NLE Climate Change Mitigation: Projected footprint of the NLE

Construction	Construction emissions are those arising during the construction of the NLE. These include emissions from embodied carbon in the extraction and processing of raw materials, as well as emissions from energy use in construction processes such as vehicles delivering building materials to the site. Two construction design options presented in Chapter 4: Description of the NLE; have been modelled to compare emissions. Construction Option A and B are mostly the same, with alternative tunnelling methods being applied for Option B.			
	Description	**Rational for calculation and assumptions**	**tCO2 - Option A**	**tCO2 - Option B**
Embodied carbon in construction materials	Embodied carbon from the extraction and processing of raw materials	Embodied carbon emissions are based multiplying the quantities of materials by published emissions factors from The Inventory of Carbon and Energy (ICE) (January 2011).	161,835.35	161,969.88
Transportation of extracted materials	Vehicles removing extracted materials from the site	Assumed distances are used for the vehicle movements based on average distances for delivery vehicles.	2,576.79	2,730.32
Transportation of materials to site	Vehicles delivering building materials to the site	Assumed distances are used for the vehicle movements based on average distances for delivery vehicles.	270.41	284.49
Construction site energy	The operation of vehicles and plant equipment in the construction of the site. On-site accommodation, lighting and any other use of fossil fuels for the construction of the project.	Emissions from construction vehicles and plant are based on the fuel requirements of typical construction vehicles over the length of the project.	25,978.99	25,978.99
TOTAL CONSTRUCTION			**190,661.54**	**190,963.69**

Baseline	The purpose of the baseline is to act as a reference to compare the impact of any new project against. The baseline accounts for emissions from indirect sources assuming no NLE is built, based on 2031 projected development. Operation of existing stations has been excluded from the baseline, as it is assumed that the energy use at existing stations will not change significantly as a result of the NLE.		
	Description	**Rational for calculation and assumptions**	**tCO2**
Transport - indirect	Indirect transport by people in the NLE area, including public transport and private vehicle use.	Based on the scenario for 'without NLE' as detailed in Chapter 2	12,883,637.24
TOTAL BASELINE			**12,883,637.24**

Operational emissions	Operational emissions are those arising during the running of a fully operational NLE. They include direct emissions from trackside and non-trackside energy use as well as vehicles associated with the maintenance and operation of the line. Indirect emissions are also included from transport in the NLE area, and from third party activities associated with the NLE operation. The operational emissions calculation is based on emissions during 2031.		
	Description	**Rational for calculation and assumptions**	**tCO2**
Scope 1			
Transport - direct	Company leased vehicles emissions (from London Underground 2008 carbon footprint data)	Total company leased vehicle emissions, for support road fleet - assumed proportional to 2008 LU carbon footprint.	4
Scope 2			
Operation - Non Trackside	Non-trackside emissions (from Energy Strategy calculations)	Heating & Domestic hot water (DHW)	NB. Not included here as this would be double-counting tube travel emissions which are built into the transport emissions.
		Cooling	
		Lighting	
		Auxiliary	
		Small Power & Escalators & Lifts	
Operation - Trackside	Trackside emissions (from London Underground 2008 carbon footprint data)	Traction - assumed proportional to 2008 LU carbon footprint.	
		Groundwater Pumps - assumed proportional to 2008 LU carbon footprint.	
		Ventilation fans - assumed proportional to 2008 LU carbon footprint.	
Scope 3			
Operation - indirect	Indirect operational emissions (from London Underground 2008 carbon footprint)	Total indirect operational emissions - assumed proportional to 2008 LU carbon footprint.	935
Transport - indirect	Indirect transport by people in the NLE area, including public transport and private vehicle use.	Based on the scenario for 'with NLE' as detailed in Chapter 2	12,880,843.17
TOTAL OPERATION			**12,881,781.98**

Construction Footprint

Two construction design options have been modelled to compare emissions. Construction Option A and B are mostly the same, with alternative tunnelling methods being applied for Option B.

Embodied Energy of Construction Materials

Design Option A

Source: Table 1-3 Clean Excavated Material Generated by the NLE (from Appendix B1 - Material Management Strategy - Draft 3)

Source: The Inventory of Carbon and Energy (ICE) (January 2011)

Location	Material	Components	Total Quantity	Unit	Density (kg/m3)	Material weight (kg)	Emissions Factor Description	Emissions Factor (kg CO2e/kg	tco2e
Running Tunnels and Cross Passages (including Battersea work	Concrete		99,625.00	m3	2,400.00	239,100,000.00	RC 40/50 Mpa (suitable for high strength a	0.17	41,603.40
Running Tunnels and Cross Passages (including Battersea work	Tunnel Linings (sprayed concrete)		2,365.00	m3	2,400.00	5,676,000.00	RC 40/50 Mpa (suitable for high strength a	0.17	987.62
Running Tunnels and Cross Passages (including Battersea work	230mm thick precast platform deck units		1,695.00	m3	2,400.00	4,068,000.00	Precast RC 40/50 MPa	0.18	732.24
Running Tunnels and Cross Passages (including Battersea work	Reinforcement		21,740.00	tonnes		21,740,000.00	Steel. Bar and rod - UK (EU) Average Recyc	1.40	30,436.00
Running Tunnels and Cross Passages (including Battersea work	Grout		14,690.00	m3	2,162.00	31,759,780.00	Cement mortar (Grout)	0.22	7,018.91
Running Tunnels and Cross Passages (including Battersea work	Tunnel Linings	PCC Segments	84,962.50	tonnes		84,962,500.00	Precast RC 40/50 MPa	0.18	15,293.25
Running Tunnels and Cross Passages (including Battersea work	Tunnel Linings	SGI lining rings (Spheroidal	310.00	tonnes		310,000.00	Iron	2.03	629.30
Nine Elms Station	Concrete		74,172.00	m3	2,400.00	178,012,800.00	RC 40/50 Mpa (suitable for high strength a	0.17	30,974.23
Nine Elms Station	Reinforcement		16,445.00	tonnes		16,445,000.00	Steel. Bar and rod - UK (EU) Average Recyc	1.40	23,023.00
Kennington Green Ventilation Shaft	Concrete		2,595.00	m3	2,400.00	6,228,000.00	RC 40/50 Mpa (suitable for high strength a	0.17	1,083.67
Kennington Green Ventilation Shaft	Grout		370.00	m3	2,162.00	799,940.00	Cement mortar (Grout)	0.22	176.79
Kennington Green Ventilation Shaft	Reinforcement		455.00	tonnes		455,000.00	Steel. Bar and rod - UK (EU) Average Recyc	1.40	637.00
Kennington Green Ventilation Shaft	Tunnel Linings	PCC lining rings	1,037.50	tonnes		1,037,500.00	Precast RC 40/50 MPa	0.18	186.75
Kennington Park Ventilation Shaft	Concrete		4,838.00	m3	2,400.00	11,611,200.00	RC 40/50 Mpa (suitable for high strength a	0.17	2,020.35
Kennington Park Ventilation Shaft	Grout		370.00	m3	2,162.00	799,940.00	Cement mortar (Grout)	0.22	176.79
Kennington Park Ventilation Shaft	Reinforcement		1,025.00	tonnes		1,025,000.00	Steel. Bar and rod - UK (EU) Average Recyc	1.40	1,435.00
Kennington Park Ventilation Shaft	Tunnel Linings	PCC lining rings	1,037.50	tonnes		1,037,500.00	Precast RC 40/50 MPa	0.18	186.75
Radcot Street and Harmsworth Street Temporary Shafts	Concrete		221.00	m3	2,400.00	530,400.00	RC 40/50 Mpa (suitable for high strength a	0.17	92.29
Radcot Street and Harmsworth Street Temporary Shafts	Grout		484.00	m3	2,162.00	1,046,408.00	Cement mortar (Grout)	0.22	231.26
Radcot Street and Harmsworth Street Temporary Shafts	Reinforcement		28.00	tonnes		28,000.00	Steel. Bar and rod - UK (EU) Average Recyc	1.40	39.20
Radcot Street and Harmsworth Street Temporary Shafts	Tunnel Linings	PCC lining rings	142.50	tonnes		142,500.00	Precast RC 40/50 MPa	0.18	25.65
Radcot Street and Harmsworth Street Temporary Shafts	Tunnel Linings	SGI lining rings (Spheroidal	102.40	tonnes		102,400.00	Iron	2.03	207.87
Step Plate junctions	Concrete		2,140.00	m3	2,400.00	5,136,000.00	RC 40/50 Mpa (suitable for high strength a	0.17	893.66
Step Plate junctions	Grout		1,534.00	m3	2,162.00	3,316,508.00	Cement mortar (Grout)	0.22	732.95
Step Plate junctions	Reinforcement		169.00	tonnes		169,000.00	Steel. Bar and rod - UK (EU) Average Recyc	1.40	236.60
Step Plate junctions	Tunnel Linings	PCC lining rings	1,535.00	tonnes		1,535,000.00	Precast RC 40/50 MPa	0.18	276.30
Step Plate junctions	Tunnel Linings	SGI lining rings (Spheroidal	1,230.80	tonnes		1,230,800.00	Iron	2.03	2,498.52
TOTAL						**618,305,176.00**			**161,835.35**

Design Option B

Source: Table 1-3 Clean Excavated Material Generated by the NLE (from Appendix B1 - Material Management Strategy - Draft 3)

Source: Email from Simon Lewis (ch2m) 27.03.13

Source: The Inventory of Carbon and Energy (ICE) (January 2011)

NB. There is no materials data for Option B and so have assumed same as Option A, except removed Radcot Street and Harmsworth Street Temporary Shafts data, as these not expected to be in Design Option 2. Have also included gallery tunnels.

Location	Material	Components	Total Quantity	Unit	Density (kg/m3)	Material weight (kg)	Emissions Factor Description	Emissions Factor (kg CO2e/kg	tco2e
Running Tunnels and Cross Passages (including Battersea work	Concrete		99,625.00	m3	2,400.00	239,100,000.00	RC 40/50 Mpa (suitable for high strength a	0.17	41,603.40
Running Tunnels and Cross Passages (including Battersea work	Tunnel Linings (sprayed concrete)		2,365.00	m3	2,400.00	5,676,000.00	RC 40/50 Mpa (suitable for high strength a	0.17	987.62
Running Tunnels and Cross Passages (including Battersea work	230mm thick precast platform deck units		1,695.00	m3	2,400.00	4,068,000.00	Precast RC 40/50 MPa	0.18	732.24
Running Tunnels and Cross Passages (including Battersea work	Reinforcement		21,740.00	tonnes		21,740,000.00	Steel. Bar and rod - UK (EU) Average Recyc	1.40	30,436.00
Running Tunnels and Cross Passages (including Battersea work	Grout		14,690.00	m3	2,162.00	31,759,780.00	Cement mortar (Grout)	0.22	7,018.91
Running Tunnels and Cross Passages (including Battersea work	Tunnel Linings	PCC Segments	84,962.50	tonnes		84,962,500.00	Precast RC 40/50 MPa	0.18	15,293.25
Running Tunnels and Cross Passages (including Battersea work	Tunnel Linings	SGI lining rings (Spheroidal	310.00	tonnes		310,000.00	Iron	2.03	629.30
Nine Elms Station	Concrete		74,172.00	m3	2,400.00	178,012,800.00	RC 40/50 Mpa (suitable for high strength a	0.17	30,974.23
Nine Elms Station	Reinforcement		16,445.00	tonnes		16,445,000.00	Steel. Bar and rod - UK (EU) Average Recyc	1.40	23,023.00
Kennington Green Ventilation Shaft	Concrete		2,595.00	m3	2,400.00	6,228,000.00	RC 40/50 Mpa (suitable for high strength a	0.17	1,083.67
Kennington Green Ventilation Shaft	Grout		370.00	m3	2,162.00	799,940.00	Cement mortar (Grout)	0.22	176.79
Kennington Green Ventilation Shaft	Reinforcement		455.00	tonnes		455,000.00	Steel. Bar and rod - UK (EU) Average Recyc	1.40	637.00
Kennington Green Ventilation Shaft	Tunnel Linings	PCC lining rings	1,037.50	tonnes		1,037,500.00	Precast RC 40/50 MPa	0.18	186.75
Kennington Green Gallery Tunnel	Tunnel Linings		1,045.00	m3	2,400.00	2,508,000.00	RC 40/50 Mpa (suitable for high strength a	0.17	436.39
Kennington Park Ventilation Shaft	Concrete		4,838.00	m3	2,400.00	11,611,200.00	RC 40/50 Mpa (suitable for high strength a	0.17	2,020.35
Kennington Park Ventilation Shaft	Grout		370.00	m3	2,162.00	799,940.00	Cement mortar (Grout)	0.22	176.79
Kennington Park Ventilation Shaft	Reinforcement		1,025.00	tonnes		1,025,000.00	Steel. Bar and rod - UK (EU) Average Recyc	1.40	1,435.00
Kennington Park Ventilation Shaft	Tunnel Linings	PCC lining rings	1,037.50	tonnes		1,037,500.00	Precast RC 40/50 MPa	0.18	186.75
Kennington Park Gallery Tunnel	Tunnel Linings		705.00	m3	2,400.00	1,692,000.00	RC 40/50 Mpa (suitable for high strength a	0.17	294.41
Step Plate junctions	Concrete		2,140.00	m3	2,400.00	5,136,000.00	RC 40/50 Mpa (suitable for high strength a	0.17	893.66
Step Plate junctions	Grout		1,534.00	m3	2,162.00	3,316,508.00	Cement mortar (Grout)	0.22	732.95
Step Plate junctions	Reinforcement		169.00	tonnes		169,000.00	Steel. Bar and rod - UK (EU) Average Recyc	1.40	236.60
Step Plate junctions	Tunnel Linings	PCC lining rings	1,535.00	tonnes		1,535,000.00	Precast RC 40/50 MPa	0.18	276.30
Step Plate junctions	Tunnel Linings	SGI lining rings (Spheroidal	1,230.80	tonnes		1,230,800.00	Iron	2.03	2,498.52
TOTAL						**620,655,468.00**			**161,969.88**

Transport of Excavated Materials (Clean)

Source: Material Volumes: Table 1-4 Clean Excavated Material Generated by the NLE (from Appendix B1 - Material Management Strategy - Draft 3)

Source: Transport Data: Battersea to Northfleet by road from Google maps direction search. Barge from Battersea Jetty to Wallasea Island see "Construction Vehicle movements for excavated materials" table below

Source: Emission Factors: Defra 2012: "Defra-ghg-conversionfactors2012" J:\Wimbledon-Jobs\Transport for London (TfL)\46368016 Northern Line Ext Climate & Ad\Technical\Carbon Footprint\Data Sources

Source: Distances travelled: GRNLEB-HGL-00-XX-TNT-MDR-00018-01_-_REV_01_-_Activity_7_-_Technical_Note_for_removal_of_Excavated_Material_at_Battersea

NB. Assumed sea-going boat has same capacity as barge for transport from Northfleet to Wallasea Island

NB. Journey distances account for return journey. Emissions factors assume boats are 60% loaded for entire trip and HGVs are 44% loaded both ways.

Design Option A

							Emission Factors		
							Road	Barge	Sea-going boat
Works	**Volume of Excavated Materials (m3)**	**Density Factor from m3 to Tonnes**	**Road (km travelled)**	**Barge (km travelled)**	**Sea-going boat (km travelled)**	**Conversion Factor to km**	**Artic Truck, 3.5-33t (kgCO2e/tonne.km)**	**General Cargo, 0-4999 dwt (kgCO2e/tonne.km)**	**General Cargo, 0-4999 dwt (kgCO2e/tonne.km)**
Nine Elms Station Box	110,310.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Battersea Station Box	76,340.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Overrun Tunnels at Battersea	12,170.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Crossover at Battersea	71,200.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Running Tunnels	141,730.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Step Plate Junctions	9,030.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Kennington Park (Permanent Shaft) and Substation	12,500.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Kennington Gardens (Permanent Shaft)	6,730.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Cross Passages	2,160.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Temporary Shafts	1,300.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Gallery Tunnels	-	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
TOTAL Excavated Material	**443,470.00**	**2.00**	**77.25**	**77.25**	**21.60**	**1.61**	**0.20**	**0.02**	**0.02**

Design Option B

							Emission Factors		
							Road	Barge	Sea-going boat
Works	**Volume of Excavated Materials (m3)**	**Density Factor from m3 to Tonnes**	**Road (km travelled)**	**Barge (km travelled)**	**Sea-going boat (km travelled)**	**Conversion Factor to km**	**Artic Truck, 3.5-33t (kgCO2e/tonne.km)**	**General Cargo, 0-4999 dwt (kgCO2e/tonne.km)**	**General Cargo, 0-4999 dwt (kgCO2e/tonne.km)**
Nine Elms Station Box	110,310.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Battersea Station Box	76,340.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Overrun Tunnels at Battersea	12,170.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Crossover at Battersea	71,200.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Running Tunnels	141,730.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Step Plate Junctions	9,030.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Kennington Park (Permanent Shaft) and Substation	12,500.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Kennington Gardens (Permanent Shaft)	6,730.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Cross Passages	2,160.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Temporary Shafts	-	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
Gallery Tunnels	6,290.00	2.00	77.25	77.25	21.60	1.61	0.20	0.02	0.02
TOTAL	**448,460.00**	**2.00**	**77.25**	**77.25**	**21.60**	**1.61**	**0.20**	**0.02**	**0.02**

Transport of Excavated Materials (Contaminated)

Source: "Draft Strategy for Excavated Material 2 TW" Extracted from source document on 15/02/2013 + Email 28.02.13 (Howard Waples)

Design Option A

Works	**Volume of Excavated Materials (m3)**	**Volume of Disposal Truck (m3)**	**Road (km travelled)**	**Emission Factors: Artic Truck, 3.5-33t (kgCO2e/vehicle km)**	**Number of Journeys**	**Total distance**	**Carbon Emissions (tCO2e)**
Contaminated Materials	4,650.00	10.00	20.00	1.11	465.00	9,300.00	10.31
Contaminated Dredged Materials	4,500.00	10.00	20.00	1.11	450.00	9,000.00	9.98

Design Option B

Works	**Volume of Excavated Materials (m3)**	**Density Factor from m3 to Tonnes**	**Road (km travelled)**	**Emission Factors: Artic Truck, 3.5-33t (kgCO2e/vehicle km)**	**Number of Journeys**	**Total distance**	**Carbon Emissions (tCO2e)**
Contaminated Materials	4,650.00	10.00	20.00	1.11	465.00	9,300.00	10.31
Contaminated Dredged Materials	4,500.00	10.00	20.00	1.11	450.00	9,000.00	9.98

Transport of Construction Materials

Design Option A

Source: GRNLEB-HGL-00-XX-SCH-MDR-00002 - 03-01 - VEHICLE MOVEMENT SCHEDULE

Backfill Materials - location	Number of lorries	Road (km travelled) - assumed 5km	Emissions factor description	Emission Factors (kgCo2e/km)	Total km travelled	Carbon Emissions (tCO2e)
Temporary Shafts at Radcot Street (shaft 1) and Harmsworth S	77.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	1.33	385.00	0.51
Radcot Street Shaft 1: connection to chamber	5.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	1.33	25.00	0.03
Radcot Street Shaft 1: Access tunnel	26.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	1.33	130.00	0.17
Harmsworth Street Shaft 2: connection chamber	5.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	1.33	25.00	0.03
Ventilation shafts at Kennington Green (Shaft 3) and Kenningto	20.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	1.33	100.00	0.13
Sub-surface tunnel	51.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	1.33	255.00	0.34
Shaft 4	31.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	1.33	155.00	0.21
Sub-surface Traction power Substation and Head house	108.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	1.33	540.00	0.72
TOTAL						**2.14**

Construction Materials - location	Materials	Number of lorries	Road (km travelled) - assumed 5km	Emissions factor description	Emission Factors (kgCo2e/km)	Total km travelled	Carbon Emissions (tCO2e)
Temporary Shafts at Radcot Street (shaft 1) and Harmsworth S	Concrete	38	5.00	Concrete wagon (6m3	1.33	190.00	0.25
Temporary Shafts at Radcot Street (shaft 1) and Harmsworth S	PCC segment, SGI segm	39	5.00	Artic wagon (40t): Arti	1.42	195.00	0.28
Temporary Shafts at Radcot Street (shaft 1) and Harmsworth S	Grout	81	5.00	Grout wagon (6m3): A	1.33	405.00	0.54
Ventilation shafts at Kennington Green (Shaft 3) and Kenningto	Concrete	1250	5.00	Concrete wagon (6m3	1.33	6,250.00	8.30
Ventilation shafts at Kennington Green (Shaft 3) and Kenningto	PCC segment, SGI segm	87	5.00	Artic wagon (40t): Arti	1.42	435.00	0.62
Ventilation shafts at Kennington Green (Shaft 3) and Kenningto	Grout	124	5.00	Grout wagon (6m3): A	1.33	620.00	0.82
Step-plate junction 1 Northbound	Concrete	181.00	5.00	Concrete wagon (6m3	1.33	905.00	1.20
Step-plate junction 1 Northbound	PCC segment, SGI segm	79.00	5.00	Artic wagon (40t): Arti	1.42	395.00	0.56
Step-plate junction 1 Northbound	Grout	133.00	5.00	Grout wagon (6m3): A	1.33	665.00	0.88
Step-plate junction 2 Southbound	Concrete	181.00	5.00	Concrete wagon (6m3	1.33	905.00	1.20
Step-plate junction 2 Southbound	PCC segment, SGI segm	78.00	5.00	Artic wagon (40t): Arti	1.42	390.00	0.56
Step-plate junction 2 Southbound	Grout	130.00	5.00	Grout wagon (6m3): A	1.33	650.00	0.86
From Kennington shaft to Kennington Loop - Running tunnel tr	Concrete	112.00	5.00	Concrete wagon (6m3	1.33	560.00	0.74
From Kennington shaft to Kennington Loop - Running tunnel tr	PCC segment, SGI segm	2.00	5.00	Artic wagon (40t): Arti	1.42	10.00	0.01
From Kennington shaft to Kennington Loop - Running tunnel tr	Grout	-	5.00	Grout wagon (6m3): A	1.33	-	-
From Battersea to Kennington shafts Both tunnels - Running tu	Concrete	3,263.00	5.00	Concrete wagon (6m3	1.33	16,315.00	21.66
From Battersea to Kennington shafts Both tunnels - Running tu	PCC segment, SGI segm	59.00	5.00	Artic wagon (40t): Arti	1.42	295.00	0.42
From Battersea to Kennington shafts Both tunnels - Running tu	Grout	-	5.00	Grout wagon (6m3): A	1.33	-	-
Crossover tunnels - Running tunnel track bed	Concrete	210.00	5.00	Concrete wagon (6m3	1.33	1,050.00	1.39
Crossover tunnels - Running tunnel track bed	PCC segment, SGI segm	4.00	5.00	Artic wagon (40t): Arti	1.42	20.00	0.03
Crossover tunnels - Running tunnel track bed	Grout	-	5.00	Grout wagon (6m3): A	1.33	-	-
Nine Elms Station	Concrete	11,999.00	5.00	Concrete wagon (6m3	1.33	59,995.00	79.67
Nine Elms Station	PCC segment, SGI segm	410.00	5.00	Artic wagon (40t): Arti	1.42	2,050.00	2.92
Nine Elms Station	Grout	-	5.00	Grout wagon (6m3): A	1.33	-	-
Battersea Station	Concrete	15,786.00	5.00	Concrete wagon (6m3	1.33	78,930.00	104.81
Battersea Station	PCC segment, SGI segm	3,407.00	5.00	Artic wagon (40t): Arti	1.42	17,035.00	24.27
Battersea Station	Grout	2,447.00	5.00	Concrete wagon (6m3	1.33	12,235.00	16.25
TOTAL							**268.26**

Design Option B

Source: GRNLEB-HGL-00-XX-SCH-MDR-00006 - REV 02-01 - VEHICLE MOVEMENT SCHEDULE ACL - ALT PRG

Backfill Materials - location	Number of lorries	Road (km travelled) - assumed 5km	Emissions factor description	Emission Factors (kgCo2e/km)	Total km travelled	Carbon Emissions (tCO2e)
Temporary Shafts at Radcot Street (shaft 1) and Harmsworth S	77.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	1.33	385.00	0.51
Radcot Street Shaft 1: connection to chamber	5.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	1.33	25.00	0.03
Radcot Street Shaft 1: Access tunnel	26.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	1.33	130.00	0.17
Harmsworth Street Shaft 2: connection chamber	5.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	1.33	25.00	0.03
Ventilation shafts at Kennington Green (Shaft 3) and Kenningto	20.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	1.33	100.00	0.13
Sub-surface tunnel	51.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	1.33	255.00	0.34
Shaft 4	31.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	1.33	155.00	0.21
Sub-surface Traction power Substation and Head house	108.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	1.33	540.00	0.72
SCL Gallery Tunnels: Kennington Green SCL Tunnel	440.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	2.33	2,200.00	5.12
SCL Gallery Tunnels: Kennington Park SCL Tunnel	297.00	5.00	Artic Truck, 3.5-33t (kgCO2e/	3.33	1,485.00	4.94
TOTAL						**12.21**

Construction Materials - location	Materials	Number of lorries	Road (km travelled) - assumed 5km	Emissions factor description	Emission Factors (kgCo2e/km)	Total km travelled	Carbon Emissions (tCO2e)
Ventilation shafts at Kennington Green (Shaft 3) and Kenningto	Concrete	1250	5.00	Concrete wagon (6m3	1.33	6,250.00	8.30
Ventilation shafts at Kennington Green (Shaft 3) and Kenningto	PCC segment, SGI segm	87	5.00	Artic wagon (40t): Arti	1.42	435.00	0.62
Ventilation shafts at Kennington Green (Shaft 3) and Kenningto	Grout	124	5.00	Grout wagon (6m3): A	1.33	620.00	0.82
Step-plate junction 1 Northbound	Concrete	181	5.00	Concrete wagon (6m3	1.33	905.00	1.20
Step-plate junction 1 Northbound	PCC segment, SGI segm	79	5.00	Artic wagon (40t): Arti	1.42	395.00	0.56
Step-plate junction 1 Northbound	Grout	133	5.00	Grout wagon (6m3): A	1.33	665.00	0.88
Step-plate junction 2 Southbound	Concrete	181	5.00	Concrete wagon (6m3	1.33	905.00	1.20
Step-plate junction 2 Southbound	PCC segment, SGI segm	76	5.00	Artic wagon (40t): Arti	1.42	380.00	0.54
Step-plate junction 2 Southbound	Grout	130	5.00	Grout wagon (6m3): A	1.33	650.00	0.86
From Kennington shaft to Kennington Loop - Running tunnel tr	Concrete	112	5.00	Concrete wagon (6m3	1.33	560.00	0.74
From Kennington shaft to Kennington Loop - Running tunnel tr	PCC segment, SGI segm	2	5.00	Artic wagon (40t): Arti	1.42	10.00	0.01
From Kennington shaft to Kennington Loop - Running tunnel tr	Grout	0	5.00	Grout wagon (6m3): A	1.33	-	-
From Battersea to Kennington shafts Both tunnels - Running tu	Concrete	3263	5.00	Concrete wagon (6m3	1.33	16,315.00	21.66
From Battersea to Kennington shafts Both tunnels - Running tu	PCC segment, SGI segm	49	5.00	Artic wagon (40t): Arti	1.42	245.00	0.35
From Battersea to Kennington shafts Both tunnels - Running tu	Grout	0	5.00	Grout wagon (6m3): A	1.33	-	-
Crossover tunnels - Running tunnel track bed	Concrete	210	5.00	Concrete wagon (6m3	1.33	1,050.00	1.39
Crossover tunnels - Running tunnel track bed	PCC segment, SGI segm	4	5.00	Artic wagon (40t): Arti	1.42	20.00	0.03
Crossover tunnels - Running tunnel track bed	Grout	0	5.00	Grout wagon (6m3): A	1.33	-	-
Nine Elms Station	Concrete	11999	5.00	Concrete wagon (6m3	1.33	59,995.00	79.67
Nine Elms Station	PCC segment, SGI segm	410	5.00	Artic wagon (40t): Arti	1.42	2,050.00	2.92
Nine Elms Station	Grout	0	5.00	Grout wagon (6m3): A	1.33	-	-
Battersea Station	Concrete	16565	5.00	Concrete wagon (6m3	1.33	82,825.00	109.98
Battersea Station	PCC segment, SGI segm	3407	5.00	Artic wagon (40t): Arti	1.42	17,035.00	24.27
Battersea Station	Grout	2447	5.00	Concrete wagon (6m3	1.33	12,235.00	16.25
TOTAL							**272.28**

Construction site energy

Source: Power requirements for construction activities -MDR-00050 - REV 01-01. Assumed 75% of peak load is used for whole construction period & powered by grid electricity. Hours of operation from CoCP (13-02-01_NLE_document_CoCP_edited draft_3).

NB. Assumed Design Option A and Option B are the same for construction power use

NB. No information on specific plant use such as TBMs etc. so assumed all equipment used for standard construction period for full years of construction. Excludes power requirements for any conveyor to the river and ship loaders

Specific Equipment & max power use	Average kW rating of equipment	Hours of construction per year	Years of construction	Total construction hours	Fuel use (kWh)	Emissions factor description	Emissions Factor (kg CO2e per kWh)	Carbon Emissions (tCO2e)
Conveyors - 1820kW	1,365.00	2,780.00	6.50	18,070.00	24,665,550.00	UK Grid Electricity for 2010	0.59	14,548.23
Lighting - 140kW	105.00	2,780.00	6.50	18,070.00	1,897,350.00	UK Grid Electricity for 2010	0.59	1,119.09
General Power - 300kW	225.00	2,780.00	6.50	18,070.00	4,065,750.00	UK Grid Electricity for 2010	0.59	2,398.06
Pumps - 20kW	15.00	2,780.00	6.50	18,070.00	271,050.00	UK Grid Electricity for 2010	0.59	159.87
Compressors - 10kW	7.50	2,780.00	6.50	18,070.00	135,525.00	UK Grid Electricity for 2010	0.59	79.94
Ventilation - 560kW	420.00	2,780.00	6.50	18,070.00	7,589,400.00	UK Grid Electricity for 2010	0.59	4,476.38
Accommodation (offices, canteens, toilet/shower blocks) - 400	300.00	2,780.00	6.50	18,070.00	5,421,000.00	UK Grid Electricity for 2010	0.59	3,197.41
TOTAL								**25,978.99**

Transport Capacity			Number of Journeys			Total tonne km per Journey			Carbon Emissions (tCO2e)			
Road	Barge	Sea-going boat	Road	Barge	Sea-going boat	Road	Barge	Sea-going boat	Construction Option 1			
Lorry Capacity per journey (tonnes)	Barge Capacity per Journey (tonnes)	Boat capacity per journey (tonnes)	Number of Journeys - assumed 30% road	Number of Journeys - assumed 70% barge	Number of Journeys - assumed 100% of trips use boat	tonne km	tonne km	tonne km	Road	Barge	Sea-going boat	TOTAL (both methods transport) to Northfleet
20	1000	1000	1654.65	77.22	110.31	1,544.97	77,248.51	21,602.90	502.05	99.26	39.65	640.96
20	1000	1000	1145.10	53.44	76.34	1,544.97	77,248.51	21,602.90	347.44	68.69	27.44	443.57
20	1000	1000	182.55	8.52	12.17	1,544.97	77,248.51	21,602.90	55.39	10.95	4.37	70.71
20	1000	1000	1068.00	49.84	71.20	1,544.97	77,248.51	21,602.90	324.05	64.07	25.59	413.71
20	1000	1000	2125.95	99.21	141.73	1,544.97	77,248.51	21,602.90	645.05	127.53	50.95	823.52
20	1000	1000	135.45	6.32	9.03	1,544.97	77,248.51	21,602.90	41.10	8.13	3.25	52.47
20	1000	1000	187.50	8.75	12.50	1,544.97	77,248.51	21,602.90	56.89	11.25	4.49	72.63
20	1000	1000	100.95	4.71	6.73	1,544.97	77,248.51	21,602.90	30.63	6.06	2.42	39.10
20	1000	1000	32.40	1.51	2.16	1,544.97	77,248.51	21,602.90	9.83	1.94	0.78	12.55
20	1000	1000	19.50	0.91	1.30	1,544.97	77,248.51	21,602.90	5.92	1.17	0.47	7.55
20	1000	1000	0.00	0.00	0.00	1,544.97	77,248.51	21,602.90	-	-	-	-
20	**1000**	**1000**	**6,652.05**	**310.43**	**443.47**	**1,544.97**	**77,248.51**	**21,602.90**	**2,018.34**	**399.03**	**159.42**	**2,576.79**

Transport Capacity			Number of journeys			Total tonne km per Journey			Carbon Emissions (tCO2e)			
Road	Barge	Sea-going boat	Road	Barge	Sea-going boat	Road	Barge	Sea-going boat	Construction Option 2			
Lorry Capacity per journey (tonnes)	Barge Capacity per Journey (tonnes)	Boat capacity per journey (tonnes)	Number of Journeys - assumed 32% road	Number of Journeys - assumed 68% barge	Number of Journeys - assumed 100% of trips use boat	tonne km	tonne km	tonne km	Road	Barge	Sea-going boat	TOTAL (both methods transport) to Northfleet
20	1000	1000	1764.96	75.01	110.31	1,544.97	77,248.51	21,602.90	535.52	96.42	39.65	671.59
20	1000	1000	1221.44	51.91	76.34	1,544.97	77,248.51	21,602.90	370.61	66.73	27.44	464.77
20	1000	1000	194.72	8.28	12.17	1,544.97	77,248.51	21,602.90	59.08	10.64	4.37	74.09
20	1000	1000	1139.20	48.42	71.20	1,544.97	77,248.51	21,602.90	345.65	62.23	25.59	433.48
20	1000	1000	2267.68	96.38	141.73	1,544.97	77,248.51	21,602.90	688.05	123.88	50.95	862.88
20	1000	1000	144.48	6.14	9.03	1,544.97	77,248.51	21,602.90	43.84	7.89	3.25	54.98
20	1000	1000	200.00	8.50	12.50	1,544.97	77,248.51	21,602.90	60.68	10.93	4.49	76.10
20	1000	1000	107.68	4.58	6.73	1,544.97	77,248.51	21,602.90	32.67	5.88	2.42	40.97
20	1000	1000	34.56	1.47	2.16	1,544.97	77,248.51	21,602.90	10.49	1.89	0.78	13.15
20	1000	1000	0.00	0.00	0.00	1,544.97	77,248.51	21,602.90	-	-	-	-
20	1000	1000	100.64	4.28	6.29	1,544.97	77,248.51	21,602.90	30.54	5.50	2.26	38.29
20	**1000**	**1000**	**7,175.36**	**304.95**	**448.46**	**1,544.97**	**77,248.51**	**21,602.90**	**2,177.12**	**391.99**	**161.21**	**2,730.32**

Baseline Footprint

Scope 1

No scope 1 emissions associated with the baseline

Scope 2

No scope 2 emissions associated with the baseline

Scope 3

Transport - indirect

no NLE is built, includes central London area

without NLE scenario	**Source**	**Unit**	**Car**	**Taxi**	**LGV**	**OGV**	**Bus**	**Tube**	**Rail**	**TOTAL tonnes CO2e**
Total distance	*tfl (motorcycle = estimation, walk/cycle from LTS)*	km/yr	20,827,716,826.00	796,345,379.00	4,200,214,701.00	3,556,160,934.00	9,030,058,979.00	16,932,243,621.00	26,256,522,722.00	
Total person trips	*tfl (motorcycle = estimation, walk/cycle from LTS)*	people trips/yr	n/a	n/a	n/a	n/a	2,573,971,137.00	2,474,320,522.00	1,185,965,557.00	
Total vehicle trips	*tfl (motorcycle = estimation, walk/cycle from LTS)*	vehicle trips/yr	2,757,241,223.00	47,655,885.00	380,043,837.00	284,331,018.00	n/a	n/a	n/a	
Average trip length	*tfl (motorcycle = estimation, walk/cycle from LTS)*	km/trip	7.55	16.71	11.05	12.51	3.50	6.80	22.10	
Emissions factor description	*Defra, all scopes grand total GHG*	kg CO2e per km	Average car unknown fuel	Taxi (black cab)	Van/Light Commercial Veh	Diesel HGV Road Freight (	Local London bus	London Underground	National rail	
Emissions factor value	*Defra*	kg CO2e per km	0.23394	0.188446667	0.29968	0.718520392	0.10005	0.08154	0.06715	
Total tonnes CO2e			**4,872,436.07**	**150,068.63**	**1,258,720.34**	**2,555,174.15**	**903,457.40**	**1,380,655.14**	**1,763,125.50**	**12,883,637.24**

Operation - indirect

Currently assuming that the energy use at existing stations will not change significantly as a result of the NLE

Operation Footprint

Scope 1

Transport - direct

LU company leased vehicles (support road fleet)

	Source	Unit	Vehicles
Total CO2e from LU footprint	*London Underground 2008 leased vehicles footprintf*	tco2e	461
Total km LU	*http://www.tfl.gov.uk/corporate/modesoftransport/londonunderground/1608.aspx*	km	402
Total km NLE		km	3
Total CO2e		**tco2e**	**4**

Scope 2 Do not include in Operation totals as this will double count the impacts of tube emissions accounted for in Scope 3.

Operation - Non Trackside

Space	Source	Location	CO2 emissions (tonnes CO2/year)						
			Space Heating	DHW	Cooling	Lighting	Auxiliary	Small Power & Escalators & Lifts	Total
Baseline Scheme	Energy Strategy provided by URS 'compliance with building regulations' scenario	Battersea Station	108	5	73	656	391	464	1,697
		Nine Elms Station	108	5	73	786	472	441	1,884
		Kennington Park	1	-	16	67	627	18	729
		Kenngington Green	-	-	16	49	606	13	683
TOTAL		**NLE**	**217**	**10**	**178**	**1,558**	**2,096**	**936**	**4,993**

Operation - Trackside

	Source	Unit	Traction	Groundwater Pumps	Ventilation fans	Total
Total CO2e from LU footprint	*London Underground 2008 footprint*	tco2e	473,491	36,339	9,027	
Total km LU	*http://www.tfl.gov.uk/corporate/modesoftransport/londonunderground/1608.aspx*	km	402	402	402	
Total km NLE		km	3	3	3	
Total CO2e		**tco2e**	**3,651**	**280.23**	**70**	**4,001**

Scope 3

Operation - indirect

	Source	Unit	Water consumption	Wastewater discharge	Waste produced	Employee commuting	Business travel	Rail replacement buses	Contracted maintenance vehicles	Purchased materials	Contracted activities	End Use products
Total CO2e from LU footprint	*London Underground 2008 footprint*	tco2e	216	38	34,872	497	718	1,521	2,567	1,775	76,670	2,407
Total km LU	*http://www.tfl.gov.uk/corporate/modesoftransport/londonunderground/1608.aspx*	km	402	402	402	402	402	402	402	402	402	402
Total km NLE		km	3	3	3	3	3	3	3	3	3	3
Total CO2e		**tco2e**	**2**	**0**	**269**	**4**	**6**	**12**	**20**	**14**	**591**	**19**

Transport - indirect

Public transport in the NLE area
(assuming NLE is built)

with NLE scenario	**Source**	**Unit**	**Car**	**Taxi**	**LGV**	**OGV**	**Bus**	**Tube**	**Rail**	**TOTAL tonnes CO2e**
Total distance	*tfl (motorcycle = estimation, walk/cycle from LTS)*	km/yr	20,806,524,950.00	796,521,494.00	4,197,665,475.00	3,553,259,608.00	9,006,700,031.00	17,017,974,628.00	26,261,370,604.00	
Total person trips	*tfl (walk/cycle from LTS)*	people trips/yr	n/a	n/a	n/a	n/a	2,570,192,878.00	2,489,233,136.00	1,184,313,433.00	
Total vehicle trips	*tfl (motorcycle = estimation, walk/cycle from LTS)*	vehicle trips/yr	2,750,860,693.00	47,655,885.00	380,512,032.00	284,625,785.00	n/a	n/a	n/a	
Average trip length	*tfl (motorcycle = estimation, walk/cycle from LTS)*	km/trip	7.56	16.71	11.03	12.48	3.50	6.80	22.20	
Defra, all scopes grand total GHG	kg CO2e per km	Average petrol moto	Average car unknown fuel	Taxi (black cab)	Van/Light Commercial Vel	Diesel HGV Road Freigh	Local London bus	London Underground	National rail	
Defra	kg CO2e per km	0.14238	0.23394	0.188446667	0.29968	0.718520392	0.10005	0.08154	0.06715	
Total tonnes CO2e			**4,867,478.45**	**150,101.82**	**1,257,956.39**	**2,553,089.49**	**901,120.34**	**1,387,645.65**	**1,763,451.04**	**12,880,843.17**

nb/ emissions for travel on the NLE are accounted for in trackside energy use

0.81

Baseline Vs Operation

without NLE scenario	Source	Unit	Car	Taxi	LGV	OGV	Bus	Tube	Rail	TOTAL tonnes CO2e
Total distance	*tfl (motorcy*	km/yr	20,827,716,826.00	796,345,379.00	4,200,214,701.00	3,556,160,934.00	9,030,058,979.00	16,932,243,621.00	26,256,522,722.00	
Total person trips	*tfl (motorcy*	people tri	n/a	n/a	n/a	n/a	2,573,971,137.00	2,474,320,522.00	1,185,965,557.00	
Total vehicle trips	*tfl (motorcy*	vehicle tri	2,757,241,223.00	47,655,885.00	380,043,837.00	284,331,018.00	n/a	n/a	n/a	
Average trip length	*tfl (motorcy*	km/trip	7.55	16.71	11.05	12.51	3.50	6.80	22.10	
Emissions factor description	*Defra, all sc*	kg CO2e p	Average car unknown fuel	Taxi (black cab)	Van/Light Commerc	Diesel HGV Road Fre	Local London bus	London Underground	National rail	
Emissions factor value	*Defra*	kg CO2e p	0.23394	0.188446667	0.29968	0.718520392	0.10005	0.08154	0.06715	
Total tonnes CO2e			**4,872,436.07**	**150,068.63**	**1,258,720.34**	**2,555,174.15**	**903,457.40**	**1,380,655.14**	**1,763,125.50**	**12,883,637.24**

with NLE scenario	Source	Unit	Car	Taxi	LGV	OGV	Bus	Tube	Rail	TOTAL tonnes CO2e
Total distance	*tfl (motorc*	km/yr	20,806,524,950.00	796,521,494.00	4,197,665,475.00	3,553,259,608.00	9,006,700,031.00	17,017,974,628.00	26,261,370,604.00	
Total person trips	*tfl (walk/cy*	people tr	n/a	n/a	n/a	n/a	2,570,192,878.00	2,489,233,136.00	1,184,313,433.00	
Total vehicle trips	*tfl (motorc*	vehicle tr	2,750,860,693.00	47,655,885.00	380,512,032.00	284,625,785.00	n/a	n/a	n/a	
Average trip length	*tfl (motorc*	km/trip	7.56	16.71	11.03	12.48	3.50	6.80	22.20	
Defra, all scopes grand total GHG	kg CO2e pe	Average p	Average car unknown fuel	Taxi (black cab)	Van/Light Commerc	Diesel HGV Road Fre	Local London bus	London Underground	National rail	
Defra	kg CO2e pe	0.14238	0.23394	0.188446667	0.29968	0.718520392	0.10005	0.08154	0.06715	
Total tonnes CO2e			**4,867,478.45**	**150,101.82**	**1,257,956.39**	**2,553,089.49**	**901,120.34**	**1,387,645.65**	**1,763,451.04**	**12,880,843.17**

Difference

Operation vs Baseline	Source	Unit	Car	Taxi	LGV	OGV	Bus	Tube	Rail	TOTAL tonnes CO2e
Total distance	*tfl (motorc*	km/yr	- 21,191,876.00	176,115.00	- 2,549,226.00	- 2,901,326.00	- 23,358,948.00	85,731,007.00	4,847,882.00	
Total person trips	*tfl (walk/cy*	people tr	n/a	n/a	n/a	n/a	- 3,778,259.00	14,912,614.00	- 1,652,124.00	
Total vehicle trips	*tfl (motorc*	vehicle tr	- 6,380,530.00	-	468,195.00	294,767.00	n/a	n/a	n/a	
Average trip length	*tfl (motorc*	km/trip	0.01	-	- 0.02	- 0.03	-	-	0.10	
Defra, all scopes grand total GHG	kg CO2e pe	Average p	Average car unknown fuel	Taxi (black cab)	Van/Light Commerc	Diesel HGV Road Fre	Local London bus	London Underground	National rail	
Defra	kg CO2e pe	0.14238	0.23394	0.188446667	0.29968	0.718520392	0.10005	0.08154	0.06715	
Total tonnes CO2e			**- 4,957.63**	**33.19**	**- 763.95**	**- 2,084.66**	**- 2,337.06**	**6,990.51**	**325.54**	**- 2,794.07**