Bucklands Farm.	Regional	Rare	High	Low	The building is surrounded by trees and the road would have only a <b>slight adverse</b> impact on its setting.
	East Tilbury Conservation area and listed buildings.	Regional	Rare	High	Low	Route 3 ESL is Some distance away from the conservation area which is an unusual modernist development housing and factories. For most of the area the impact would be <b>neutral</b> with <b>slight adverse</b> on the setting of western edge.
	Grade II listed buildings close to the proposed Route 3 ESL junction with the A13: Whitecrofts, Heath House, Murrels Cottage.	Regional	Rare regionally	High regionally	Low	<b>Moderate adverse</b> to the setting of Heath House & Murrels Cottage due to the closeness of the junction. Slig adverse impact to Whitcrofts.
	Scheduled monument. Causewayed enclosure and Anglo-Saxon cemetery close to proposed junction of Route 3 ESL with the A13.	National	Rare	High in national context	Low	<b>Moderate adverse.</b> The monument is not clearly visible from ground level but from the air. While not having a impact on the structure of the monument the proposed junction would change its landscape setting which could important in understanding the causewayed enclosure in particular.
	4 listed buildings west of Orsett: two at Orsett House (one grade II and the other grade II*), Poplars Farm (grade II), and south of the B188 (grade II).	Grade 1 and II* national value, grade II regional	Rare	High	Low	Moderate adverse to the setting of those at Orsett House due to the closeness of the road, with Poplars Farmadverse.
	Conservation area, grade I listed building and grade II listed buildings in Orsett.	National for grade 1 listed building. Regional local for conservation area and grade II listed buildings	Rare nationally/locally	High in national/local context	Low	Neutral. Although within 500m of Route 3 ESL all of the buildings and the conservation area are screened by surrounding development.
	Scheduled monument. Springfield type enclosure and iron age enclosures at Baker Street.	National	Rare	High in national context	Low	Neutral - the monument is not visible at ground level.
	Scheduled monument - Bishop Bonners Palace Orsett.	National	Rare	High in national context	Low	Slight adverse - The monument is largely screened from Route 3 ESL by trees.
	Scheduled monument and listed building (gatehouse and moat of South Ockendon Hall) and Scheduled Monument Roman barrow. All over 500m from the Route 3 ESL.	National	Rare	High in national context	Low	Slight adverse - The current monuments are surrounded by a flat, broad expanse of arable fields. Despite th distance from the proposed route the road infrastructure would have some impact on their setting.
	3 grade II listed buildings, a grade 1 listed building & North Ockendon conservation area.	Regional/national for grade 1 listed building	Rare nationally/regionally	High in national/regional context	Low	Slight adverse - North Ockendon is already impacted by the presence of the M25. Route 3 ESL would be lar screened by existing trees and hedges.

Features	Description	Scale it matters	Rarity	Importance	Substitutability	Impact
	South of the A2 the grounds of Cobham Hall are a Registered Park and Garden comprising an intact 18th century parkland, gardens, estate woodlands and golf course.	National	Rare	High in National context	Low	<b>Neutral.</b> Part of junction of Route 3 ESL with the A2 would be located inside of the registered park, although in reality this is outside of the of the current park boundary. The registered park boundary should be altered to accommodate current transport infrastructure.
	The A2/M2 transport corridor dominates the surrounding rural landscape.	Local	Common	Low	High	Slight adverse. A new road junction would have little impact on land use other than to remove areas of planting and increase the area of road surface.
	The villages of Shorne and Shorne Ridgeway are on the higher land which is also well wooded and includes Shorne and Great Crabbles Woods amongst others.	Local	Medium locally	Medium	Low	Large adverse. A road would change the current land cover next to Southern Alternative from a predominantly rural one to one dominated by transport infrastructure. Large earthworks would be necessary to cut through the high land at Pear Tree Land requiring an extensive footprint.
	South of the A226 the lower areas are predominantly of arable fields bounded by hedges and woodlands.	Local	Medium locally	Medium	Low	Moderate adverse. A road would change the current land cover next to Southern Alternative from a predominantly rural one of fields and woodlands to one dominated by transport infrastructure.
	Between the A226 and the Thames corridor landcover is of large arable fields and small groups of houses. To the west is the suburban edge of Chalk.	Local	Low	Medium	High	<b>Moderate adverse.</b> A road would change the current land cover next to Southern Alternative from a predominantly rural one of arable fields to one dominated by transport infrastructure.
Landcover	The characteristic landcover of the Thames river corridor consists of open flat grazing marsh with sparse scrub and trees cover with emergent plants along ditches. The Thames is lined with inter tidal mud flats and gravel foreshore. On the north side of the Thames there are extensive former mineral workings some of which have been backfilled with landfill.	Regional	Rare	High in regional context	Low	A bored tunnel would have <b>neutral</b> impact immediacy adjacent to the river. Above ground the current agricultural landcover would change along the route to one dominated by transport infrastructure, in the long term there would be the potential for Route 3 to create changes to the surrounding agricultural land which would be bisected and would become less viable to farm.
	North of the Thames corridor the landcover is mostly of arable fields, with hedges and boundary trees. Crossed by a number of small roads and 2 major roads. Areas of old clay pits now used as landfill. Parkland landscape to the west of Orsett.	Local	common	Medium in local context	Relatively easy to improve/plant hedges and trees nearby	Moderate adverse in the immediate vicinity of Route 3 ESL, which would change the existing rural landcover to a transport dominated one.
Summary of character	Open gently rolling arable countryside with sparse hedges and boundary trees, with surviving areas of historic field patterns, minor roads and small settlements. Prominent features consist of arterial roads, pylons, and the distant urban edge of large settlements. The land rises south of the A226 with villages and woodland on the higher land. Further south still is the busy A2/M2 road corridor.	Regional	Regionally medium	Regionally medium	Medium	Large adverse. Although there are major roads running through the parts landscape, Route 3 ESL would introduce a new transport corridor through areas that are largely rural in character in particular around Shorne and the AONB. In places this would dramatically change the character of the landscape from a rural one to one dominated by transport infrastructure and have a wider effect on the surrounding area than the immediate footprint of the road.

### Reference Sources

Department of Transport TAG Unit A3 Environmental Impact Appraisal May 2014, Magic.gov.uk, Google Maps satellite photography, OS Maps, Thurrock UDP deposit draft 2003 (unadopted). National Character Area 111 Northern Thames Basin, National Character Area 81 Greater Thames Estuary.

## Step 5 - Summary Assessment Score

Large adverse

## **Qualitative Comments**

Route 3 ESL would create a new road corridor and introduce a significant change to the existing landscape character which is designated as Green Belt and part of which is an AONB. Infrastructure associated with the road such as embankments, retaining structures, bridges, signage and lighting, would be notable additional built elements within the open rural landscape. The new road corridor and junction infrastructure associated with Route 3 ESL would impact directly and indirectly on locally, regionally and nationally valued features including scheduled monuments and listed buildings.

## **Annex 7 – Water Worksheet**

## Annex 7: Water Environment Impacts Worksheet

## Route 3 ESL Bored

March   Marc	Route 3 ESL Bored									
The state of the control of the cont	summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity		Importance	Magnitude	Significance
Married   Marr	Potential Impacts: Morphological and hydrodynamic changes to the			Recommended Marine Conservation Zone. Heavily modified water body at Moderate Ecological Potential and					Negligible	Low significance
The first process of the control of	and spillage risk during operation	Water Body Thames Middle) ID No:	products / recreation / aesthetics / cultural heritage / value to	s Important river of national significance with commercial and social value, including depository for effluent discharges, abstraction of water supply, recreation and, navigation. South Thames Estuary and Marshes	(excludes biodiversity	Rare	Not feasible	Very High	Assume assessment of the new roads runoff and spillage risk is carried out and treatment /	Insignificant
Part     Part   Part   Part     Part   Part     Part     Part     Part     Part     Part     Part   Part   Part     Part     Part     Part     Part     Part     Part     Part     Part     Part     Part     Part     Part     Part     Part   Part     Part     Part     Part     Part     Part     Part   Part     Part     Part   Part     Part   Part     Part	Study Area: Mar Dyke								<u> </u>	
Production of the Control of the C	and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures	WFD Water body ID	transport & dilution waste	Waterbody currently at Moderate Ecological Status. Target Good Ecological Status by 2027 Water available for abstraction		target WFD status, water	Not feasible	Medium	Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable	Insignificant
The control of the co	and spillage risk during operation			(Roding Beam Ingrebourne and		availability)			Negligible (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures	
Register incomes fluid to creat and accounts making the second of the company of	and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures	WFD water body ID	transport & dilution waste	Waterbody currently at Poor Ecological Potential. Target Good Ecological Potential by 2027 Water available for abstraction		target WFD status, water	Not feasible	Medium	Slight adverse Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable	
The production of the producti	and spillage risk during operation	32.0000.02002	, (objective)	Roding Beam Ingrebourne and					Negligible (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures	
National Registers useful and a language Parties useful and a language parties as assessment of the new roads and and social position in the process of the control of the new roads and and social position of the new roads and and and social position of the new roads and and and social position of the new roads and and and social position of the new roads and and and social position of the new roads and and and social position of the new roads and and and social position of the new roads and and and social position of the new roads and and social position of the ne	and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures	WFD water Body ID GB106037027970	transport & dilution waste	Waterbody currently at Moderate Ecological Potential. Target Good Ecological Potential by 2027 Water available for abstraction		target WFD status, water	Not feasible	Medium	Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable	Insignificant
Description   Properties   Pr	and spillage risk during operation		podded / Teoledien	(Roding Beam Ingrebourne and					Negligible (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment	
Posential Impacts: Murry valencourses and disablage disches and Michael Variable (See also Michael Variable) (Foreign and Mi	Study Area: Thames and Medway	Canal								
Cost	and hydrodynamic changes to the	Thomas and Madusu Const		separately) Thames and Medway Canal good potential, no other water quality data					Assumes bored tunnel section passes beneath canal and has no impact on surface water	Insignificant
Potential Impacts: Morphological changes to minor watercourses and drainage networks  Assumes bored tunnel section has no impact on insignificant surface water courses and drainage networks.  More water courses and drainage networks  Assumes bored tunnel section has no impact on insignificant surface water courses.  Medium  Could support protected ecological species. Assumed interaction with water environment not biodiversity.  Potential impacts: Routiner rundfi and spillage risk during operation.  Study Area: Minor watercourses and drainage ditches north of the River Thames (see also Mardyke water body)  Potential impacts: Morphological changes to drainage networks.  Minor watercourses and drainage ditches north of the River Thames (see also Mardyke water body)  Potential impacts: Morphological changes to drainage networks.  Minor watercourses and drainage ditches at East Tilbury Marshes.  More watercourses and drainage ditches at East Tilbury Marshes.  More watercourses and drainage ditches at East Tilbury Marshes.  Modium  Could support protected ecological pecies. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity.  Limited fleasibility  Medium  Common Limited  Negligible  Assumes watercourse crossings and or displacement includes appropriate mitigation.  Insignificant courses and displacement includes appropriate mitigation.  Insignificant displacement includes appropriate mitigation in a pecing pecing and propriate displacement includes appropriate mitigation.  Modium  Could support protected ecological pecies. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity.  Medium  Could support protected ecological fleasibility.  Medium  Could support period ecological fleasibility.  Medium  Could suppo	and spillage risk during operation	(Ca18)	waste products / recreation /	known whether these water bodies have any intrinsic social or economic value. Not currently used for navigation. Appraisal on water		Moderate		Medium	Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted. Note: Best practice drainage design precludes discharge to	Insignificant
Assumes bored tunnel section has no impact on Insignificant and drainage networks  Minor water courses and drainage networks  Medium Could support protected ecological species. Assumed interaction with shallow groundwater. Appraisal on a water environment not biodiversity  Potential Impacts: Routine runoff and spillage risk during operation of the new roads  Minor watercourses and drainage ditches north of the River Thames (see also Mardyke water body)  Biodiversity / recreation / Study Area: Minor watercourses and drainage ditches north of the River Thames (see also Mardyke water body)  Potential Impacts: Morphological changes to drainage networks  Minor watercourses and drainage ditches at East Tilbury Marshes  Minor watercourses and drainage ditches at East Tilbury Marshes  Minor watercourses and drainage ditches at East Tilbury Marshes  Medium  Could support protected ecological species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity  Marshes  Medium  Common  Limited feasibility  Assumes assessment of the new roads runoff and finage interaction with shallow groundwater. Appraisal on water environment not biodiversity  Marshes  Medium  Could support protected ecological species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity  Marshes  Medium  Could support protected ecological species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity  Medium  Could support protected ecological species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity  Medium	Study Area: Minor watercourses	and drainage ditches at South	Thames Estuary and Marshes (e	excluding Thames and Medway canal	) T	-		Γ	T	
Potential Impacts: Routine runoff and spillage risk during operation of the new road  Study Area: Minor watercourses and drainage ditches north of the River Thames (see also Mardyke water body)  Potential Impacts: Morphological changes to drainage networks  Minor watercourses and drainage ditches at East Tilbury Marshes  Biodiversity / recreation / amenity  Marshes  Water environment not biodiversity  water body)  Stight adverse  Assumes watercourse crossings and or displacement includes appropriate mitigation  linsignificant  Common Limited  feasibility  Medium  (Moderate adverse)  Negligible  Assumes watercourse crossings and or displacement includes appropriate mitigation  water environment not biodiversity  leading officence and spillage risk during operation  Insignificant line includes appropriate mitigation  Insignificant line includes appropriate mitigation  Assumes watercourse crossings and or displacement includes appropriate mitigation  (Moderate adverse)  Negligible  Assumes watercourse crossings and or displacement includes appropriate mitigation  water environment not biodiversity  and appliage risk during operation  Assumes watercourse crossings and or displacement includes appropriate mitigation  (Moderate adverse)  Negligible  Assumes watercourse and appliage risk during operation  Insignificant displacement includes appropriate mitigation  Assumes watercourse and appliage risk during operation and appliage risk during operation.	changes to minor watercourses	of Shorne, Eastcourt, Great Clane Lane and Filborough		Could support protected ecological species. Assumed interaction with	Local	Common		Medium	Assumes bored tunnel section has no impact on	Insignificant
Potential Impacts: Morphological changes to drainage networks  Minor watercourses and drainage ditches at East Tilbury Marshes  Medium  Could support protected ecological species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity  Potential Impacts: Routine runoff and spillage risk during operation  Assume assessment of the new roads runoff and longingficant longingificant.  Local  Common  Limited feasibility  Medium  (Moderate adverse) Negligible Assume assessment of the new roads runoff and longingificant.  Local  Local  Local  Assumes assessment of the new roads runoff and longingificant.  Local  Local  Assume assessment of the new roads runoff and longingificant.  Local  Local  Local  Local  Local  Assume assessment of the new roads runoff and longingificant.  Local  Lo	and spillage risk during operation	Estuary and Marshes SSSI and							Assume assessment of the new roads runoff and spillage risk is carried out and treatment /	Insignificant
Assumes watercourse crossings and or displacement includes appropriate mitigation  Minor watercourses and drainage ditches at East Tilbury Marshes  Medium  Could support protected ecological species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity  Potential Impacts: Routine runoff and spillage risk during operation  Assumes watercourse crossings and or displacement includes appropriate mitigation  Local  Common  Limited feasibility  Medium  (Moderate adverse)  Negligible  Assume swatercourse crossings and or displacement includes appropriate mitigation  Insignificant  Insignificant  Insignificant  Local  Assumes watercourse crossings and or displacement includes appropriate mitigation  Insignificant  Local  Assumes watercourse crossings and or displacement includes appropriate mitigation  Insignificant  Local  Assumes watercourse crossings and or displacement includes appropriate mitigation  Insignificant  Local  Local  Local  Local  Local  Assumes watercourse crossings and or displacement includes appropriate mitigation  Insignificant  Local  Assumes watercourse crossings and or displacement includes appropriate mitigation  Local  Lo	Study Area: Minor watercourses	and drainage ditches north of	the River Thames (see also Mar	dyke water body)	Τ				T	
Marshes shallow groundwater. Appraisal on water environment not biodiversity  Potential Impacts: Routine runoff and spillage risk during operation  Marshes  Shallow groundwater. Appraisal on water environment not biodiversity  (Moderate adverse)  Negligible Assume assessment of the new roads runoff and law gignificants  Law gignificance		drainage ditches at East Tilbury		Could support protected ecological species. Assumed interaction with	Local	Common		Medium	Assumes watercourse crossings and or	Insignificant
of the new road spillage risk is carried out and treatment / containment measures adopted			amenity	shallow groundwater. Appraisal on			reasionity		Negligible Assume assessment of the new roads runoff and spillage risk is carried out and treatment /	

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
Study Area: Lakes and ponds								Negligible:	
Loss of or other physical impact on standing water bodies  Potential Impacts: Routine runoff and spillage risk during operation of the new road	Standing water features (natural and man made) on land to N and S of River Thames including ponds and lakes and standing water in marsh areas	Biodiversity / recreation / amenity / water supply (small reservoirs and dams)	Low - Medium Could support protected ecological species. Some reservoirs and local (largely) agricultural water supplies	Local	Common	Limited feasibility	Low	Negligible:  Negligible: Assumes no drainage to standing water in accordance with best practice.	Insignificant Insignificant
Study Area: Groundwater north	of River Thames			I.	<u>I</u>				
	South Essex Thurrock Chalk (GB40601G401100)	WFD water body status; water supply / resources; groundwater dependent ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Source Protection Zones 2 and 3 ((Linford / East Tilbury) Local commercial / industrial /agricultural licenced supplies Roding Beam Ingrebourne and Mardyke CAMS - no water available for further abstraction	Regional (ref WFD water body status)	Rare (CAMS shows restricted water availability)	Not feasible	High (based on resource availability, WFD target)	(Moderate adverse) Depends on whether permanent structures and or permanent dewatering (including at portal) impact groundwater flow Slight adverse with mitigation. Assumes any drainage to ground managed in accordance with best practice	Low significance (significant)
Potential Impact: Impact on groundwater quality from potentially polluting surface activities/ highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnel portals (if required) or disruption to	Essex gravels (GB40503G000400)	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Local commercial / industrial / agricultural licenced supplies	Regional (ref WFD water body status	Moderate	Not feasible	Medium	Negligible - slight adverse Assumes at grade road would not significantly impact groundwater and cuttings have minor impact on shallow groundwater. Drainage to ground managed in accordance with best practice. No exposure of this formation at Thames crossing	Insignificant
natural groundwater flow by underground structures. Long term impacts from mobilisation of leachates from contaminated land / old landfill	South Essex Lower London Tertiaries (G16) (GB40602G401000)	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium - low WFD water body status (current poor, target good)	Regional (ref WFD water body status	Moderate	Not feasible	Medium	Negligible: Little exposure of this formation Assumes any drainage to ground managed in accordance with best practice	Insignificant
	Shallow groundwater in alluvium, gravels and other superficial deposits (non WFD water bodies)	Groundwater dependant ecosystems (biodiversity); local water supply (agriculture)	Low	Local	Common	Not feasible	Low	Slight to moderate adverse. Depends on whether permanent structures and or permanent dewatering (including at portal) impact shallow groundwater flow Assumes any drainage to ground managed in accordance with best practice. Also assumes any landfill leachate appropriately managed	Insignificant
Study Area: Groundwater south	of River Thames	I							
Potential Impact: Impact on groundwater quality from potentially polluting surface activities/ highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels and tunnel portals (if required) or disruption to natural groundwater flow by underground structures	North Kent Medway Chalk WFD Water body ID GB40601G500300	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	High WFD water body status (current poor, target good). Source Protection Zones 1, 2 and 3 (SE of Shorne) Local commercial / industrial / agricultural licenced supplies	Regional (ref WFD water body status	Rare (CAMS shows restricted water availability)	Not feasible	High (based on resource availability, WFD target)	(Moderate adverse) Depends on whether permanent structures and or permanent dewatering (including at portal) impact groundwater flow Slight adverse with mitigation. Assumes any drainage to ground managed in accordance with best practice	Low significance (significant)
Potential Impact: Impact on groundwater quality from potentially polluting surface activities/ highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels (if required) or disruption to natural groundwater flow by underground structures. Derogation of water in SSSI	Shallow groundwater (terrace gravels/ alluvium) feeding South Thames Estuary and Marshes SSSI	Groundwater dependant ecosystems (biodiversity); local water supply (agriculture)	Low (Ramsar/SSSI covered by biodiversity)	Local (National / International value covered by biodiversity)	Common	Not feasible	Low	Slight adverse Bored tunnel would pass beneath any shallow aquifer north of portal but may be impacted by long term dewatering at portal. Assumes any drainage to ground managed in accordance with best practice	Insignificant
Study Area: River Thames Flood	Zone 2/3 and associated defen	ces	<u> </u>		1	T		T	
Potential Impacts: Direct risk of flooding to highway from watercourse or tidal source (Thames)	River Thames crossing route	Transport link - improves efficiency of existing network	High	Regional	Moderate	Feasible (alternative crossing locations)	High	Slight adverse - portals and approaches off (defended floodplain) crossing closures due to flood conditions unlikely , further mitigation through design and integrated defences	Low significance
Potential impacts: Impedance of flood flows in River Thames channel due to crossing resulting in obstruction to flow	River Thames channel	Conveyance of flood flows	High - managed watercourse draining large upstream catchment	Local (immediate vicinity of crossing and City of London upstream)	Moderate	Not feasible	High	Negligible (bored tunnel would not interact with Thames channel flows)	Insignificant
Potential Impacts: Loss of flood storage volume (including loss through impedance of flood flows) due to the development (e.g. embankments, cuttings) or permanent spoil disposal sites leading to increased flood risk	River Thames floodplain	Conveyance and storage of flood flows: Mostly defended floodplain at present in vicinity of proposed route.  TE2100 Policy P4 implies improved defences in the future will ensure route remains in the defended floodplain	Medium - significant potential storage volume but not currently used for flood storage as the natural floodplain is defended	Local	Moderate	Feasible: Loss of (defended) floodplain storage substitutable	Medium (not currently used for flood storage)	Slight adverse: Assumes minimal loss of floodplain storage within defended River Thames floodplain	Insignificant
Potential impacts: Increase in flood risk by affecting existing flood defence or by preventing future flood defence development (e.g. actions under Thames Estuary TE 2100 planning)	River Thames flood defences	Protection of property/assets from flooding	High - provides protection for large urban area	Local	Moderate	Not feasible: Unlikely to be substitutable	High	Slight adverse: Assumes minimal loss of floodplain storage within defended River Thames floodplain	Insignificant

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
Study Area: Mardyke Flood Zone 2	2/ 3 and associated defences			L	1	1		1	<u> </u>
Potential Impacts: Direct risk of flooding to highway from watercourse or tidal source (Mar Dyke)	River Thames crossing route	Transport link - improves efficiency of existing network	High	Regional	Common	Feasible (alternative crossing locations)	High	(Moderate Adverse) Slight adverse (mitigation available, design to manage flood risk - defended floodplain)	Low significance (Significant)
Potential Impacts: Loss of flood storage volume (including loss through impedance of flood flows) due to the development (e.g. embankments, cuttings) or permanent spoil disposal sites leading to increased flood risk	Mardyke floodplain	Conveyance and storage of flood flows: Defended floodplain at present in vicinity of proposed route.  TE2100 Policy P4 implies improved defences in the future will ensure route remains in the defended floodplain	Medium - potential flood storage shown in vicinity of route (EA flood Map) but shown as defended flood plain	Local	Common	Feasible: Loss of (defended) floodplain storage substitutable	Low	(Moderate adverse) -potential to increase flood risk upstream for mostly rural area. Slight adverse with mitigation - viaduct spans flood plain	Low significance (Significant)
Potential Impacts: Risk of afflux flooding (upstream) due to crossing of watercourse or land drain	Mardyke channel	Conveyance of flood flows.	High - river channel shown (EA Flood Map) to convey flood flows at least up to 100-yr return period	Local	Moderate	Not feasible	High	(Moderate adverse) -potential to increase flood risk upstream for mostly rural area.  Slight adverse with mitigation - viaduct spans flood plain	Low significance (Significant)
Potential impacts: Increase in flood risk paffecting existing flood defence or by preventing future flood defence development (e.g. actions under Thames Estuary TE 2100 planning)	Mardyke flood defences	Protection of property / assets from flooding	Low? - none shown on EA floodmap in vicinity of route	Local	Moderate	n/a - no defences shown (EA Flood map) in vicinity of proposed route	n/a	n/a - no defences shown (EA Flood map) in vicinity of proposed route	Insignificant - no defences shown (EA Flood map) in vicinity of proposed route
Study Area: Area surrounding Mai	in Rivers, Ordinary Watercours	ses, land drains and ditches, inc	luding marshes			•			
of watercourse or land drain	Minor drainage networks within the land to N and S of Rilver Thames, including drainage of Stone, Purfleet and West Thurrock Marshes ("West Thurrock Main Sewer")	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	Low	(Moderate adverse) (potential increase in flood risk). Slight adverse to negligible with mitigation	Insignificant Low significance
Potential Impacts: Risk of increased runoff to watercourse or land drain causing increase in flood risk from watercourse	As above	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	low	(Moderate adverse) (potential increase in flood risk).  Slight adverse to negligible with mitigation	Insignificant Low significance
Potential Impacts: Risk of flooding resulting from change in watercourse/drain flow regime due to morphological changes for development	As above	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	Low	(Moderate adverse) (potential increase in flood risk). Slight adverse to negligible with mitigation	Insignificant Low significance
Study Area: Entire route.									
Potential Impacts: Risk of flooding from overland surface water flows (surface water "pluvial" flooding)	Various floodplains and surface water drainage areas	Flood risk: People and property	Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	(Moderate adverse) (potential increase in flood risk) Slight adverse after mitigation	Insignificant Low significance
Potential Impacts: Risk of flooding from groundwater	water drainage areas	Flood risk: People and property	Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	(Moderate adverse) (potential increase in flood risk) Slight adverse after mitigation	Insignificant Low significance
Potential Impacts: Risk of flooding from drains, sewers, and water mains	Various floodplains and surface water drainage areas	Flood risk: People and property	Medium Located across multiple flood zones	Local	Common	Limited feasibility	Low	(Moderate adverse) (potential increase in flood risk) Slight adverse after mitigation	Insignificant Low significance

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North Kent Rivers Catchment Flood Management Plan (CFMP). Environment Agency. 2009.
Highways Agency Drainage Data Management System (HA DDMS)

## Summary Assessment Score

(Post mitigation) Moderate Adverse impacts

#### **Qualitative Comments**

Note 1: Risks from construction are only considered where they may have a permanent impact on the water environment once construction is completed.

lote 2: Impacts on biodiversity may occur as a result of changes in water courses, river morphology, sedimentation, water quality and/or flow. Impacts on habitats / ecosystems / flora / fauna are covered separately under biodiversity and not included here to avoid "double counting"

vote 3: For some features, the magnitude of impacts is shown without mitigation (bold red font in parentheses) and with mitigation (bold, the convention for webTAG assessment). In these cases significance of effect is shown both without (red font in parentheses) and with mitigation

Surface Water: The bridge crossing over the Thames will need to be developed to minimise impacts on river morphology from the bridge, although these are expected to be relatively localised with small increases inflow velocity within +/-2000m and there is little impact on HWL. Navigation will be affected by the position of the piers and bank structures, but the design will ensure main navigable channels remain relatively unaltered. The bored tunnel would have little impact on the quality or morphology of the River Thames. Assuming the current bed profile is restored post construction, impacts from the immersed tunnel depend primarily on the scale of any permanent effects (if any) that arise through the construction process (morphology, sedimentation, water quality, fisheries, navigational channels). Whilst these may have local impact, within the context of the Thames Middle water body verall, these are considered to be likely to be at worst moderate adverse. The long term impacts of sedimentation change (brought about during construction) are mostly related to tidal and inter tidal habitats, assessed under biodiversity.

npacts on the Mardyke (WFD water body) will depend on the nature of the crossings adopted, fully spanning and viaduct crossings are likely to have only slight impacts, where smaller channel crossings are employed, mitigation is generally available to reduce impacts to slight adverse.

mpacts on the Thames and Medway canal (WFD water body) depend on the construction methods adopted, a cut and cover tunnel through this area (immersed tunnel option) would lead to a loss of part of the water body and could impact its WFD status, however if mitigation in the form of full canal estoration post construction is adopted, these impacts could be reduced from moderate (or even large) adverse to slight adverse

are considered mostly slight adverse once mitigation is applied, although pending a full understanding of the impacts of the construction of the immersed tunnel, these impacts on the Tidal waters of the Thames remain moderate adverse

Groundwater: Issues with rising groundwater levels have been identified regionally although it is understood these are less problematic in this immediate area. A tunnel crossing will require temporary dewatering during construction and may need longer term dewatering at portals. Larger proundwater resources and public supplies, primarily from the Chalk at depth are unlikely to be impacted, although there may be some impact on local licensed commercial/ industrial/ agricultural supplies from shallow groundwater in the gravels, these are not thought to be significant. Through possible impacts on groundwater quality and flow from the construction of a long bored tunnel there may be residual slight adverse impacts on completion. Impact at source protection zones (especially SPZ 1 near Shorne) may be mitigated by adopting appropriate construction and drainage

WFD status: A Water Framework Directive assessment will be required due to the potential for direct effects on biological, chemical and physical WFD parameters for both surface waters (Thames, Mardyke, Thames and Medway canal) and WFD groundwater bodies (north and south of the river). With appropriate mitigation, it is not anticipated that the River Thames crossing or impacts on the Mardyke or groundwaters will lead to a reduction on WFD status or will prevent these water bodies reaching good status or potential in the future. For the assessment, it is generally assumed that the arget 2027 status of good applies, even though current status of most water bodies is poor.

The bridge option has some potential to increase flood risk in the River Thames channel upstream due to piers and other structures impeding channel conveyance. The bored and immersed tube tunnels would have no impact on channel conveyance. The impact of the bridge on channel conveyance is kely to be mitigated through design (adequate span, minimise pier dimensions).

unnel options would be at higher risk of route closure due to high flood levels (i.e. through breach or overtopping of existing defences).

All bridge and tunnel options would require a design that integrates with (or does not compromise) TE2100 River Thames flood defence plans. At the River Thames flood defence locations the current Route 3 bridge design indicates the bridge would be significantly higher (and on viaduct) than the lood defences south of the River Thames which are located at the approximate transition between a raised viaduct and suspended bridge (no defences are shown on the north bank of the River Thames as here high ground forms the defence line). The Route 3 bored tunnel and immersed tunnel ptions have portals set back from the River Thames (south embankment) flood defences. However, there would still be a need to consider the impact of a tunnel on flood defences e.g. due to interference with flood defence piling by the tunnel.

P4 for Policy Unit Purlleet, Grays and Tilbury, north of the River Thames (take further action to keep up with climate change and land use change so that flooding does not increase)
P3 for Policy Unit East Tilbury and Mucking Marshes, north of the river Thames (continue with existing or alternative actions to manage flood risk)
P3 for Policy Unit North Kent Marshes, south of the River Thames (continue with existing or alternative actions to manage flood risk). TE2100 includes an action to provide a secondary defence to Gravesend to protect from flooding from the tidal River Thames from the east. There is an opportunity for the Route 3 road embankment to provide this structural defence.

CFMP policies for Route 3 south of the River Thames (North Kent Rivers CFMP) are P3 for the North Kent Marshes Policy Unit (areas of low to moderate flood risk where we are generally managing existing flood risk effectively - i.e. no anticipated increase in FRM measures) and P1 for the North ent Downs Policy Unit (areas of little or no flood risk where we will continue to monitor and advise).

CFMP policies for Route 3 north of the River Thames (South Essex CFMP - Thames Urban Tidal Policy Unit) are P4 for the Thames Urban Tidal Policy Unit (take further FRM actions to keep pace with climate change) and P6 for the Upper Mardyke Policy Unit (store water or manage run-off in ocations that provide overall flood risk reduction or environmental benefits). Where Route 3 crosses the Mardyke floodplain there may be opportunities to increase flood storage upstream of the road to provide benefits downstream.

Route 3 crosses the Mardyke flood plain. Whilst this may present a flood risk to the proposed road and the potential for the road to increase flood risk upstream, there is also potential for the road embankment to be designed to hold back flood water and hence alleviate flood risk downstream consistent with South Essex CFMP policy).

Thurrock SWMP (URS 2013) identifies Critical Drainage Areas (CDAs). Route option C2 passes through CDA\_012, and so the road should be designed so that any drainage problems in this area are not exacerbated (with improvements provided where feasible). Thameside SWMP (JBA 2013) is a Stage 1 SWMP and does not provide much detail in relation to the Option C3 route alignment and implications for local flood risk.

The surface water drainage strategy / design (in accordance with HE guidance and standards) should be agreed with the relevant Lead Local Flood Risk Authorities. It is likely this will require that surface water runoff from the proposed crossing does not exceed existing rates (using SUDs where

## **Annex 8 - Noise Worksheet**

Annex 8: Noise Worksheet Route 3 ESL Bored Tunnel APPRAISAL - NOISE POLLUTION Present value base year: 2010 2015 Current year: 2025 Proposal Opening Year: Average Household Size: 2.36 Project (Road or Rail): Road No. of households experiencing 'without scheme' & 'with scheme' noise levels (given in dB<sub>Leq</sub>) in Opening Year With 45-47.9 | 48-50.9 | 51-53.9 | 54-56.9 | 57-59.9 | 60-62.9 | 63-65.9 | 66-68.9 | 69-71.9 | 72-74.9 | 75-77.9 | 78-80.9 Without scheme <45 45-47.9 9699 1030 307 4595 68 293 60 15 48-50.9 51-53.9 1348 5043 316 4646 42 15 10 1211 0 54-56.9 57-59.9 184 915 3416 39 0 43 676 2532 710 166 12 60-62.9 0 13 150 63-65.9 0 524 2767 93 1750 866 72-74.9 75-77.9 197 49 0 0 0 0 53 No. of households experiencing 'without scheme' & 'with scheme' noise levels (given in dB<sub>Leq</sub>) in 15th Year After Opening 48-50.9 51-53.9 54-56.9 57-59.9 60-62.9 63-65.9 66-68.9 69-71.9 72-74.9 75-77.9 78-80.9 45-47.9 Without scheme 9334 985 <45 <45 45-47.9 48-50.9 51-53.9 54-56.9 57-59.9 1169 5243 44 182 875 60-62.9 63-65.9 66-68.9 69-71.9 654 2746 165 1825 72-74.9 75-77.9 39 78-80.9 81+ £9,958,130 Net Present Value of Noise of Proposal \*positive value reflects a net benefit (i.e. noise reduction) (60 Year Period) Estimated Population Annoyed (Do-Minimum): 12418 Estimated Population Annoyed (Do-Something): 12169 Net Noise Annoyance Change in 15th Year After -249 sitive value reflects an increase in people annoyed by noise Opening (no. of people):

# Appendix 7.6 Appraisal Summary Table Route 4 ESL (BT)

Appraisal Summary Table Route 4 ESL (BT)

Annex 1: TEE table

Annex 2: PA table

Annex 3: AMCB table

Annex 4: Biodiversity worksheet

Annex 5: Historic environment worksheet

Annex 6: Landscape/ townscape worksheet

Annex 7: Water worksheet

Annex 8: Noise worksheet

Appra	aisal Summary Table	Route 4, Eastern Southern Link, Bored Tunnel	Date produced: 22 Jan 2016			Contact:		
Do	Name of scheme: escription of scheme:	Route 4 Bored Tunnel with Eastern Southern Link - Core Growth, Central Case costs New Dual 2 lane trunk road (70mph) from M25 J29, linking with A127 and running pa additional lane for future proofing, 2km to the east of Gravesend with an easterly south	rallel to A128, crossing t			th an	Name Organisation Role	Chris Taylor Highways England Project Sponsor
	Impacts	Summary of key impacts	Qı	uantitative	Asses	sment Qualitative	Monetary £(NPV)	Distributional 7-pt scale/ vulnerable grp
Economy	Business users & transport providers	Large time savings estimated for business travellers, including freight, due to reduced congestion and improved connectivity. Small vehicle operating cost benefits would also occur due to reduced congestion. Small user charge disbenefits as there will be charges on the new crossing.	0 to 2min 2	ey time changes (£) 2 to 5min	£2,838m > 5min :2,207m	N/A	£3,352m	Not appraised yet
	Reliability impact on Business users	The option would improve journey time reliability for journeys across the Thames by providing a completely alternative route, and relieving congestion on the existing Dartford Crossing.		N/A		N/A	£110m	
	Regeneration Wider Impacts	Not appraised using WebTAG, but see complementary wider economic modelling Wider Impact (WI) benefits are more than double those for Route 1. More than 80% of WI benefits are from the agglomeration of business activities.	Agglomeration Output in imperfectly co Labour supply impacts	N/A mpetitive markets	£1,398m £335m £1m	N/A N/A	N/A £1,735m	
Environmental	Noise	There is a small net benefit. Whilst there are reductions in noise along the M25/ A282 corridor, there are increases in noise for communities along the new route.	312 people would benefit to people being annoyed by redecreasing to 12,107 people.	noise in the without sch	eme situation	N/A	£12m	Not appraised yet
Envir	Air Quality	All properties which are predicted to exceed or are at risk of exceeding the AQSO in the without Scheme situation would experience an improvement in air quality with the Scheme.	AQSO without the scheme 60 receptors), but these re compared to the without so	Two of the receptors modelled are predicted to exceed the AQSO without the scheme (representing up to approximately 60 receptors), but these receptors experience an improvement compared to the without scheme. The scheme is not predicted to lead to any new exceedences.		N/A	N/A	Not appraised yet
	Greenhouse gases	The option is forecast to result in an increase in both non-traded and traded carbon emissions	Change in traded carbon of	Change in non-traded carbon over 60y (CO2e)  6,637,840 tonnes  Change in traded carbon over 60y (CO2e)  17,848 tonnes		N/A	-£304m	
	Landscape	A new road would adversely affect the landscape character including in the vicinity of Shorne and Shorne Ridgeway, green belt and intrude into the AONB. A bored tunnel would have limited impact on the character of the Thames corridor although new road infrastructure could potentially be visible from the AONB.	N/A		Large Adverse	N/A		
	Townscape	See Landscape entry	N/A		N/A	N/A		
	Historic Environment	Direct physical impacts to one Grade II* registered park and garden, one conservation area and one Grade II listed building. Potential impacts to the setting of a number of designated heritage assets and direct effects on non-designated archaeological remains within the scheme footprint	N/A		Large Adverse	N/A		
	Biodiversity	Potential indirect effects on the Thames Estuary & Marshes SPA (loss of functionally linked land) and areas of ancient woodland, including Cobham Woods SSSI. Impacts on LWSs, areas of BAP Priority Habitat & direct loss of habitat from ancient woodland sites, including Great Crabbles Wood SSSI & Court Wood.	N/A		Very Large Adverse	N/A		
	Water Environment	Negligible impacts on Mardyke.		N/A		Slight Adverse	N/A	
Social	Commuting and Other users	Compared to business users, relatively small time savings arise for commuters and other users due to reduced congestion and improved connectivity. Vehicle operating cost disbenefits due to increased travel and lack of perception by non-business travellers. Small road user charge disbenefit as there will be charges on the new crossing		ey time changes (£) 2 to 5min	£676m > 5min £625m	N/A	£260m	Not appraised yet
	Reliability impact on Commuting and Other users	The option would improve journey time reliability for journeys across the Thames by providing a completely alternative route, and relieving congestion on the existing Dartford Crossing.		N/A		N/A	£40m	
	Physical activity	The option has no impact on walking and cycling The route would provide a new high standard free-flowing solution and would relieve traffic from		N/A		N/A	N/A	
	Journey quality	The route would provide a new high standard free-illowing solution and would relieve trainic from the existing crossing at Dartford and other routes including the A2. The ESL is the only option which provides a motorway to motorway link, connecting the M2 with the M25. Route 4 uses the A127 (a heavily used dual carriageway County road) for part of the route, which will involve mixing of strategic and County road traffic		N/A		Moderate Beneficial	N/A	
	Accidents	DfT's COBALT tool has been used to appraise accidents and shows a net increase in the number and value of accidents across the road network, as a result of this being a new route. However a separate appraisal has also been undertaken using actual accident data across the road network, which shows that the option will lead to a reduction in the rate of accidents (as measured by the Fatal and Weighted Injury rate per billion vehicle kilometres).	Because it is a new route 2,147 additional accidents are predicted over 60 years, including 32 fatalities, 238 serious injuries and 3,071 slight casualties		N/A	-£113m	Not appraised yet	
	Security	Lighting will be provided in accordance with Highways England's TA49/07 standard for new and replacement lighting on the strategic road network	N/A		Slight Adverse	N/A	Not appraised yet	
	Access to services Affordability	Not appraised because this criteria relates to public transport options  The appraisal has assumed the same charges for the new crossing in real terms as those at	N/A		N/A	N/A	N/A	
	Severance	Dartford Crossing today  Safe re-provision will be made for all existing rights of way for pedestrians and cyclists that cross the new trunk road. There will be permanent severance of some community facilities and public natural assets and mitigation options need to be developed	N/A N/A		Neutral Slight Adverse	N/A N/A	Not appraised yet  Not appraised yet	
	Option and non-use values	Not appraised because this criteria relates to public transport options		N/A		N/A	N/A	
Public Accounts	Cost to Broad Transport Budget (2010 Present Values)	The impacts on the transport budget would be twofold; the capital cost of construction and the subsequent maintenance and operating cost of the infrastructure offset by revenue collected from the additional user charges	Investment costs: £2,380m Operating costs £309m Operator revenue £ 835m longer term)		ost over the	N/A	£1,855m	
	Indirect Tax Revenues	A tax benefit to central government is forecast as a result of additional traffic using the road network and particularly the Dartford Crossing		N/A		N/A	£629m	

## Annex 1 - TEE Table

Annex 1: TEE Table

## Economic Efficiency of the Transport System (TEE): Route 4/WSL

Non-business: Commuting	ALL MODES		ROAD		BUS and COACH	RAIL		OTHER
User benefits	TOTAL		Private Cars and L	GVs	Passengers	Passengers		
Travel time	£76,530,261			£76,530,261				
Vehicle operating costs	-£67,605,062			-£67,605,062				
User charges	£98,558			£98,558				
During Construction & Maintenance	£0							
COMMUTING	£9,023,757	(1a)		£9,023,757				
Non-business: Other	ALL MODES		ROAD		BUS and COACH	RAIL		OTHER
User benefits	TOTAL		Private Cars and L	GVs	Passengers	Passengers		
Travel time	£555,682,179			£555,682,179				
Vehicle operating costs	-£383,358,007			-£383,358,007				
User charges	-£1,870,014			-£1,870,014				
During Construction & Maintenance	£0							
NET NON-BUSINESS BENEFITS: OTHER	£170,454,158	(1b)		£170,454,158				
<u>Business</u>				Business Cars &				
User benefits			Goods Vehicles	LGVs	Passengers	Freight	Passengers	
Travel time	£2,603,048,124		£630,288,024	£1,972,760,100				
Vehicle operating costs	£460,095,818		£299,551,311	£160,544,508				
User charges	-£97,736,627		-£40,800,776	-£56,935,851				
During Construction & Maintenance	£0							
Subtotal	£2,965,407,315	(2)	£889,038,558	£2,076,368,757				
Private sector provider impacts						Freight	Passengers	
Revenue								
Operating costs								
Investment costs								
Grant/subsidy								
Subtotal	03	(3)						
Other business impacts						-	-	
Developer contributions		(4)						
NET BUSINESS IMPACT	£2,965,407,315	(5) = (2) +	(3) + (4)					
TOTAL								
Benefits (TEE)	£3,144,885,230	(6) = (1a) +	- (1h) + (5)					
DONORIO (TEE)				eto appoar ao nossa	vo numboro			
	Notes: Benefits appea All entries are		d present values, in 2					

## Annex 2 - PA Table

## Annex 2: Public Accounts (PA) Table

## **Route 4 ESL Bored Tunnel**

	ALL MODES	ROAD	BUS and COACH	RAIL	OTHER
Local Government Funding	TOTAL	INFRASTRUCTUR	E		
Revenue					
Operating Costs					
Investment Costs					
Developer and Other Contributions					
Grant/Subsidy Payments					
NET IMPACT	£0 (7)				
Central Government Funding: Trans	sport .				
Revenue	-£834,580,979	-£	834,580,979		
Operating costs	£308,940,780	£	308,940,780		
Investment Costs	£2,380,397,594	£2	380,397,594		
Developer and Other Contributions					
Grant/Subsidy Payments					
NET IMPACT	£1,854,757,394 (8)	£1	854,757,394		
Central Government Funding: Non-	<u> Transport</u>				
Indirect Tax Revenues	-£628,774,533 <i>(9)</i>	-£	628,774,533		
<u>TOTALS</u>					
Broad Transport Budget	£1,854,757,394 (10)	(7) = (7) + (8)			
Wider Public Finances	-£628,774,533 (11)	) = (9)			
	Notes: Costs appear as posi	•	es and 'Developer and Other Contributions'	appear as negative numbers.	

## Annex 3 - AMCB Table

## **Annex 3: AMCB Table**

## **Route 4 ESL Bored Tunnel**

and should not be used as the sole basis for decisions.

Analysis of Monetised Costs and Benefi	ts
Noise	£12,356,117 (12)
Local Air Quality	(13)
Greenhouse Gases	-£303,611,808
Journey Quality	(15)
Physical Activity	(16)
Accidents	-£112,854,800 <i>(17)</i>
Economic Efficiency: Consumer Users (Commuting)	£23,436,712 (1a)
Economic Efficiency: Consumer Users (Other)	£236,996,267 (1b)
Economic Efficiency: Business Users and Providers	£3,351,849,965 (5)
Wider Public Finances (Indirect Taxation Revenues)	£628,774,533 - (11) - sign changed from PA table, as PA table represents costs, not benefits
Present Value of Benefits (see notes) (PVB)	£3,836,946,987 (PVB) = (12) + (13) + (14) + (15) + (16) + (17) + (1a) + (1b) + (5) - (11)
Broad Transport Budget	£1,854,757,394 (10)
Present Value of Costs (see notes) (PVC)	£1,854,757,394 (PVC) = (10)
OVERALL IMPACTS	
Net Present Value (NPV)	£1,982,189,592 NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	2.1 BCR=PVB/PVC

## **Annex 4 – Biodiversity Worksheet**

## Annex 4: TAG Biodiversity Impacts Worksheet

## Route 4 ESL Bored

Step Area	Description of feature/	Scale (at which attribute matters)	Importance (of attribute)	Step 3 Trend (in relation to target)	Substitution possibilities	Biodiversity and earth heritage value	Step 4 Magnitude of impact	Step 5 Assessment Score
	Ramsar criterion 2 The site supports one	International	Attribute a qualifying feature of Internationally designated site so very	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 2	Minor Negative	Slight Adverse
Thames Estuary and Marshes Ramsar	endangered plant species and at least 14 nationally scarce plants of wetland habitats. The site also supports more than 20 British Red Data Book invertebrates.		high importance.					
	Ramsar criterion 5 Assemblages of international	International	Attribute a qualifying feature of Internationally designated site so very	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 5	Minor Negative	Slight Adverse
Thames Estuary and Marshes Ramsar	importance: Species with peak counts in		high importance.					
Thames Estuary and Marshes Ramsar	Ramsar criterion 6 species/populations occurring at levels of international importance (includes species with peak counts in autumn/winter and in spring)	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Ramsar Criterion 6	Minor Negative	Slight Adverse
Thames Estuary and Marshes SPA	Article 4.1 Qualification (79/409/EEC). Over winter the area regularly supports 1% of the population in GB of Circus cyaneus	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.1 qualification	Minor Negative	Slight Adverse
Thames Estuary and Marshes SPA	Article 4.2 Qualification (79/409/EEC). Over winter the area regularly supports significant populations of a number of wading birds. On passage the area regularly supports 2.6% of the population of Charadrius hiaticula	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.2 qualification	Minor Negative	Slight Adverse
Thames Estuary and Marshes SPA	Article 4.2 Qualification (79/409/EEC): An internationally important assemblage of birds. Over winter the area regularly supports 75019 waterfowl (5 year peak mean 21/03/2000).	International	Attribute a qualifying feature of Internationally designated site so very high importance.	Unknown at present	Not possible to substitute	Very high - Article 4.2 qualification	Minor Negative	Slight Adverse
Mucking Flats and Marshes SSSI	Botanical interest: Mudflats and Saltmarsh	National	Attribute a qualifying feature of Nationally designated site so high importance.	Majority Favourable with small area Unfavourable Recovering status.	Not possible to substitute	High - nationally important habitats	Neutral	Neutral
Mucking Flats and Marshes SSSI	Wintering wildfowl and waders	National	Attribute a qualifying feature of Nationally designated site so high importance.	Majority Favourable with small area Unfavourable Recovering status.	Not possible to substitute	High - nationally important species	Minor Negative	Slight Adverse
	Designated Ancient Woodland	National	Attribute a qualifying feature of	Favourable to	Not possible to substitute	High - nationally	Minor Negative	Slight Adverse
Shorne and Ashenbank Woods SSSI			Nationally designated site so high importance.	Unfavourable Recovering Status		important ancient woodland		
Shorne and Ashenbank Woods SSSI	Woodland invertebrates	National	Attribute a qualifying feature of Nationally designated site so high importance.	Favourable to Unfavourable Recovering Status	Not possible to substitute	High - nationally important invertebrates	Minor Negative	Slight Adverse
South Thames Estuary and Marshes SSSI	Wading birds and other overwintering species (such as short-eared owl)	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining	Not possible to substitute	High - nationally important birds	Minor Negative	Slight Adverse
South Thames Estuary and Marshes SSSI	Botanical importance (saltmarsh, freshwater habitats and grazing marshes)	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining	Not possible to substitute	High - nationally important botany	Minor Negative	Slight Adverse
South Thames Estuary and Marshes SSSI	Invertebrate interest (saltmarsh, freshwater habitats and grazing marshes)	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, small areas Unfavourable Declining	Not possible to substitute	High - nationally important invertebrates	Minor Negative	Slight Adverse
Thorndon Park SSSI	Botanical importance (semi- natural broad-leaved woodland)	National	Attribute a qualifying feature of Nationally designated site so high importance.	Generally Favourable to Unfavourable Recovering Status, some areas Unfavourable Declining	Not possible to substitute	High - nationally important	Minor Negative	Slight Adverse
Great Crabbles Wood SSSI	Botanical importance - broadleaved mixed and yew lowland woodland - designated Ancient Woodland	National	Attribute a qualifying feature of Nationally designated site - High importance.	Unfavourable - Recovering. The whole area is classified as being in a 'no change' condition due to the lack of forestry and woodland management		High - nationally important ancient woodland	Major Negative	Very Large Adverse
Cobham Woods SSSI (includes Great Wood - ancient woodland)	Botanical importance - designated Ancient Woodland	National	Attribute a qualifying feature of Nationally designated site - High importance.	Over 81% of the area is in a 'favourable' or 'recovering' condition. The remaining area is classified as 'no change' as the area is neglected and subject to multiple ownership.	Not possible to substitute ancient woodland plant species without ancient woodland	High - nationally important botany	Minor Negative	Slight Adverse

Step	2			Step 3			Step 4	Step 5
Area	Description of feature/	Scale (at which attribute matters)	Importance (of attribute)	Trend (in relation to target)	Substitution possibilities	Biodiversity and earth	Magnitude of impact	Assessment Score
	Botanical importance - woodland	National National	Attribute a qualifying feature of	Over 81% of the area is	Not possible to substitute	High - nationally	Minor Negative	Slight Adverse
	edge/ arable land plant species		Nationally designated site - High importance.	in a 'favourable' or 'recovering' condition.		important botany		
Cobham Woods SSSI (includes Great Wood - ancient woodland)				The remaining area is classified as 'no change'				
woodiana)				as the area is neglected and subject to multiple				
				ownership.				
	Woodland birds	National	Attribute a qualifying feature of Nationally designated site - High	Favourable to Unfavourable Recovering	Not possible to substitute	High - nationally important birds	Minor Negative	Slight Adverse
Cobham Woods SSSI (includes Great			importance.	Status				
Wood - ancient woodland)								
	Marine and estuarine habitats	National	Attribute a qualifying feature of	Marine and estuarine	Not possible to substitute	Very High -	Neutral	Neutral
	and species		Nationally designated site so high importance.	habitats in the Thames are being degraded		undesignated site hosting		
Thames Estuary recommended MCZ				through issues such as pollution and climate		habitats/species of (European) Community		
(on hold)				change.		interest (annexes 1 & 2, Habitats Directive,		
						1992)		
	Complex of habitats of value for	Regional	Attribute of value to local communities,	Some goals are being	Not possible to substitute	Medium - community	Minor Negative	Slight Adverse
	biodiversity and as a community resource		of Medium importance	achieved.	due to the extensive nature of the area involved	value and extensive area		
Greater Thames Marshes Nature Improvement Area								
improvement / trea								
	Local Wildlife Site Ancient and Ancient Semi-natural	Local	Area of degraded ancient woodland, high importance with a derelict orchard	Much of this woodland has been converted to	Not possible to substitute ancient woodland	High - ancient woodland	Major Negative	Very Large Adverse
Court Wood, Shorne (GR1) - includes	Woodland; derelict orchard and semi-improved neutral grassland		and area of unmanaged semi-improved neutral grassland of limited botanical	chestnut but still retains a good diversity of flowering				
Starmore Wood and Peartree Wood (ancient woodlands)			interest that supports invertebrates.	plants, including many ancient woodland				
				indicator species				
	Local Wildlife Site	Local	Area of unimproved pasture on acid,	unknown - not indicated	Soil translocation a	Low - local value	Neutral	Neutral
	Grassland, scrub		dry pebbly soils. Supports a herb-rich flora - Low importance	on Kent Local Wildlife Site schedule.		grassland and scrub		
Shorne Pasture (GR18)								
	Ancient Woodland	National	Area of degraded ancient woodland - High importance	unknown, but likely to be declining due to isolation	Not possible to substitute ancient woodland	High - ancient woodland	Minor Negative	Slight Adverse
			i ligit importance	and impact of poor air	ancient woodland	Woodiand		
Un-named ancient woodland (at centre of M2 J1 interchange)				quality				
	A maile and NA/a and larger	Masianal	Avec of desired and and and		Nick consider to substitute	lilah anakant	Minor Negative	Climba Advance
	Ancient Woodland	National	Area of degraded ancient woodland - High importance	declining due to impact of	Not possible to substitute ancient woodland	High - ancient woodland	Minor Negative	Slight Adverse
Un-named ancient woodland (south of				poor air quality given proximity to M2				
M2 J1 interchange, to the west of the M2)								
	Local Wildlife Site	Local	Lowland mixed deciduous woodland	Nationally, ancient	Not possible to substitute	High - important ancient	Major Negative	Very Large Adverse
	Ancient woodland		(BAP habitat) and ancient woodland - High importance	woodland is being lost or degraded due to habitat		woodland		
				loss and environmental factors such as climate				
Hobbs Hole (Bre66)				change and imported tree pathogens				
				patriogens				
	Local Wildlife Site Ancient woodland	Local	Lowland mixed deciduous woodland (BAP habitat) and ancient woodland -	Nationally, ancient woodland is being lost or	Not possible to substitute	High - important ancient woodland	Major Negative	Very Large Adverse
			High importance	degraded due to habitat				
Codham Hall Woods (Bre59)				factors such as climate				
Countain Flair Woods (Bress)				change and imported tree pathogens				
	11481 117 - 011							
	Local Wildlife Site Ancient woodland	Local	Lowland mixed deciduous woodland (BAP habitat) and ancient woodland -	Nationally, ancient woodland is being lost or	Not possible to substitute	High - important ancient woodland	intermediate Negative	Large Adverse
W. J. H. H. W. J. (D. 05)			High importance	degraded due to habitat loss and environmental				
Warley Hall Wood (Bre85)				factors such as climate change and imported tree				
				pathogens				
	Local Wildlife Site	Local	Lowland meadows; Lowland mixed	Nationally, ancient	Not possible to substitute	High - important ancient	Minor Negative	Slight Adverse
	ancient woodland; wood-pasture and parkland; lowland meadows;		deciduous woodland; Hedgerows (BAP Habitats) and ancient woodland - High	woodland is being lost or degraded due to habitat		woodland		
	neutral grassland; small- component mosaics; accessible		importance	loss and environmental factors such as climate				
	natural greenspace			change and imported tree pathogens. Parkland				
Thorndon Country Park South				habitat believed to be declining nationally.				
(Bre106) Includes Mill Wood (ancient woodland)				However, there are no				
				reliable statistics on the extent of the overall				
				resource, nor on historical				
				current rates of loss or degradation of this type of				
				habitat.				
	Local Wildlife Site Lowland Mixed Deciduous	Local	Lowland mixed deciduous woodland - Medium (BAP Habitat)	Nationally, deciduous woodland is declining due	Not possible to substitute mature habitats	Medium - BAP priority habitat	Major Negative	Moderate Adverse
	Woodland on Non-ancient Sites			to clearance, over- grazing and replanting				
Barrett's Shaw (Bre105)				with non-native species.				
	Local Wildlife Site Ancient woodland	Local	Lowland mixed deciduous woodland (BAP habitat) and ancient woodland -	Nationally, ancient woodland is being lost or	Not possible to substitute	High - important ancient woodland	Minor Negative	Slight Adverse
			High importance	degraded due to habitat loss and environmental				
Round Shaw (Bre112)				factors such as climate change and imported tree				
				pathogens				
	Local Wildlife Site	Local	Lowland mixed deciduous woodland	Nationally, ancient	Not possible to substitute	High - important ancient	Major Negative	Very Large Adverse
	Ancient woodland	LUCAI	(BAP habitat) and ancient woodland -	woodland is being lost or	TAOL POSSIDIE LO SUBSTITUTE	woodland	iviajoi inegative	very Large Adverse
			high importance.	degraded due to habitat loss and environmental				
Straight Path Shaw (Bre113)				factors such as climate change and imported tree				
				pathogens				

Step	2			Step 3			Step 4	Step 5
Area	Description of feature/ attribute	Scale (at which attribute matters)	Importance (of attribute)	Trend (in relation to target)	Substitution possibilities	Biodiversity and earth heritage value	Magnitude of impact	Assessment Score
	Local Wildlife Site Ancient woodland	Local	Lowland mixed deciduous woodland (BAP habitat) and ancient woodland -	Nationally, ancient woodland is being lost or	Not possible to substitute	High - important ancient woodland	Major Negative	Very Large Adverse
	Ancient woodland		High importance	degraded due to habitat		Woodiand		
This hall the Deliver Ober (Del 145)				loss and environmental factors such as climate				
Thick/Hollow Bottom Shaws (Bre115)				change and imported tree pathogens				
	Local Wildlife Site Neutral grassland	Local	Neutral grassland and hedgerows - Medium (BAP Habitats)	Favourable condition	Habitat/soil translocation a possibility but requires	Medium - BAP priority habitat	Neutral	Neutral
All Saints Churchyard and Keepers	-				suitable substrate to maintain required pH.			
Cottages Meadow (Bre118)								
	Local Wildlife Site Ancient woodland; habitat	Local	Lowland mixed deciduous woodland (BAP habitat) and ancient woodland -	Nationally, ancient woodland is being lost or	Not possible to substitute	Hight - important ancient woodland	Minor Negative	Slight Adverse
	extension mosaics		high importance.	degraded due to habitat loss and environmental				
Eastlands Spring (Bre134)				factors such as climate				
				change and imported tree pathogens				
	Local Wildlife Site	l and	HO-10, CO-4, CO-11, CO-10, CO-10	Red Data Book	Not possible to substitute	I linkdanimatad	Nandon	Neutral
	Invertebrates; reptiles	Local	HCr19; SCr4; SCr11; SCr12; SCr13. Important acid grassland; six Red Data	(Endangered)	Not possible to substitute	High - undesignated site hosts Red Data	Neutral	Neutrai
Orsett Camp Quarry (Th44)			Book invertebrates 16 nationally scarce species and three UK BAP bees	invertebrate species.		Book species and UK BAP species		
orosa samp asany (mm)			species; reptiles include adder, common lizard and slow worm. High					
			importance					
	Local Wildlife Site Flora; invertebrates	Local	Thames Terrace grasslands and ancient heathland. Site supports 4	Unknown at present, but a rare grassland habitat	Not possible to substitute	Medium importance Thames Terrace	Neutral	Neutral
Muslims Heath (That)			nationally rare and 50 nationally scarce invertebrate species. Medium	and associated invertebrate fauna,		grassland and invertebrates		
Mucking Heath (Th41)			importance.	associated with Thames Terrace soils.		invertebrates		
				Terrace soils.				
	Local Wildlife Site Acid grassland	Local	Acid grassland which supports BAP invertebrate (Bombus humilis). Medium	Developing site (former sand pit)	Habitat/soil translocation a possibility but requires	Medium - BAP priority habitat	Neutral	Neutral
D 11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	. Sia gracolana		importance.		suitable substrate to maintain required pH.			
Buckingham Hill (Th50)					таптат гецигео рн.			
	Local Wildlife Site	Local	Ancient woodland habitat, high	Nationally, ancient	Not possible to substitute	High - important ancient	Minor Negative	Slight Adverse
	Ancient woodland		importance for biodiversity	woodland is being lost or degraded due to habitat		woodland		
Rainbow Shaw (Th45)				loss and environmental factors such as climate				
				change and imported tree pathogens				
	Local Wildlife Site Invertebrates	Local	SCr11; SCr12. An important brownfield site that supports 5 Red Data Book	unfavourable (caused by	established brownfield	High - undesignated site hosts Red Data	Minor Negative	Slight Adverse
			invertebrates including two bees (Andrena florea and Nomada	extremes of management and adverse heavily	sites	Book species		
Linford Pit (Th46)			fulvicornis) two wasps (Cerceris quinquefasciata (a BAP species) and	localised recreational pressure)				
			Hedychrum niemelai) and a rare fly (Myopa polystigma). High importance	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,				
			( <i>Myopa polystigma</i> ). High importance					
	Local Wildlife Site Wet woodland complex	Local	HCr2(b); HCr5; HCr6(b); HCr6(d). Wet woodland UK BAP habitat. Medium	Current condition not known, but habitat	Not possible to substitute without similar hydrology	Medium - BAP priority habitat	Neutral	Neutral
	vet woodiand complex		importance.	requires management to	to maintain water table	Habitat		
Linford Wood (Th51)				and woodland types.	required for wet woodland			
	Local Wildlife Site Invertebrates; flora	Local	HCr11; SCr11; SCr12; SCr13. Thames Terrace grassland supports a diverse	Unknown at present, but a rare grassland habitat	Not possible to substitute	Medium importance Thames Terrace	Major Negative	Moderate Adverse
	invertebrates, nora		invertebrate fauna including UK BAP	and associated		grassland and		
Low Street Pit (Th47)			invertebrate (Hornet Robber fly (Asilus crabroniformis)) Medium importance.	invertebrate fauna, associated with Thames		invertebrates		
				Terrace soils.				
	L LIME BY O'		110 10 00 1 0 0 1	D.F. H. L. C. H.	L to Doc Call Miles	M. F. BAR	Maria	Olivet Advanced
	Local Wildlife Site Acid grassland; reptiles	Local	HCr19; SCr4. Brownfield site with acid grassland that supports all four	Believed to be favourable, but identified as a site a	temporarily disturbed.	Medium - BAP priority habitat	Minor Negative	Slight Adverse
			common species of reptile (adder, grass snake, common lizard and slow	risk from development.	Reptile translocation required. Habitat			
Lytag Brownfield (Th39)			worm). Medium importance		reinstatement a possibility but requires suitable			
					substrate to maintain required pH for habitats to			
					establish.			
	Local wildlife Site - deciduous woodland.	Local	This old landfill area supports two important species populations: the	Red Data species but unknown at present.	Creation of replacement habitat possible?	High - UK BAP species and Red Data Book	Intermediate Negative	Large Adverse
			nationally rare Red Data plant Stinking Goosefoot and the UK BAP species			plant species.		
Goshems Farm (Th49)			Hornet Robber fly. Also made up of a large of deciduous woodland. Medium					
			importance.					
	Local Wildlife Site Restored Higham Canal and	Local	Recently established reedbeds, damp disturbed grassland and a dyke system.	Site recently improved with active management	Not possible to substitute	Medium - BAP priority habitat	Neutral	Neutral
Canal and avariag March 18 to	coastal grazing marsh (UK BAP		Medium importance	by RSPB.				
Canal and grazing Marsh, Higham (Gr17)	habitat)							
	Ancient Woodland	National	Ancient woodland habitat, high	Nationally, ancient	Not possible to substitute	High - important ancient	Major Negative	Very Large Adverse
			importance for biodiversity	woodland is being lost or degraded due to habitat		woodland	.,	, _u.go naveise
				loss and environmental factors such as climate				
ancient woodland immediately to the north west of M25 J29				change and imported tree				
				pathogens				
Datasia (1999) - Buryana	Priority habitat	Local	Medium importance, BAP habitat	Nationally, deciduous			Major Negative	Moderate Adverse
Priority Habitat - Deciduous Woodland (south west of M25 J29; north east of				woodland is declining due to clearance, over-	Replacement planting	habitat		
M25 J29; south of A127 East Horndon interchange; adjacent to railway line				grazing and replanting with non-native species.	and/or translocation of habitats and/or soils a			
south of Dunton Hall; north west of Linford; east of Low Street; areas				·	possibility			
included in East Tilbury Marshes; north of the A226 opposite Church Lane;								
adjacent to the A2 immediately west of								
Shorne and Ashenbank Woods SSSI)	D : 2 + 12 :		Mar and a second	N. C.	No.	M. P. 515	Maria Na es	
Priority Habitat - Deciduous Woodland	Priority habitat	Local	Medium importance, BAP habitat	Nationally, deciduous woodland is declining due		Medium - BAP priority habitat	Minor Negative	Slight Adverse
(north of A127 opposite Great Warley Hall; adjacent to railway line south of				to clearance, over- grazing and replanting	Replacement planting and/or translocation of			
Dunton Hall; north of Horndon on the Hill; south west of Dame Elyns; east of				with non-native species.	habitats and/or soils a possibility			
Buckland; north east of East Court Manor; adjacent to the A2 immediately					possionity			
west of Shorne and Ashenbank Woods								
SSSI)								

Step	2			Step 3			Step 4	Step 5
Area	Description of feature/	Scale (at which	Importance (of attribute)	Trend (in relation to	Substitution	Biodiversity and earth		Assessment Score
Priority Habitat - Wood-pasture and Parkland (between Round Shaw and Hollow Bottom Shaw/Thick Shaw north of the A127)	attribute Priority habitat	attribute matters) Local		target) Generally believed to be declining nationally. However, there are no reliable statistics on the extent of the overall resource, nor on historical and current rates of loss or degradation of this type of habitat.	mature habitats.	heritage value Medium - BAP priority habitat	Minor Negative	Slight Adverse
Priority Habitat - Wood-pasture and Parkland (between Round Shaw and Hollow Bottom Shaw/Thick Shaw south of the A127)	Priority habitat	Local	Medium importance, BAP habitat	Generally believed to be declining nationally. However, there are no reliable statistics on the extent of the overall resource, nor on historical and current rates of loss or degradation of this type of habitat.	Not possible to substitute mature habitats.	Medium - BAP priority habitat	Major Negative	Moderate Adverse
Priority Habitat - Traditional Orchards (south of Horndon on the Hill; south west of Dame Elyns)	Priority habitat	Local	Medium importance, BAP habitat	Declining due to a loss of sites only partially compensated for by improved management and restoration.	Not possible to substitute mature habitats.	Medium - BAP priority habitat	Minor Negative	Slight Adverse
Priority Habitat - Traditional Orchards (on Church Lane north of A226)	Priority habitat	Local	Medium importance, BAP habitat	Declining due to a loss of sites only partially compensated for by improved management and restoration.	Not possible to substitute mature habitats.	Medium - BAP priority habitat	Major Negative	Moderate Adverse
Grazing Marsh (East Tilbury Marshes north of Thames; MoD firing range, Thames Estuary and Marshes Ramsar	Priority habitat. Of importance for cohesion between designated sites and for sustaining populations of waterfowl and of value for notable invertebrates and plants.	National (contiguous with similar habitat of international importance within designated sites)	Low to High, dependant on functioning within the wider network of habitats	Likely to be decreasing due to agricultural improvement, drainage and development	Not possible to substitute easily as reliant on suitable groundwater conditions (hydrology) for replacement habitat to establish.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Minor Negative	Slight Adverse
	Priority habitat. Important for cohesion between designated sites and for sustaining populations of wading birds.	National (contiguous with similar habitat of international importance within designated sites)	Importance will be dependant on functioning within the wider network of habitats, likely to be Medium to High Importance	Likely to be decreasing due to coastal erosion, climate change and development	Creation of replacement habitat through managed realignment a possibility, but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Neutral	Neutral
Priority Habitat - Mudflats (East of Tilbury Power Station)	Priority habitat. Important for cohesion between designated sites and for sustaining populations of wading birds.	National (contiguous with similar habitat of international importance within designated sites)	Importance will be dependant on functioning within the wider network of habitats, likely to be Medium to High Importance	Likely to be decreasing due to coastal erosion, climate change and development	Creation of replacement habitat through managed realignment a possibility, but very limited opportunities locally due to lack of available land.	Medium to High, BAP priority habitat which is likely to support SPA qualifying species.	Minor Negative	Slight Adverse
Priority habitat - Traditional Orchards (adjacent to the A289 at M2 J1 interchange; on Church Lane and adjacent to the A226 north of Shorne)	Priority BAP habitat	Local	Traditional Orchards BAP habitat - Medium importance	Declining due to a loss of sites only partially compensated for by improved management and restoration.	Not possible to recreate mature habitats, replanting and (if possible) translocation of habitats and/or soils a possibility	Medium - BAP priority habitat	Major Negative	Moderate Adverse
Priority habitat - Deciduous Woodland (adjacent to M2 J1 interchange; Great Crabbles Wood; and along northern edge of the A226 near Church Lane)	Priority BAP habitat	Local	Deciduous Woodland BAP habitat - Medium importance	Nationally lowland mixed deciduous woodland is declining due to clearance, over-grazing and replanting with nonnative species.	Replacement planting and/or translocation of habitats and/or soils a possibility	Medium - BAP priority habitat	Minor Negative	Slight Adverse
Tentacled lagoon worm ( <i>Alkmaria</i> romijni)	Tentacled lagoon worm is protected under Schedule 5 of the Wildlife and Countryside Act 1981	National	High importance (protected under Schedule 5 of the Wildlife and Countryside Act). Nationally scarce marine animal	Considered scarce wihtin the UK; vulnerable to changes to, or loss of, the habitats in which they live	Not possible to substitute	High	Neutral	Neutral
European eel ( <i>Anguilla anguilla</i> )	European eel is a UK BAP Priority Species (BAP species are now Species of Principal Importance/Priority Species)	National	Medium importance, BAP species	Listed as Critically Endangered on the IUCN Red List; on the OSPAR list of threatened and/or declining species and habitats.	Not possible to substitute	Medium	Neutral	Neutral
Smelt ( <i>Osmerus eperlanus</i> )	Smelt is a UK BAP Priority Species (BAP species are now Species of Principal Importance/Priority Species)	National	Medium importance, BAP species	Declining, most of the recorded populations in Scotland are now extinct, as are a third of those from estuaries in England and Wales	Not possible to substitute	Medium	Neutral	Neutral
Harbour Porpoise ( <i>Phocoena</i> phocoena)	Annex II of the European Commission's Habitats Directive (92/43/EEC); Schedule 5 of the Wildlife and Countryside Act	National	High importance	Common to all UK waters 'favourable conservation status', but due to incidental fisheries by- catch, the species has been assessed as under threat/in decline in the Greater North Sea and Celtic Sea.	Not possible to substitute	High	Neutral	Neutral
Reference Sources			-					

## Reference Sources

MAGIC website for designated site locations; ancient woodland locations; priority habitat locations
JNCC website for Ramsar, SPA, SAC and SSSI site designations
Natural England website for Local Nature Reserve designations
Natural England website for Local Nature Reserve designations
Thurrock Biodiversity Study 2006-2011
Essex Wildlife Trust website for locations of Local Wildlife Sites (http://www.essexwtrecords.org.uk/lowsfinder)
Kent Wildlife Trust website for locations of Local Wildlife Sites (https://cms.esriuk.com/tunbridgewells/Sites/KWT\_External/#)
Green Infrastructure Assets Baseline Report, Gravesham Borough, December 2009 (http://docs.gravesham.gov.uk/WebDocs/Environment%20and%20Planning/LDF/Green\_Infrastructure\_Assets\_Baseline\_Report\_1\_Main.pdf)
Review of Lower Thames Crossing Options: Final Review Report Appendices, AECOM, 2013
UK Biodiversity Action Plan; Priority Habitat Descriptions. BRIG (ed. Ant Maddock) 2008 (Updated Dec 2011).

## Summary Assessment Score

Very Large Adverse\*

#### **Qualitative Comments**

Route 4 bisects a number of designated and local wildlife sites and areas of Biodiversity Action Plan habitat. These include an area of the Thames Estuary and Marshes which is designated as an internationally important Ramsar site and SSSI, and is also a RSPB reserve. The route bisects a number of important habitats which will result in varying degrees of disturbance, habitat loss and habitat fragmentation. Specific comments on the potential design options for a new river crossing are outlined below:

The main impacts are associated with the construction phase. A completed tunnel would not impact the marine environment and the coastal/terrestrial impacts would be greatly reduced in comparison to the erection of a bridge (where permanent effects from loss of habitat and shading effects will occur) or immersed tube tunnel (with very large impacts on habitats and species during construction). The location of the tunnel entrance to the north of the crossing (and, in particular, the temporary works area associated with the tunnel portal) currently has a significant impact on an area of historic coastal grazing marsh and local wildlife site, which supports a diverse range of Red Data Book Invertebrates and may be also provide important functionally linked land for the SPA designated species (e.g. high tide roost). Micro-siting this entrance point to minimise impacts of habitat loss/deterioration and disturbance to SPA species is recommended. However there is potential for offset mitigation by enhancing land adjacent to the site which is currently agricultural land. Habitat loss and fragmentation of five areas of ancient woodland along the northern extent and two along the southern extent of the new road, would involve a very large adverse effect on Ancient Woodland habitat that is irreplaceable (as discussed above).

\* Note the Summary Assessment Score is skewed by impacts on ancient woodland (seven areas of ancient woodland affected, including Great Crabbles Wood SSSI) from the proposed route alignment.

## **Annex 5 – Historic Environment Worksheet**

## **Annex 5: Historic Environment Impacts Worksheet**

## Route 4 ESL Bored

	Step 2		Step 3		Step 4
Feature	Description	Scale it matters	Significance	Rarity	Impact
Form	The historic landscape within the study area is predominantly rural in character and the result of post-medieval farming activity. The study area also contains portions of settlements such as West Horndon, Horndon on the Hill, West Tilbury and Gravesend.  The study area contains a number of listed buildings (designated heritage assets), largely in rural settings, although there are small clusters in settlements such as East Tilbury. In total there are 67 Grade II, eight Grade II* and one Grade I listed buildings within the study area (Grade II*: Little Warley Hall, Little Warley; Church of All Saints, East Hornden; Old Plough House, Bulphan; Marshall's Cottages and Church of St James, West Tilbury; Church of St Mary, East Court Manor and Little St Katerines and Chruch of St Peter and St Paul, Shorne. Grade I: Church of St Peter, Little Warley). The study area contains five conservation areas (designated assets): Thorndon Park, West Tilbury, East Tilbury, Shorne Village and Chestnut Green, Shorne. Thorndon Park is also a Grade II* registered park and garden.  Known archaeological remains within the study area date from the prehistoric to post-medieval periods. There are five scheduled monuments (designated heritage assets) within the study area: a former parish church and churchyard of St Nicholas; Thorndon Old Hall and gardens; earthworks at West Tilbury and a Second World War anti-aircraft battery at Bowaters Farm.	at a national level under the Planning (Listed Buildings and Conservation Areas) Act 1990 and are a material consideration at national level in the NPPF and NN-NPS.  The scheduled monuments are also designated heritage assets and are afforded protection at a national level under the Ancient Monuments and Archaeological Areas Act 1979. They are also a material consideration at national level in the NPPF and NN-NPS.  Whilst registered parks and gardens do not have statutory protection, they area a material consideration in the planning process and are considered at a national level in the NPPF and NN-NPS.  The treatment of non-designated archaeological remains within the planning process is also considered	The scheduled monuments are of high value and the non-designated archaeological remains range in value from low to medium.	represented types on a national and regional level and are of moderate rarity. East Tilbury conservation area is a rare example of a planned modernist factory town. The other four conservation areas are relatively well represented regionally and nationally.  Thorndon Park registered park and garden contains considerable time depth and incorporates or is associated with a number of other high value assets and is rare on a national level.	The Scheme will have a direct physical impact on the Grade II listed Dunton Hills Farm, which will be removed. The scheme may impact on the settings of the listed buildings along the route. The scheme will have direct physical impact on the Thorndon Park conservation area and registered park and garden. The scheme may also impact on the settings of the West Tilbury, East Tilbury and Shorne Village conservation areas. The setting impacts may arise as a result of the introduction of a new linear element, the road, in a currently open rural landscape  The scheme may also impact on the settings of the scheduled monuments at Thorndon Old Hall, former parish church and churchyard of St Nicholas, West Tilbury and Bowaters Farm. The impacts may arise as a result of the introduction of a new linear element, the road, in a currently open rural landscape.  Construction excavations associated with the proposed road and tunnel may impact on non-designated archaeological remains within the scheme footprint via their complete or partial removal.
Survival	The survival of the listed buildings and the conservations areas is comparable with others in the region and is generally good.  The survival of Thorndon Park registered park and garden is generally good.  The survival of the scheduled monuments is generally good. The survival of the archaeological remains has not yet been fully determined.	The NPPF and NN-NPS takes the survival of heritage assets into account at a national level.	Survival of the designated heritage assets is of moderate to high significance as they contribute to the character of the area.  Survival of the non-designated archaeological remains is of low to moderate significance as surviving remains of these types are important in terms of our understanding of the human past.	Farm anti-aircraft battery, the survival of which is rare at both regional and national levels, the survival of the scheduled monuments is of moderate rarity value.	The scheme would not impact on the survival of designated assets within the study area, with the exception of Thorndon Park registered park and garden and conservation area, which would be subject to the direct physical impacts as the result of road construction within the designated area.  The scheme would not impact on the survival of non-designated assets within the study area as a whole, but would have impact within the scheme footprint.
Condition	The condition of the listed buildings and conservation areas is generally good.  The condition of Thorndon Park registered park and garden is generally good.  The condition of the scheduled monuments is generally good, with the exception of the Bowaters Farm anti-aircraft battery, the condition of which is poor. The condition of the non-designated archaeological remains is currently unknown	assets into account at a national level.	The condition of the listed buildings, conservation areas and registered park and garden is of moderate significance as they have they have a beneficial effect on the character and amenity value of the study area.  The condition of scheduled monuments and non designated archaeological remains is of high and moderate significance respectively, as in good condition they can inform our understanding of the human past.	condition are relatively common in this region and have low rarity value. Registered parks and garden in good condition are also relatively common, but have moderate rarity due to their relative scarcity	The scheme would not impact on the condition of designated assets within the study area, with the exception of Thorndon Park registered park and garden and conservation area, which would be subject to the direct physical impacts as the result of road construction within the scheduled area.  The scheme would have not impact on the condition of non-designated assets within the study area as a whole, but would have some impact within the scheme footprint.
Complexity	The listed buildings and conservation areas are not unusually complex and represents a standard mix of agricultural, residential, ecclesiastical and commercial buildings. Thorndon Park is relatively complex as it represents several phases of development.  Archaeological remains, both scheduled monuments and non-designated, represent activity from a number of periods and in relation to a number of industrial, settlement, funerary and agricultural processes. They are moderately complex but not unusual in a regional context.		The complexity of the historic environment resource has moderate significance as it represents both time-depth and potential to provide positive benefits to the character and amenity value and is also indicative of potential value in terms of our understanding of the human past.		The scheme would not impact on the complexity of designated assets within the study area.  The scheme would not impact on the complexity of non-designated assets within the study area as a whole and the scheme footprint.
Context	The study area lies within the Greater London / Thames Estuary areas and the historic environment resource within the study area reflect this wider context.	The NPPF and NN-NPS takes the context of heritage assets into account at a national level.	The context of the historic environment resource within the study area informs their settings and as such is of moderate to high significance.	The context of the historic environment resource within the study area is relatively common and as such is of low rarity.	The scheme would not impact on the context of the historic environment resource within the study area.

	Step 2		Step 3		Step 4
Feature	Description	Scale it matters	Significance	Rarity	Impact
Period	The listed buildings and conservation areas date from the medieval to modern periods.  Thorndon Park registered park and garden dates from the early medieval to modern periods.  The scheduled monuments date from the Neolithic to the modern period, whilst the non-designated archaeological remains date from the prehistoric period onwards.			The range of periods represented by the histori environment resource within the study is common to the region and as such is of low rarity.	The scheme would not impact on the periods represented by the historic environment resource within the study area.

## Reference Sources

TAG Unit A3 (November 2014); DMRB Volume11, Section 3, Part 2 (2007); National Heritage List for England; Greater London Historic Environment Record; Essex Historic Environment Record, Thames Estuary Partnership Archaeological Research Framework (1999); Thames Estuary Partnership Greater Thames Research Framework (2010)

#### Step 5 - Summary Assessment Score

Large Adverse

#### **Qualitative Comments**

The scheme covers an area that is largely open and rural in character but containing urban areas that expanded during the 19th and 20th centuries. One Grade II listed building (Dunton Hills Farm) will suffer a direct physical impact through its removal, the effect of which is predicted to be Large Adverse. Potential impacts to the settings of the following designated heritage assets have been identified as a result of scheme: scheduled monuments at Thorndon Old Hall, former parish church and churchyard of St Nicholas, West Tilbury and Bowaters Farm, listed buildings along the route; West Tilbury, East Tilbury and Shorne Village conservation areas. These effects are predicted to be Slight Adverse with regard to the listed buildings and Moderate Adverse with regard to the conservation areas and scheduled monuments. Road construction within the registered area of the Thorndon Park registered park and garden and conservation area will cause a direct physical impact to this designated asset. Due to the high value of the assets, the effects are predicted to be Large Adverse. Construction excavations associated with the proposed road and tunnel may have a physical impact on any non-designated archaeological remains within the scheme footprint are predicted.

# **Annex 6 – Landscape / Townscape Worksheet**

## Annex 6: Landscape Impacts Worksheet

### **Route 4 ESL Bored**

	Step 2		1	ep 3	T	Step 4
Features	<b>Description</b> Between the A2 corridor and the A226 the landform is	Scale it matters	Rarity Rare	Importance Medium	Substitutability Low. It is not possible to	Impact Large adverse. Route 4 ESL would cut across the pattern of the landscape particularly to the
	undulating and rises towards the south. The higher land is well wooded, some of the woods are ancient woodlands, with the settlements of Shorne and Shorne Ridgeway running along ridges. Arable fields defined by hedges and trees fill the lower land close to the A226 and in the valleys either side of Shorne. Properties along Pear tree Lane have extensive gardens/grounds, some with horse paddocks.				replace ancient woodland.	east of Shorne where it would run across a valley and then through a hill requiring extensive earthworks. An area of ancient woodland in Great Crabbles Wood would be destroyed.
Pattern	Between the A226 and the Thames Corridor the landscape is gently undulating, with large open arable fields and few hedgerows. These are mainly along the roads and around the small settlements.	Local	Rare in a local context	Medium		<b>Moderate adverse.</b> Route 4 ESL would have a direct and indirect impact on the pattern of the existing landscape. In places the it would cut through the gently undulating landform.
	The Thames river corridor consists of flood embankments along the river edge backed by expansive marshlands with rough grazing and sparse scrub. On the north side there are extensive areas of old mineral workings some of which have been backfilled as landfill.	Local	Rare in a local context	High in a local context	Low	<b>Neutral.</b> The tunnel portals would be located to the north and south of the Thames corridor.
	From the junction of the A127 with the M25 Route 4 ESL would pass through open gently rolling countryside of medium sized, enclosed fields and small settlements. Further south the settlements become larger as do the size of the fields. Power lines become a more prominent feature.	Local	Common	Medium		<b>Moderate Adverse.</b> Route 4 ESL would impose a linear transport corridor through a largely rural area and break up the existing scale of the field pattern. Where it follows the line of the existing A127 the impact would be <b>slight adverse.</b>
	South of Shorne and Shorne Ridgeway, noise from the A2 and M2 becomes increasing intrusive, although visually due to the screening effect of trees the area is rural in appearance. The immediate area around the M2, A2, A289 junction is dominated by the roads despite extensive planting.	Local	Medium	Medium		Moderate adverse away from the existing A2/M2 transport corridor. Route 4 ESL would introduce high levels of traffic noise and transport infrastructure into the currently rural scene. Closer to the existing roads the impact would be less. Some residents on the western edge of Strood would experience an increase in noise and increased visual impact of road infrastructure.
	The area around Shorne and Shorne Ridgeway has an unspoilt rural feel considering its closeness to Gravesend and the Medway towns. It is relatively free from traffic noise and the visual intrusion of industry and power lines. There are distant views over the Thames corridor to Essex and Tilbury power station.	Local	Medium	Medium		Large adverse. Route 4 ESL would introduce high levels of traffic noise and transport infrastructure into a currently tranquil rural scene. Some residents of Pear Tree Lane, Shorne Ridgeway, Shorne and Lower Shorne would have a significantly reduced level of tranquillity.
	Between the Thames corridor to the A226 there is visual intrusion on the landscape of urban settlements, roads and pylons. There is constant, although mostly distant, road noise. The sweeping views across the Thames are dominated by Tilbury power station.	Local	Common	Medium		Moderate adverse. A new road would increase the levels of road noise considerably and introduce transport infrastructure into the view. Some residents of Chalk and Church Lane would have a significantly reduced level of tranquillity.
Tranquillity	Within the Thames corridor there are expansive views over the river and surrounding marshland from the riverside paths which are often some distance from the nearest road. There is always the visual intrusion of man made structures such as jetties, river traffic and Tilbury power station.	Local	Common	High in local context		Slight adverse. A tunnel would pass below the Thames corridor the portal being located to the south of the Lower Higham Road. Noise levels and visual intrusion would be much the same as they are at present, with the exception of locations closest to the portal and ventilation building.
	North of the Thames corridor the level of tranquillity varies considerably with location. There are large roads such as the M25, A13 and A127 which generate traffic noise and disrupt tranquillity whilst there are open areas of countryside between that are broken only by the occasional small road. Nowhere is it completely tranquil due to distant road noise and the visual intrusion of small settlements, roads and pylons.	Local	Common	Low		Moderate adverse in the vicinity of Route 4 ESL. While there is some road noise in most areas at present this would increase considerably in the majority of locations. The presence of road infrastructure would also have an impact on the rural character of the area. For some residents of East Tilbury, West Tilbury, Linford, Southfield, Horndon on the Hill and west Horndon the route change the view and increase noise, having a detrimental impact on tranquillity.

	Step 2		Ste	1		Step 4
Features	Description  Most of Route 4 ESL is located within Green Belt.	Scale it matters	Rarity	Importance	Substitutability	Impact  Medavate advance. The Creen Belt is a valued wirel consisting between settlements to this
	Most of Houte 4 ESL is located within Green Belt.	Regional	Regionally medium	High in regional context	Low	Moderate adverse. The Green Belt is a valued rural separation between settlements. In this location Route 4 ESL would introduce a new urban element into the Green Belt that has been planned to separate Basildon, Grays, Tilbury and Gravesend from nearby villages.
	Public rights of way.	Local	Common	Medium	High	Impact depends on the right of way but some will be crossed by the route and this would have a <b>Moderate adverse</b> impact on the users of the paths.
	South of the A2 is Cobham Hall which is included in the register of parks and gardens comprising intact 18th century parkland, gardens, estate woodlands and golf course.	National	Rare	High in a national context	Low	<b>Neutral.</b> Part of the Route 4 ESL/ A2/M2 junction would be located within the registered park, however in reality it is outside of the current park boundary. The registered park boundary should be altered to accommodate current transport infrastructure.
	Kent Downs Area of Outstanding Natural Beauty (AONB).	National	Rare nationally	High nationally	Low. It would not be possible to replicate the features of the AONB elsewhere.	The route 4 ESL junction with the A2, A289 and M2 would affect an area on the edge of the AONB and an area immediately around it which is important in terms of its landscape character, although not designated. The new junction would totally destroy this area and part of Great Crabbles Woods having a <b>large adverse</b> impact despite the existing large roads nearby.
	Grade II listed building in Old Watling Street.	Regional	Regionally rare	High in regional context	Low	Slight adverse. The proposed changes to the existing junction will mean that roads are closer to the building.
	Well Tree Cottage & Bushylees grade II listed buildings off Pear Tree Lane.	Regional	Regionally rare	High in regional context	Low	There would be a <b>slight adverse</b> impact on the setting of the rear of the buildings.
	Shorne conservation area. Listed buildings in Shorne within 500m of Route 3 ESL: Front garden wall & gate piers to Pipes Place, Pipes place, Chapel of St Katherine, St Katherine's House, all grade II & Little St Katherine's grade II*.	Grade II * listed building national. Grade Ii listed buildings local. Conservation area regional.	Grade II* listed building nationally rare, listed buildings and conservation area regionally rare.	High in national/local context	Low	Slight adverse impact on the northern most part of Shorne conservation area. Neutral for the remainder of Shorne conservation area and the listed buildings.
	Listed buildings located close to Route 4 ESL between the A226 and the Thames: Filborough Farmhouse, Barn to the north west of Filborough Farmhouse, the granary at Little Filborough Farm East Court Manor (all grade II & Church of St Mary in Chalk (grade II*).	National/regional	Nationally/ regionally rare	High in national/regional context	Low	There would be a <b>moderate adverse</b> impact of Route 4 ESL on the setting of the listed buildings.
	National Cycle Routes 1 and 13 and other public rights of way.	National/local	Rare/common	High/low	High as easily relocated.	Moderate adverse for rights of way and national cycle routes located close Route 4 ESL due to the visual impact of road infrastructure and increased noise levels.
	Thames and Medway canal route (no longer navigable). Not designated.	Local	Rare locally	Medium in a local context	Low	Neutral The portal and road would be located some distance to the south.
	Saxon Shore Way leisure route along the Thames and public right of way on northern side of the Thames.	Regional/local	Rare regionally	High in a local context	Low	Neutral. The tunnel would pass below the paths.
Cultural	Scheduled monument. Coalhouse Fort battery and artillery defences.	National	Rare	High at a national level	Low	Neutral. A tunnel will have no impact on the setting to the monument.
	Scheduled monument at Bowaters Farm WWII anti aircraft battery.	National	Rare	High at a national level	Low	The monument is largely hidden from view by scrub and despite the closeness of Route 4 ESL it would only have a <b>slight adverse</b> impact on the setting.
	Grade II listed building at Bucklands Farm.	Regional	Rare	High	Low	The building is surrounded by trees and the road would have only a <b>slight adverse</b> impact on its setting.
	East Tilbury Conservation area and listed buildings.	Regional	Rare	High	Low	Some distance away from the conservation area which is an unusual modernist development of housing and factories. For most of the area the impact would be <b>neutral</b> with <b>slight adverse</b> on the setting of the western edge.

	Step 2		_	Step 3		Step 4		
Features	Description	Scale it matters	Rarity	Importance	Substitutability	Impact		
	Grade II listed buildings in the vicinity of Hordon on the Hill within 500m of Route 4 ESL. 2 at Ongar Hall Farm, 2 at Wyfields Farm, Linsteads Farm, Chorleys farm, 2 at Saffron Gardens.		Rare	High	Low	Generally a <b>slight adverse</b> impact on the setting of the buildings due to the distance from Route 4 ESL. At Chorleys farm the impact will be <b>moderate adverse</b> as the route is close to the building and would considerable change the setting from arable field to the east.		
		National	Rare	High at a national level	Low	Large adverse impact on the setting of the scheduled monument due to the closeness of the road to an extremely rare example of a bombing decoy.		
	Dunton Halls Golf Course.	Local	Medium	Low	Medium	Moderate adverse. Route 4 ESL would run through part of the golf course which would have to be relocated.		
	All saints Church grade II*, Freman Monument grade II & Stabling at Church of all Saints grade II, listed buildings.	National/regional	Rare	High	Low	Slight adverse The new junction with the distributer road would have an impact on the setting of the buildings.		
	Grade II listed buildings at East Horndon Hall, Dunton Hills Farm & 2 at Dunton Hall.	Regional	Rare	High	Low	Moderate adverse to East Horndon Hall as the building would become surrounded by roads severely affecting its setting. Dunton Hills Farm would be demolished and the impacts will be addressed as part of the heritage worksheet. The other listed buildings are further from the route which would only have a slight adverse impact on their setting.		
	Thordon Hall scheduled monument.	National	Rare	High	Low	Slight adverse. The slip roads connecting Route 4 ESL with the A127 and the new distribute road would have some impact on the setting of the monument although it will be largely hidden by vegetation.		
	Thordon park registered park and conservation area.	National	Rare	High	Low	Moderate adverse. The southern part of the registered park and the conservation area will be affected by the 2 new slip roads to linking Route 4 ESL with the A127 and a new distributer road will cut through the southern part of the conservation area and the registered park. This will isolate small sections of both from the remainder.		
	A grade I & II* listed buildings at Little Warley.	Regional/national	Rare	High	Low	Slight beneficial. The removal of the junction with the A127 and the demolition of the exiting service station would have a small improvement on the setting of the listed buildings.		
	2 grade II Listed buildings, Hulmers and The Kilns Hotel on the B186 north of the A127.	Regional/national	Rare	High	Low	Neutral. The removal of the junction between the B186 and the A127 would have an advantages impact on the setting of the buildings. The proposed slip road between the A127 and the M25 and the junction of the distributer road with the B186 would have a slight adverse impact on the setting of the buildings. Overall the impact would be neutral.		
	South of the A2 the grounds of Cobham Hall are a Registered Park and Garden comprising an intact 18th century parkland, gardens, estate woodlands and golf course.	National	Rare	High in National context	Low	<b>Neutral.</b> Part of junction of Route 4 ESL with the A2 would be located inside of the registered park, although in reality this is outside of the of the current park boundary. The registered park boundary should be altered to accommodate current transport infrastructure.		
	The A2/M2 transport corridor dominates the surrounding rural landscape.	Local	Common	Low	High	Slight adverse. A new road junction would have little impact on land use other than to remove areas of planting and increase the area of road surface.		
	The villages of Shorne and Shorne Ridgeway are on the higher land which is also well wooded and includes Shorne and Great Crabbles Woods amongst others.	Local	Medium locally	Medium	Low	Large adverse. A road would change the current land cover next to Southern Alternative from a predominantly rural one to one dominated by transport infrastructure. Large earthworks would be necessary to cut through the high land at Pear Tree Land requiring an extensive footprint.		
	South of the A226 the lower areas are predominantly of arable fields bounded by hedges and woodlands.	Local	Medium locally	Medium	Low	<b>Moderate adverse</b> . A road would change the current land cover next to Southern Alternative from a predominantly rural one of fields and woodlands to one dominated by transport infrastructure.		
	Between the A226 and the Thames corridor landcover is of large arable fields and small groups of houses. To the west is the suburban edge of Chalk.	Local	Low	Medium	High	Moderate adverse. A road would change the current land cover next to Southern Alternative from a predominantly rural one of arable fields to one dominated by transport infrastructure.		
Landcover								
	The characteristic landcover of the Thames river corridor consists of open flat grazing marsh with sparse scrub and trees cover with emergent plants along ditches. The Thames is lined with inter tidal mud flats and gravel foreshore. On the north side there are extensive former mineral workings some of which have been backfilled with landfill.	Regional	Rare	High in regional context	Low	A bored tunnel would have <b>neutral</b> impact immediacy adjacent to the river. Above ground the current agricultural landcover would change along the route to one dominated by transport infrastructure, in the long term there would be the potential for Route 4 ESL to create changes to the surrounding agricultural land which would be bisected and would become less viable to farm.		
	South of the A13 there are more settlements. Arable fields are still a feature but this are mixed with rough grassland, golf courses and gravel extraction.  Overhead power lines become a common feature.	Local	Medium	Medium in local context	High.	Moderate adverse. Despite the urban fringe character the introduction of Route 4 ESL would significantly change the land use in the immediate vicinity of the road and some arable fields would no longer be viable.		

	Step 2			Step 3	Step 4	
Features	Description	Scale it matters	Rarity	Importance	Substitutability	Impact
	From the M25 junction with the A127 to the A13 the landcover is mostly of arable fields, with hedges and boundary trees, with settlements some distance away. There is a golf course at Dunton. Areas of woodland at the junction with the M25 including a small area of ancient woodland would be destroyed by the new slip roads.	Local	Medium	Medium in local context	High. The most important features the trees and hedges can easily be replaced. Ancien woodland low.	Moderate adverse The current agricultural landcover would change along Route 4 ESL, to one dominated by transport infrastructure.
Summary of character	The Thames river corridor has a strong identity with large expansive horizontal visits dominated by the interplay of water and sky. The area to the north along Route 4 ESL consists of open arable farmland north of the A13, with settlements and urban fringe areas becoming more dominant to the south. Prominent features consist of arterial roads, pylons, and the distant urban edge of large settlements. The land rises up to the south and the AONB with areas of woodland and heathland beyond which is the A2/M2 transport corridor.		Medium regionally	Medium regionally	Medium	Large adverse. Although there are major roads running through the parts landscape, Route 4 ESL would introduce a new transport corridor through areas that are largely rural in character in particular around Shorne and the AONB. In places this would dramatically change the character of the landscape from a rural one to one dominated by transport infrastructure and have a wider effect on the surrounding area than the immediate footprint of the road.

#### **Reference Sources**

Department of Transport TAG Unit A3 Environmental Impact Appraisal May 2014, Magic.gov.uk, Google Maps satellite photography, OS Maps, Thurrock UDP deposit draft 2003 (unadopted). National Character Area 111 Northern Thames Basin, National Character Area 81 Greater Thames Estuary, National Character Area 113 North Kent Plain, The Landscape Assessment of Kent 2004, Essex Landscape Character Assessment, Gravesham Local Plan 2nd review

#### Step 5 - Summary Assessment Score

Large adverse

#### **Qualitative Comments**

Route 4 ESL would create a new road corridor and introduce a significant change to the existing landscape character which is designated as Green Belt, due to the introduction of a major new transport corridor with its associated infrastructure such as signage, lighting, bridges and embankments, into a largely rural area. Route 4 ESL would have a considerable impact on the area around Shorne and the AONB The new road corridor and junction infrastructure associated with Route 4 ESL would impact on locally, regionally and nationally valued features including scheduled monuments and listed buildings.

## **Annex 7 – Water Worksheet**

### Annex 7: Water Environment Impacts Worksheet

Route 4 ESL Bored  Description of study area/	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
summary of potential impacts	Key environmental resource	reatures	Quanty	Scale	Harity	Substitute - ability	importance	мадпіцое	Significance
Study area: River Thames		1	T	T	1	1		,	
Potential Impacts: Morphological and hydrodynamic changes to the River Thames due to river crossing	River Thames Estuarine/ transitional waters (WFD Water Body Thames Middle) ID No: GB530603911402	Water supply / biodiversity / transport & dilution waste products / recreation / aesthetics / cultural heritage / value to economy / navigation	High Recommended Marine Conservation Zone. Heavily modified water body at Moderate Ecological Potential and failing Chemical Status. Important river of national significance with commercial and social value, including depository for effluent discharges, abstraction of water supply, recreation and, navigation.	Regional/ National (excludes biodiversity considerations)	Rare	Not feasible	Very High	Negligible  Negligible	Low significance
and spillage risk during operation of the new road			South Thames Estuary and Marshes SSSI and Ramsar site to south						Insignificant
Study Area: Mardyke									
Potential Impacts: Morphological and hydrodynamic changes to the								Slight adverse	
Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke and Fobbing (R4) WFD Water body ID GB106037028030	Water supply / biodiversity / transport & dilution waste products / recreation	Water available for abstraction licensing, subject to limitations (	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	Assumes watercourse crossings and or displacement includes	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road			Roding Beam Ingrebourne and Mardyke CAMS)		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			(Moderate adverse)  Negligible (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Potential Impacts: Morphological and hydrodynamic changes to the								(Moderate adverse)	
Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke (East Tributary- R8) WFD water body ID GB106037028070	Water supply / biodiversity / transport & dilution waste products / recreation	Water available for abstraction licensing, subject to limitations (	Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible	Medium	(Larger tributary crossing) Slight adverse Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant (Low significance)
Potential Impacts: Routine runoff and spillage risk during operation of the new road	:		Roding Beam Ingrebourne and Mardyke CAMS)		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			(Moderate adverse)  Negligible (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts,		Water supply / biodiversity / transport & dilution waste products / recreation		Regional (ref WFD water body status)	Moderate (ref target WFD status, water supply availability)	Not feasible		Slight adverse Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable	Insignificant
embankments and other structures in the flood plain	Mardyke (West Tributary) R9 WFD water Body ID GB106037028080						Medium	design and naturalisation where possible	
Potential Impacts: Routine runoff and spillage risk during operation of the new road								(Moderate adverse)  Negligible (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Potential Impacts: Morphological and hydrodynamic changes to the Mardyke and associated water courses due to crossings, viaducts, embankments and other structures in the flood plain	Mardyke and Fobbing (R11) WFD water Body ID GB106037027970 Includes East Tilbury main	Water supply / biodiversity / transport & dilution waste products / recreation	Water available for abstraction	Regional (ref WFD water body	Moderate (ref target WFD status, water supply	Not feasible	Medium	Slight adverse Assumes watercourse crossings and or displacement includes appropriate mitigation including viaduct sections, culverts with suitable design and naturalisation where possible	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road	drains	products / recreation	licensing, subject to limitations ( Roding Beam Ingrebourne and Mardyke CAMS)	status)	availability)			(Moderate adverse) Negligible (assuming appropriate assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures proposed)	Insignificant (Low significance)
Study Area: Thames and Medway	/ Canal			<u> </u>	1	I			
Potential Impacts: Morphological and hydrodynamic changes to the River Thames due to river crossing	Thames and Medway Canal (Ca18) (GB70610011)	Biodiversity / transport dilution waste products /recreation / navigation	Medium (biodiversity evaluated separately) Thames and Medway Canal good potential, no other water quality data available at this stage. Could support protected ecological species. It is not known whether these water bodies	Regional (ref WFD water body status)	Moderate	Limited feasibility	Medium	Negligible Assumes bored tunnel section has no impact on surface water courses	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road		(potential)	have any intrinsic social or economic value. Not currently used for navigation. Appraisal on water environment not biodiversity	status)				Negligible Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted. Note: Best practice drainage design precludes discharge to canals	Insignificant
Study Area: Minor watercourses a	and drainage ditches at South	Thames Estuary and Marshe	es (excluding Thames and Medway ca	nal)	1	1		,	
Potential Impacts: Morphological changes to minor watercourses and drainage networks	Minor water courses and drains of Shorne, Eastcourt, Great		Medium Could support protected ecological					Negligible Assumes bored tunnel section has no impact on surface water courses	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road	Clane Lane and Filborough Marshes. South Thames Estuary and Marshes SSSI and Ramsar site.	Biodiversity / recreation / amenity	species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity	Local	Common	Limited feasibility	Medium	Negligible Assume assessment of the new roads runoff and spillage risk is carried out and treatment / containment measures adopted	Insignificant
Study Area: Minor watercourses	and drainage ditches north of	the River Thames (see also	Mardyke water body)						
Potential Impacts: Morphological changes to drainage networks	Minor watercourses and	Diodinoscit.	Medium Could support protected ecological					Slight adverse Assumes watercourse crossings and or displacement includes appropriate mitigation	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road	drainage ditches at East Tilbury Marshes	Biodiversity / recreation / amenity	species. Assumed interaction with shallow groundwater. Appraisal on water environment not biodiversity	Local	Common	Limited feasibility	Medium		Insignificant Low significance
Study Area: Lakes and ponds									
Loss of or other physical impact on standing water bodies	(natural and man made) on land to N and S of River	Biodiversity / recreation /	Low - Medium Could support protected ecological	Local	Comm	Limited f"	Low	Negligible: No significant standing waters crossed or intercepted.	Insignificant
Potential Impacts: Routine runoff and spillage risk during operation of the new road	Thames including ponds and lakes and standing water in	amenity / water supply (small reservoirs and dams)	species. Some reservoirs and local (largely) agricultural water supplies	Local	Common	Limited feasibility	Low	Negligible: Assumes no drainage to standing water in accordance with best practice	Insignificant

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude	Significance
ourman, or potential impacts									
Study Area: Groundwater north	of River Thames	1		T	ı	T	T		
	South Essex Thurrock Chalk (GB40601G401100)	WFD water body status; water supply / resources; groundwater dependent ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Source Protection Zones 2 and 3 (Linford / East Tilbury) Local commercial / industrial / agricultural licenced supplies Roding Beam Ingrebourne and Mardyke CAMS - no water available for further abstraction	Regional (ref WFD water body status)	Rare (CAMS shows restricted water availability)	Not feasible	High (based on resource availability, WFD target )	(Moderate adverse) Depends on whether permanent structures and or permanent dewatering (including at portal) impact groundwater flow Slight adverse with mitigation.  Assumes any drainage to ground managed in accordance with best practice	Low significance (significant)
Potential Impact Impact on groundwater quality from potentially polluting surface activities/ highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels and tunnel portals (if required) or disruption to natural groundwater flow by	Fessy gravels	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium WFD water body status (current poor, target good). Local commercial /industrial/agricultural licenced supplies	Regional (ref WFD water body status)	Moderate	Not feasible	Medium	Negligible - slight adverse Assumes at grade road would not significantly impact groundwater and cuttings have minor impact on shallow groundwater. Drainage to ground managed in accordance with best practice. No exposure of this formation at Thames crossing	Insignificant
underground structures. Long term impacts from mobilisation of leachates from contaminated land / old landfill	South Essex Lower London Tertiaries (G16) (GB40602G401000)	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	Medium - low WFD water body status (current poor, target good)	Regional (ref WFD water body status)	Moderate	Not feasible	Medium	Negligible: Little exposure of this formation Assumes any drainage to ground managed in accordance with best practice	Insignificant
		Groundwater dependant ecosystems (biodiversity); local water supply (agriculture)	Low	Local	Common	Not feasible	Low	Slight to moderate adverse. Depends on whether permanent structures and or permanent dewatering (including at portal) impact shallow groundwater flow Assumes any drainage to ground managed in accordance with best practice. Also assumes any landfill leachate appropriately managed	Insignificant
Study Area: Groundwater south	of River Thames		<u> </u>	T		T			
Potential Impact: Impact on groundwater quality from potentially polluting surface activities / highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels and tunnel portals (if required) or disruption to natural groundwater flow by underground structures.	North Kent Medway Chalk WFD Water body ID GB40601G500300	WFD water body status; water supply / resources; groundwater dependant ecosystems; groundwater flow / quality	High WFD water body status (current poor, target good). Source Protection Zones 1, 2 and 3 (SE of Shorne) Local commercial /industrial/agricultural licenced supplies	Regional (ref WFD water body status)	Rare (CAMS shows restricted water availability)	Not feasible	High (based on resource availability, WFD target)	(Moderate adverse) Depends on whether permanent structures and or permanent dewatering (including at portal) impact groundwater flow Slight adverse with mitigation. Assumes any drainage to ground managed in accordance with best practice	Low significance (significant)
Potential Impact: Impact on groundwater quality from potentially polluting surface activities/ highway drainage. Potential impact on groundwater flow from permanent dewatering of cuttings and tunnels (if required) or disruption to natural groundwater flow by underground structures. Derogation of water in SSSI	gravels / alluvium) feeding South Thames Estuary and	Groundwater dependant ecosystems (biodiversity); local water supply (agriculture)	Low (Ramsar/ SSSI covered by biodiversity)	Local (National / International value covered by biodiversity)	Common	Not feasible	Low	Slight adverse Bored tunnel would pass beneath any shallow aquifer north of portal but may be impacted by long term dewatering at portal. Assumes any drainage to ground managed in accordance with best practice	Insignificant
Study Area: River Thames Flood	Zone 2/3 and associated defen	ces	<u> </u>	T	I		T		
Potential Impacts: Direct risk of flooding to highway from watercourse or tidal source (Thames)	River Thames crossing route	Transport link - improves efficiency of existing network	High	Regional	Moderate	Feasible (alternative crossing locations)	High	Slight adverse - portals and approaches off (defended floodplain) crossing closures due to flood conditions unlikely , further mitigation through design and integrated defences	Low significance
Potential impacts: Impedance of flood flows in River Thames channel due to crossing resulting in obstruction to flow	River Thames channel	Conveyance of flood flows	High - managed watercourse draining large upstream catchment	Local (immediate vicinity of crossing and City of London upstream)	Moderate	Not feasible	High	Negligible (bored tunnel would not interact with Thames channel flows)	Insignificant
Potential Impacts: Loss of flood storage volume (including loss through impedance of flood flows) due to the development (e.g. embankments, cuttings) or permanent spoil disposal sites leading to increased flood risk	River Thames floodplain	Conveyance and storage of flood flows: Mostly defended floodplain at present in vicinity of proposed route.  TE2100 Policy P4 implies improved defences in the future will ensure route remains in the defended floodplain	Medium - significant potential storage volume but not currently used for flood storage as the natural floodplain is defended	Local	Moderate	Feasible: Loss of (defended) floodplain storage substitutable	Medium (not currently used for flood storage)	Slight adverse: Assumes minimal loss of floodplain storage within defended River Thames floodplain	Insignificant
Potential impacts: Increase in flood risks by affecting existing flood defence or by preventing future flood defence development (e.g. actions under Thames Estuary TE 2100 planning)	River Thames flood defences	Protection of property/assets from flooding	High - provides protection for large urban area	Local	Moderate	Not feasible: Unlikely to be substitutable	High	Slight adverse: Assumes minimal loss of floodplain storage within defended River Thames floodplain	Insignificant
Study Area: Mardyke Flood Zone	2/ 3 and associated defences								
Potential Impacts: Direct risk of flooding to highway from watercourse or tidal source (Mar Dyke)	River Thames crossing route	Transport link - improves efficiency of existing network	High	Regional	Common	Feasible (alternative crossing locations)	High	(Moderate Adverse) Slight adverse (mitigation available, design to manage flood risk - defended floodplain)	Low significance (Significant)
Potential Impacts: Loss of flood storage volume (including loss through impedance of flood flows) due to the development (e.g. embankments, cuttings) or permanent spoil disposal sites leading to increased flood risk	Mar Dyke floodplain	Conveyance and storage of flood flows: Defended floodplain at present in vicinity of proposed route.  TE2100 Policy P4 implies improved defences in the future will ensure route remains in the defended floodplain.	Medium - potential flood storage shown in vicinity of route (EA flood Map) but shown as defended flood plain.	Local	Common	Feasible: Loss of (defended) floodplain storage substitutable	Low	(Moderate adverse) -potential to increase flood risk upstream for mostly rural area.  Slight adverse with mitigation - where crossings span flood plain.	Low significance (Significant)
Potential Impacts: Risk of afflux flooding (upstream) due to crossing of watercourse or land drain.	Mar Dyke channel	Conveyance of flood flows.	High - river channel shown (EA Flood Map) to convey flood flows at least up to 100-yr return period.	Local	Moderate	Not feasible	High	(Moderate adverse) -potential to increase flood risk upstream for mostly rural area.  Slight adverse with mitigation - where crossings span flood plain.	Low significance (Significant)
Potential impacts: Increase in flood risk by affecting existing flood defence or by preventing future flood defence development (e.g. actions under Thames Estuary TE 2100 planning)	Mar Dyke flood defences	Protection of property/assets from flooding	Low? - none shown on EA floodmap in vicinity of route	Local	Moderate	n/a - no defences shown (EA Flood map) in vicinity of proposed route	n/a	n/a - no defences shown (EA Flood map) in vicinity of proposed route	Insignificant - no defences shown (EA Flood map) in vicinity of proposed route
Study Area: Area surrounding Ma	in Rivers, Ordinary Watercours	ses, land drains and ditches,	including marshes	T	1		T		
Potential Impacts: Risk of afflux flooding (upstream) due to crossing of watercourse or land drain	Minor drainage networks within the land to N and S of River Thames, including drainage of Stone, Purfleet and West Thurrock Marshes ("West Thurrock Main Sewer")	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	Low	(Moderate adverse) (potential increase in flood risk). Slight adverse to negligible with mitigation	Insignificant Low significance
Potential Impacts: Risk of increased runoff to watercourse or land drain causing increase in flood risk from watercourse	As above	Drainage of surface water, local flood risk	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility	low	(Moderate adverse) (potential increase in flood risk). Slight adverse to negligible with mitigation	Insignificant Low significance

Description of study area/ summary of potential impacts	Key environmental resource	Features	Quality	Scale	Rarity	Substitute - ability	Importance	Magnitude Magnitude	Significance
Potential Impacts: Risk of flooding resulting from change in watercourse/drain flow regime due to morphological changes for development	As above	Drainage of surface water,	Medium Provides drainage of significant area of land	Local	Common	Limited feasibility		(Moderate adverse) (potential increase in flood risk). Slight adverse to negligible with mitigation	Insignificant Low significance
Study Area: Entire route.									
	Various floodplains and surface water drainage areas		Medium Located across multiple flood zones	Local	Common	Limited feasibility		(Moderate adverse) (potential increase in flood risk) Slight adverse after mitigation	Insignificant Low significance
	Various floodplains and surface water drainage areas		Medium Located across multiple flood zones	Local	Common	Limited feasibility		(Moderate adverse) (potential increase in flood risk) Slight adverse after mitigation	Insignificant Low significance
	Various floodplains and surface water drainage areas	Flood risk: People and property	Medium Located across multiple flood zones	Local	Common	Limited feasibility		(Moderate adverse) (potential increase in flood risk) Slight adverse after mitigation	Insignificant Low significance

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#### **Summary Assessment Score**

Post mitigation) Moderate Adverse impacts

#### Qualitative Comments

Note 1: Risks from construction are only considered where they may have a permanent impact on the water environment once construction is completed.

Note 2: Impacts on biodiversity may occur as a result of changes in water courses, river morphology, sedimentation, water quality and/or flow. Impacts on habitats / ecosystems / flora / fauna are covered separately under biodiversity and not included here to avoid "double counting"

lote 3: For some features, the magnitude of impacts is shown without mitigation (bold red font in parentheses) and with mitigation (bold, the convention for webTAG assessment). In these cases significance of effect is shown both without (red font in parent

Surface Water: The bridge crossing over the Thames will need to be developed to minimise impacts on river morphology from the bridge, although these are expected to be relatively localised with small increases inflow velocity within +/-2000m and there is little impact on HWL. Navigation will be affected by he position of the piers and bank structures, but the design will ensure main navigable channels ermain relatively unaltered. The bored tunnel would have little impact on the quality or morphology of the River Thames. Assuming the current bed profile is restored post construction, impacts from the immersed unnel depend primarily on the scale of any permanent effects (if any) that arise through the construction process (morphology, sedimentation, water quality, fisheries, navigational channels). Whilst these may have local impact, within the context of the Thames Middle water body overall , these are considered to tell and inter tidal habitats, assessed under biodiversity.

mpacts on the Mardyke (WFD water body) will depend on the nature of the crossings adopted, fully spanning and viaduct crossings are likely to have only slight impacts, where smaller channel crossings are employed, mitigation is generally available to reduce impacts to slight adverse

Impacts on the Thames and Medway canal (WFD water body) depend on the construction methods adopted, a cut and cover tunnel through this area (immersed tunnel option) would lead to a loss of part of the water body and could impact its WFD status, however if mitigation in the form of full canal restoration ost construction is adopted, these impacts could be reduced from moderate (or even large) adverse to slight adverse

mpacts are considered mostly slight adverse once mitigation is applied, although pending a full understanding of the impacts of the construction of the immersed tunnel, the impacts on the Tidal waters of the Thames remain moderate adverse.

Groundwater: Issues with rising groundwater levels have been identified regionally although it is understood these are less problematic in this immediate area. A tunnel crossing will require temporary dewatering during construction and may need longer term dewatering at portals. Larger groundwater resource and public supplies, primarily from the Chalk at depth are unlikely to be impacted, although there may be some impact on local licensed commercial/ industrial / agricultural supplies from shallow groundwater in the gravels, these are not thought to be significant. Impact at source protection zones may be initigated by adopting appropriate construction and drainage practices. Through possible impacts on groundwater quality and flow from the construction of a long bored tunnel there may be residual slight adverse impacts on completion. Impact at source protection zones (especially SPZ 1 near Shorne) may be nitigated by adopting appropriate construction and drainage practices.

NFD status: A Water Framework Directive assessment will be required due to the potential for direct effects on biological, chemical and physical WFD parameters for both surface waters (Thames, Mardyke, Thames and Medway canal) and WFD groundwater bodies (north and south of the river). With appropriate mitigation, it is not anticipated that the River Thames crossing or impacts on the Mardyke or groundwaters will lead to a reduction on WFD status or will prevent these water bodies reaching good status or potential in the future. For the assessment, it is generally assumed that the target 2027 status of good applies, even though current status of most water bodies is poor.

#### Flood Risk

The bridge option has some potential to increase flood risk in the River Thames channel upstream due to piers and other structures impeding channel conveyance. The bored and immersed tube tunnels would have no impact on channel conveyance. The impact of the bridge on channel conveyance is likely to be itigated through design (adequate span, minimise pier dim

uld be at higher risk of route closure due to high flood levels (i.e. through breach or overtopping of existing defences).

All bridge and tunnel options would require a design that integrates with (or does not compromise) TE2100 River Thames flood defence plans. At the River Thames flood defence locations the current Route 4 bridge design indicates the bridge would be significantly higher than the flood defences south of the River Thames which are located at the approximate transition between a raised viaduct and suspended bridge (no defences are shown on the north bank of the River Thames as here high ground forms the defence line). The Route 4 bored tunnel and immersed tunnel options have portals set back from the River Thames (south embankment) flood defences. However, there would still be a need to consider the impact of a tunnel on flood defences e.g. due to interference with flood defence piling by the tunnel.

TE2100 policies at the location of the Route 4 crossing are:

TEZ100 policies at the location of the Route 4 crossing are:
P4 for Policy Unit Purifiest, Grays and Tilbury, north of the River Thames (take further action to keep up with climate change and land use change so that flooding does not increase)
P3 for Policy Unit East Tilbury and Mucking Marshes, north of the river Thames (continue with existing or alternative actions to manage flood risk)
P3 for Policy Unit North Kent Marshes, south of the River Thames (continue with existing or alternative actions to manage flood risk). TE2100 includes an action to provide a secondary defence to Gravesend to protect from flooding from the tidal River Thames from the east. There is an opportunity for the Route

CFMP policies for Route 4 south of the River Thames (North Kent Rivers CFMP) are P3 for the North Kent Marshes Policy Unit (areas of low to moderate flood risk where we are generally managing existing flood risk effectively - i.e. no anticipated increase in FRM measures) and P1 for the North Kent Downs Policy Unit (areas of little or no flood risk where we will continue to monitor and advise).

CFMP policies for Route 4 north of the River Thames (South Essex CFMP - Thames Urban Tidal Policy Unit) are P4 for the Thames Urban Tidal Policy Unit (take further FRM actions to keep pace with climate change) and P6 for the Upper Mardyke Policy Unit (store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits). Route 4 crosses the Mardyke floodplain near the upstream extent of Mardyke catchment. Whilst this may present a flood risk to the proposed road and the potential for the road to increase flood risk upstream, there is also potential for the road embankment to be designed to hold back flood water and hence alleviate flood risk downstream (consistent with South Essex CFMP Policy).

Thurrock SWMP (URS 2013) identifies Critical Drainage Areas (CDAs). Route 4 passes through CDA\_010a and CDA\_010b (located west of Stanford-le-Hope) and CDA\_011 (located in the upper Mardyke catchment in and around Bulphan. For these areas there is potential for the road design to act to reduce ocal flood risk e.g. by providing attenuation of road drainage, providing flood storage directly upstream of the road. None of these CDAs are crossed by the proposed Route 4. Thameside SWMP (JBA 2013) is a Stage 1 SWMP and does not provide much detail in relation to the Route 4 route alignment and nplications for local flood risk

The surface water drainage strategy / design (in accordance with HE guidance and standards) should be agreed with the relevant Lead Local Flood Risk Authorities. It is likely this will require that surface water runoff from the proposed crossing does not exceed existing rates (using SUDs where feasible).

## **Annex 8 - Noise Worksheet**

Annex 8: Noise Worksheet Route 4 ESL Bored Tunnel APPRAISAL - NOISE POLLUTION Present value base year: 2010 2015 Current year: 2025 Proposal Opening Year: Average Household Size: 2.36 Project (Road or Rail): Road No. of households experiencing 'without scheme' & 'with scheme' noise levels (given in dB<sub>Leq</sub>) in Opening Year With 45-47.9 | 48-50.9 | 51-53.9 | 54-56.9 | 57-59.9 | 60-62.9 | 63-65.9 | 66-68.9 | 69-71.9 | 72-74.9 | 75-77.9 | 78-80.9 Without scheme <45 45-47.9 63 202 227 4561 1166 18 20 48-50.9 51-53.9 1416 5065 252 4698 33 18 1218 18 0 54-56.9 57-59.9 60-62.9 961 3384 191 19 151 0 690 2524 728 12 0 185 20 63-65.9 0 10 541 2760 81 245 72-74.9 75-77.9 198 0 0 0 0 55 46 No. of households experiencing 'without scheme' & 'with scheme' noise levels (given in dB<sub>Leq</sub>) in 15th Year After Opening 48-50.9 51-53.9 54-56.9 57-59.9 60-62.9 63-65.9 66-68.9 69-71.9 72-74.9 75-77.9 78-80.9 45-47.9 Without scheme <45 9442 190 <45 45-47.9 48-50.9 51-53.9 54-56.9 57-59.9 1068 4600 19 1183 24 13 175 867 60-62.9 63-65.9 66-68.9 69-71.9 620 146 97 1821 72-74.9 75-77.9 214 38 78-80.9 81+ £12,356,117 Net Present Value of Noise of Proposal \*positive value reflects a net benefit (i.e. noise reduction) (60 Year Period) Estimated Population Annoyed (Do-Minimum): 12418 Estimated Population Annoyed (Do-Something): 12107 Net Noise Annoyance Change in 15th Year After -312 ositive value reflects an increase in people annoyed by noise Opening (no. of people):

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The Pre-Consultation Scheme Assessment Report details the assessment of options leading up to consultation. A final Scheme Assessment Report will be published post consultation.