



Title: New Cross

LPN Regional Development Plan

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All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

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1 Executive Summary

This Development Plan reviews the EHV network supplied from New Cross 66kV and New Cross 132kV grid supply points (GSP's) which supply 6 grid, 14 primary and 4 Network Rail substations predominantly within the London Boroughs of Southwark and Lambeth.

New Cross has increasing strategic importance. There is existing 132kV interconnection to the adjacent 1GW Wimbledon and City Road GSP's, with further interconnection to City Road via the City of London under construction. This interconnection provides a high level of resilience and allows the optimisation of network capacity between exit points as appropriate to demand levels and operational requirements.

The principal development influencing the plan is the construction of the New Cross to Finsbury Market deep cable tunnel with the associated transfer of Osborn Street substation demand from City Road to New Cross 132kV. This project establishes transformer capacity headroom for the developing 33kV City of London network and relieves the capacity constraint on the three circuit City Road- Finsbury Market cable connection. The tunnel will also facilitate the establishment of a new 33kV and 11kV main substation at Wellclose Square to provide capacity for the 3rd (blue) 33kV network feeder group supplying larger point loads on the eastern fringe of the City of London and western boundary of Tower Hamlets. The 11kV capacity will support the local network and relieve capacity and space constraints at adjacent substations between the Square Mile and Canary Wharf. The tunnel construction includes an underground chamber to enable future construction of a spur extension to the proposed new South Isle of Dogs main substation.

New Cross also supplies the South Bank via Bankside substation including the London Bridge Shard development. Work currently programmed to complete during DPCR5 will reinforce Fisher Street (located close to Holborn) and transfer this demand to Bankside via new cables installed in an existing deep cable tunnel.

Both Tower Hamlets and Southwark Borough Council are centrally located with significant regeneration potential. Their Local Development Framework plans identify 'opportunity areas' and the recommended strategy for this supply area is designed to promote flexible and timely response to customer requirements while ensuring continued adherence to the security of supply criteria and maintain reliable network operation by asset replacement, or refurbishment, of poorly performing equipment identified through asset condition monitoring techniques.

Proposed Projects >£1M

• Neckinger: Combined reinforcement and asset replacement	£13.1M
• Verney Road: Substation reinforcement	£4.1M
• Clapham Park Road: Substation reinforcement	£7.0M
• Wellclose Square: Establish 132/33/11kV main substation	£20.7M
• New Cross- South Bank: 66kV cable asset replacement	£8.5M
• Deptford-Bengeworth Road: 132kv cable replacement	£3.7M
• Hearn Street: Replant as 132/11kV substation	£12.8M
• Shorts Gardens: Replant as 132/11kV substation	£10.4M

New Cross

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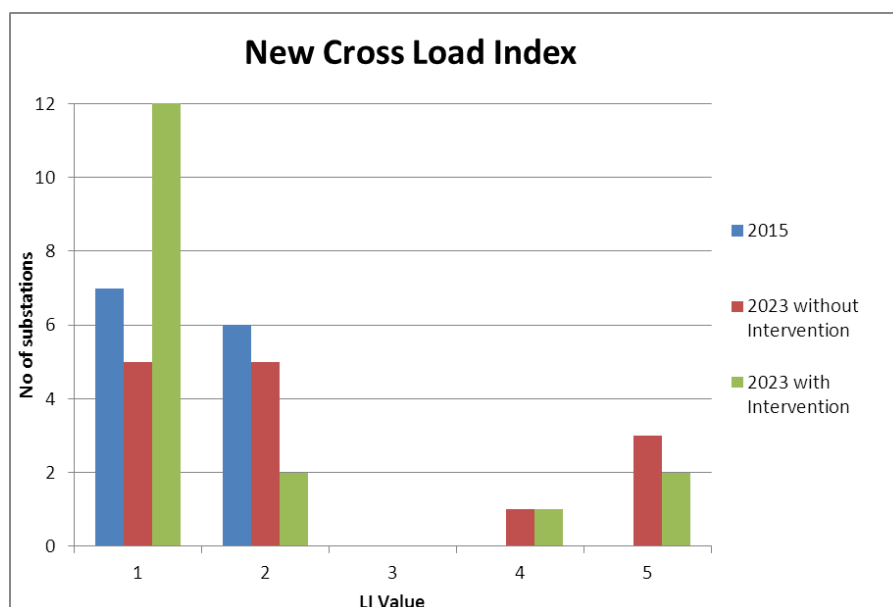
Cost Profiles (£k)

Cat.	Reference	Description	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
A&H		Total Asset Replacement	0	0	1,408	5,154	160	1,330	7,749	8,926	2,779	0
R		Total Reinforcement	0	103	5,439	4,134	10,325	11,425	14,985	10,757	4,268	5,689
		Grand Total	0	0	6,847	9,288	10,485	12,755	22,734	19,684	7,047	5,689

The cost profiles above provide the forecast aggregate NAMP cost for network expenditure under this RDP during the last two years of DPCR5 and the ED1 period subject to project feasibility studies and final approval. These costs do not include work in progress, listed in paragraph 2.3.

Output Measures - Load Index

The forecast load indices for 2023, with and without intervention, are detailed below:

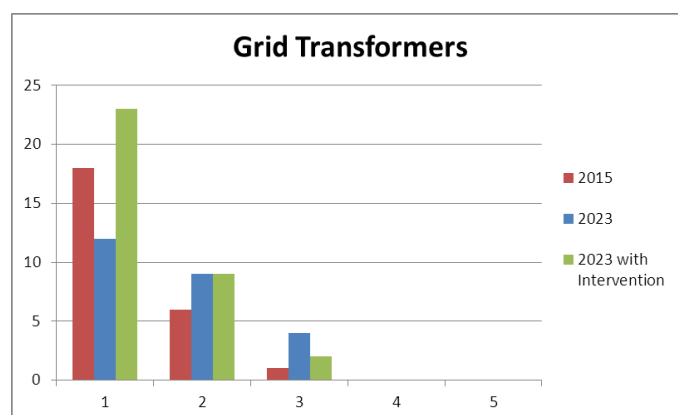
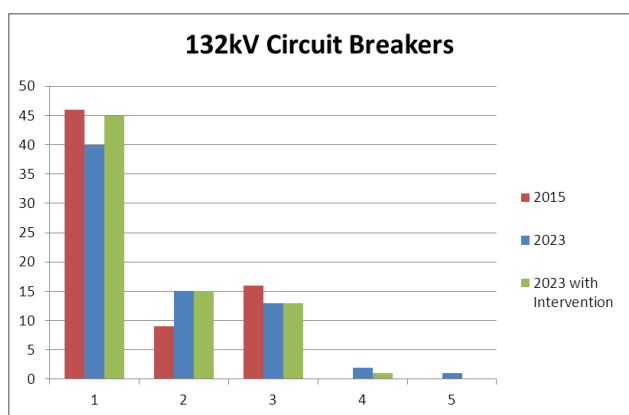
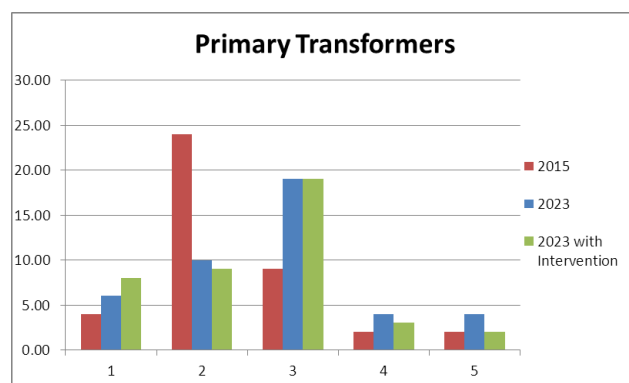
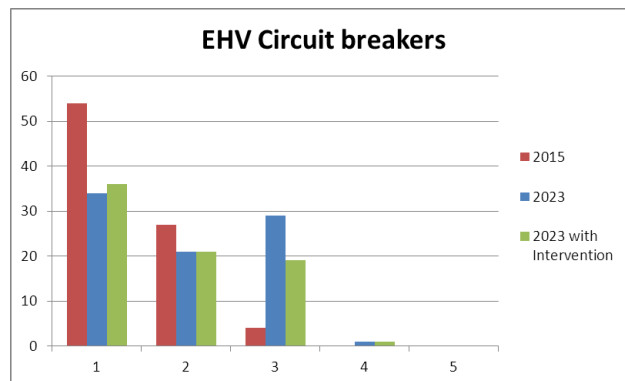
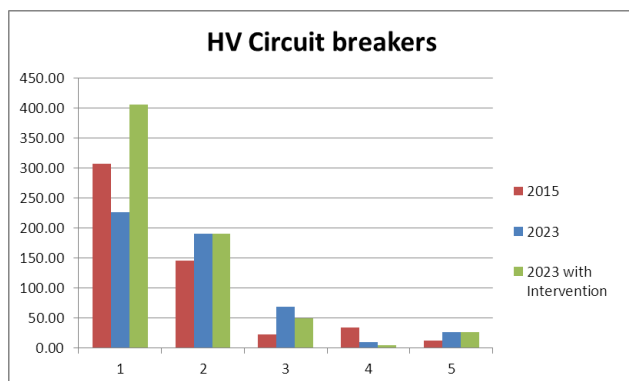


New Cross

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Output Measures - Health Index

The forecast health indices for 2015 and 2023, with and without intervention, for each plant category are detailed below:



Principal Risks, Dependencies and Assumptions

The schemes covered in this RDP have been planned based on the planning load estimates 2013 with the 2011/12 maximum demand. The load forecasts are based on the element energy model. If the economic situation improves there is a risk that there will be a shortfall of reinforcement schemes in the plan.

The load forecasts also include an assumed level of embedded generation being connected to the network. Should this generation not materialise, then a larger than forecast load growth could be realised.

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Where Demand Side Response has been included at a substation, this is based on an assumption that customers will be willing to accept the scheme. In most cases these customers have not as yet been identified.

2 Network configuration

2.1 Existing Network

This Development Plan reviews the LPN EHV network supplied from New Cross 132kV and New Cross 66kV grid supply points (GSP's).

Geographic and single line network diagrams (SLD's) are attached in Appendices A & B.

New Cross 132kV:

The substation is supplied by 2x 240MVA 275/132kV super grid transformers connected to an indoor 11 panel, 2 section GIS switchboard equipped with Areva F35 circuit breakers. With the exception of Canal Junction all feeder bays are fitted with double banking boxes.

A double circuit cable provides interconnection to Wimbledon GSP via Deptford and Bengeworth Road.

New Cross 66kV:

The 66kV substation is supplied by four 180MVA 275/66kV SGT's connected to a 20 panel, indoor AIS switchboard equipped with a combination of Reyrolle open terminal OB10 ACB's and SPL SF6 CB's .

Three feeder transformer circuits supply Chadwick Road 66/33kV substation with interconnection to Bengeworth Road 33kV via four open-cut installed 33kV cables.

The substation hierarchy is detailed in Table 1.

Deptford 132kV Site Overview

Deptford 132kV is a 3 switch mesh substation connected to the New Cross – Wimbledon circuits. A series reactor is connected between the No1 and No2 circuits to control fault levels when the two GSP's are operating in parallel.

Deptford 11kV is a 66 panel, single busbar substation equipped with Siemens 8DA10 vacuum circuit breakers.

Deptford 22kV is a 1963 legacy site associated with the decommissioned and closed Deptford Power Station. The switchboard is equipped with Reyrolle L42 switchgear with no local demand. Two 22kV transformer feeder circuits supply Neckinger 22/11kV substation.

Bengeworth Road 132kV Site Overview

Bengeworth 132kV is a two switch mesh substation with four 132/33kV transformers supplying the local 33kV switchboard with connections to 4 primary substations at Montford Place, Clapham Park Road, Brixton 'B' and Bengeworth 11kV. Under intact running arrangements, Bengeworth Road and Brixton 'B' are normally supplied from Chadwick Road with the interconnection to New Cross 66kV providing the ability to optimise network and SGT utilisation during outage conditions.

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3 New Cross RDP Substations

Table 1. New Cross RDP Substations

Substation & Voltages	
New Cross 66kV	New Cross 132kV
Verney Rd 66/11kV	Tooley St 132/11kV
South Bank 66/11kV	Canal Junction 132/33kV
	Deptford 132/11kV
Network Rail	
Nunhead BR 66/33kV	Bankside F 132kV
Sth Bermondsey BR 66/11kV	Bankside C 132/11kV & B3 11kV
Lewisham BR 66/11kV	Bankside D 132/20kV
	Newington House 20/11kV
Chadwich Rd 66/33kV	Charing Cross 20/6.6kV
North Cross 33/11kV	
Bengeworth Rd 33/11kV	Deptford West 132/22kV
Brixton B 33/11kV	Neckinger 22/11kV
	Bengeworth Rd 132kV
	Bengeworth Rd 33kV
	Clpham Park Rd 33/11kV
	Montford Place 33/11kV

3.1 Network changes in progress

Network changes in progress are detailed in Table 2.

Switchgear and transformer asset replacement or refurbishment is in progress at 4 sites, with the Newington House replacement harmonised with reinforcement.

In addition to Newington House, significant reinforcement schemes include:

Establishment of Osborn Street 'B' 3x66MVA substation supplied by new 132kV cables to be installed in the New Cross - Finsbury Market deep cable tunnel which is currently under construction.

Fisher Street. This project reinforces Fisher Street with 3x33MVA transformers supplied from new circuit breakers installed on the Bankside 'F' switchboard. The 132kV supply cables are to be installed in the existing bankside-Kingsway-Shorts gardens deep cable tunnel.

These 2 schemes both result in the transfer of demand from City Road to New Cross GSP and an associated 3rd SGT is programmed to commission at New Cross in Q2 2015.

Cable asset replacement has been completed between Bengeworth Road and Deptford with replacement of the fluid filled cables between South Bank and Bankside forecast to commence in early 2015.

The requirement for a new substation in the southern area of the Isle of Dogs has been recognised following enquiries from key stakeholders and Developers who are exploring opportunities to re-develop land adjacent to Millwall Outer Dock (Sites 3 & 18, Figure 1 refers). This area is currently supplied at 11kV from Deptford main substation with cables routed in a Thames crossing tunnel (shown as 'red' in Figure 1). The tunnel is space constrained and cannot accommodate additional cables. Deptford substation comprises a fully utilised 66 panel single busbar 11kV switchboard with no space for further additions or reinforcement. A substation in the

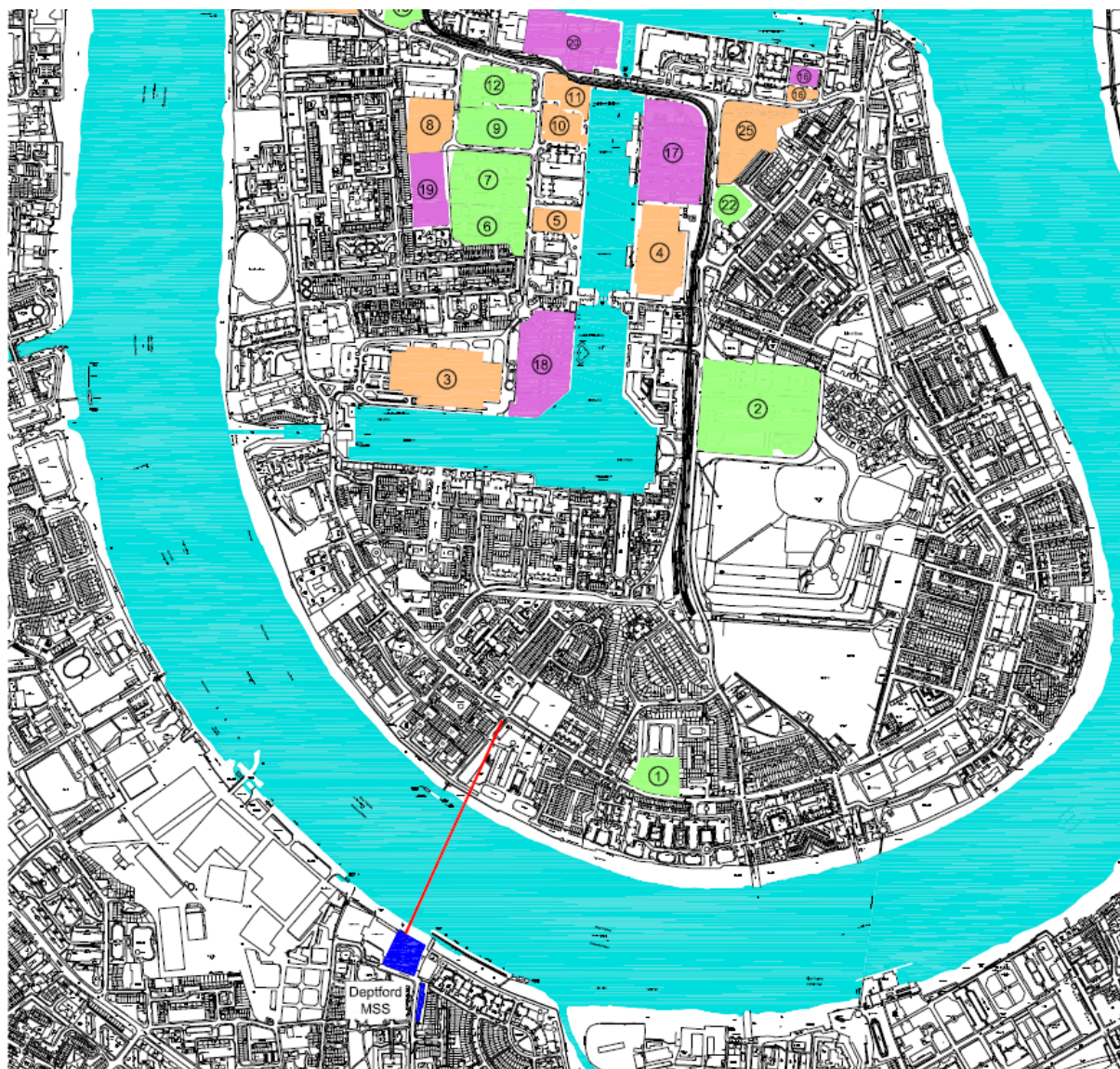
New Cross

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southern area of the Isle of Dogs therefore presents an opportunity to overcome both of these constraints while providing capacity for new connections.

Identifying land in urban areas which is suitable for a substation construction is problematic. Searches have identified a suitable plot fronting West Ferry Road as an ideal location and budget provision has been made for land purchase whilst it remains on the market (Scheme 1.35.07.5820). The design of the New Cross to Finsbury market deep cables tunnel (under construction) includes a reception chamber to accept a spur extension to this site for the 132kV supply cables.

Figure 1: Isle of Dogs South - sites with development potential



New Cross

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Table 2. Summary of Work in Progress

Cat.	Reference	Description	2013/14	2014/15	2015/16	2016/17
A	1.50.01.4061	Bengeworth Road 11kV 26 x Retrofit CB	128	0	0	0
A	1.50.01.4063	Newington House: 11kV Switchboard Replacement	1,246	751	75	0
A	1.50.01.5821	Clapham Park Rd: 11kV Switchboard Replacement	215	938	876	0
A	1.51.03.5502	Newington House: Reconfiguration to New Bankside Substation	995	724	0	0
A	1.51.03.5827	South Bank: Replace T2 & T4	201	917	0	0
A	1.51.11.5895	Bengeworth Road Grid TX Refurbishment	144	0	0	0
A	1.55.02.2746	New Cross GSP 66kV Circuit Breaker Refurbishment	292	0	0	0
H	1.29.02.3554	Deptford/Bengeworth (Part) FFC - Replacement	106	0	0	0
R	1.33.01.4346	Montford Place: Transformer Asset Replacement	143	0	0	0
R	1.34.02.5874	Reinforce and Transfer South Bank SE Group to Newington House	84	75	0	0
R	1.35.01.2622	Osborn St: Establish New Osborn Street B 132/11kV Substation	7,473	1,808	0	0
R	1.35.07.5820	Isle of Dogs: Establish New Substation Site	99	5,822	0	0
R	1.36.01.3661	New Cross 132kV Substation: Reinforcement and Extension	1,498	323	0	0
R	1.36.01.5581	Fisher St 132/11kV Reinforcement: Extend Bankside 132kV Busbars	575	0	0	0
R	1.37.06.5582	Fisher St 132/11kV Reinforcement: Install 132kV Cables from Bankside	1,055	492	96	0
R	1.37.09.3524	New Cross-Osborn Street - Install 3x132kV Circuits (DR5 costs)	0	5,054	0	0
R	1.37.09.3525	Construct Wellclose Square to Finsbury Market Cable Tunnel	1,506	15	0	0
R	1.37.09.4379	Finsbury Market: Deep Cable Tunnel Extension	2,526	0	0	0
R	1.37.09.5470	New Cross - Wellclose Square Cable Tunnel Construction_JN Feb 2013	8,312	9,660	0	0
R	1.36.01.5578	Fisher St 132/11kV Reinforcement: ITC	1,334	1,875	893	0

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4 Network Development Considerations

4.1 Development Areas & Local Development Framework

The New Cross supply area covers parts of the London Boroughs of Southwark, Lambeth, Tower Hamlets, Westminster and the City of London. It is therefore a significant and critical infrastructure asset for the capital.

Figure 2: Borough Boundaries



The Boroughs are diverse with each having their own Local Development Framework which may have overlapping and common themes coordinated by the Mayor of London or Central Government.

Each area is already highly developed with scope for new housing restricted by land availability with new build now tending to be predominantly high rise and occupying brown field sites or infill locations.

Business and commercial developments respond to the wider economic climate and can add significantly to peak demand. Many of these are catered for by the City of London 33kV and the Bankside 20kV networks.

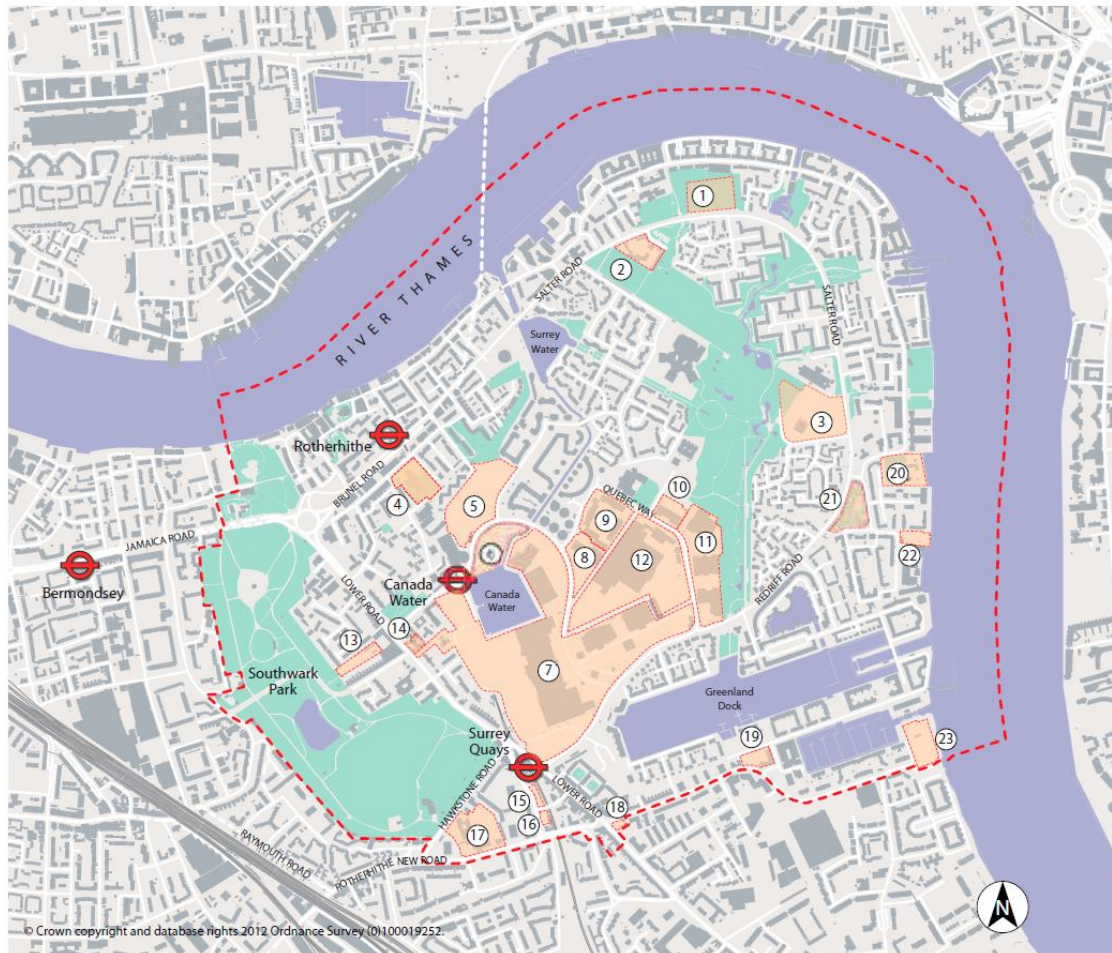
Southwark Council

Development areas which have been assessed as impacting on the New Cross network are Bermondsey and Surrey Quays detailed in Southwark Council's 'Canada Water Area Action Plan' (Figures 3 & 4 refer) and south Isle of Dogs (Figure 1 refers) which includes redevelopment of the West Ferry Printers site and is expected to include new data centre activity.

There are a number of additional 'action and opportunity' areas shown in Figure 4. It is intended to proactively monitor these areas to assess their impact on capacity requirements both for magnitude and timing.

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Figure 3: Canada Water Development Area

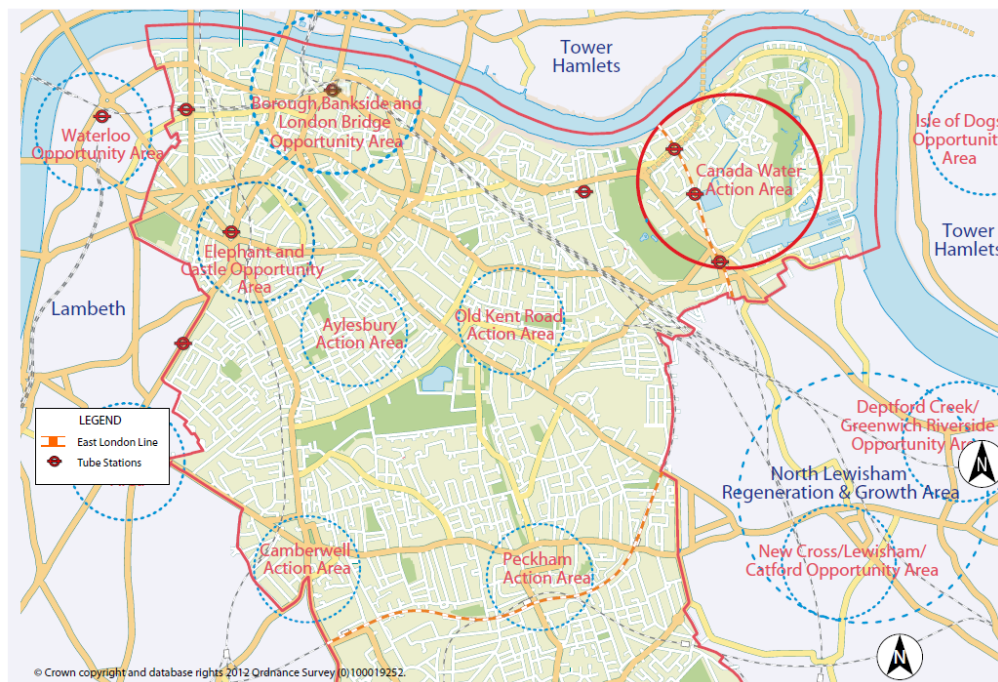


- New Proposals Sites
- Wider AAP area

- | | |
|--|--|
| 1. St Pauls Sports Ground (CWAAP 1) | 12. Harmsworth Quays (CWAAP 12) |
| 2. Land adjacent to Surrey Docks Stadium (CWAAP 2) | 13. Former Nursery (CWAAP 13) |
| 3. Downtown (CWAAP 3) | 14. Rotherhithe Police Station (CWAAP 14) |
| 4. Albion Primary School (CWAAP 4) | 15. 23 Rotherhithe Old Road (CWAAP 15) |
| 5. Site A (CWAAP 5) | 16. 41-55 Rotherhithe Old Road (CWAAP 16) |
| 6. Site B (CWAAP 6) | 17. Rotherhithe Primary School (CWAAP 17) |
| 7. Decathlon site, Surrey Quay Leisure Park, Surrey Quays Shopping Centre and overflow carpark (CWAAP 7) | 18. 247-251 Lower Road (CWAAP 18) |
| 8. Site E (CWAAP 8) | 19. Tavern Quay (East and West) (CWAAP 19) |
| 9. Mulberry Business Park (CWAAP 9) | 20. Surrey Docks Farm (CWAAP 20) |
| 10. 24-28 Quebec Way (CWAAP 10) | 21. Dockland Settlement (CWAAP 21) |
| 11. Quebec Industrial Estate (CWAAP 11) | 22. Odessa Street Youth Club (CWAAP 22) |
| | 23. St George's Wharf (CWAAP 23) |

Figure 4: Opportunity and Development Areas

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Tower Hamlets

Tower Hamlets is positioned between the city, canary wharf and Stratford and, as a relatively under developed area of London has significant potential for regeneration and growth.

Figure 5: **Tower Hamlets: Borough orientation to adjacent districts**

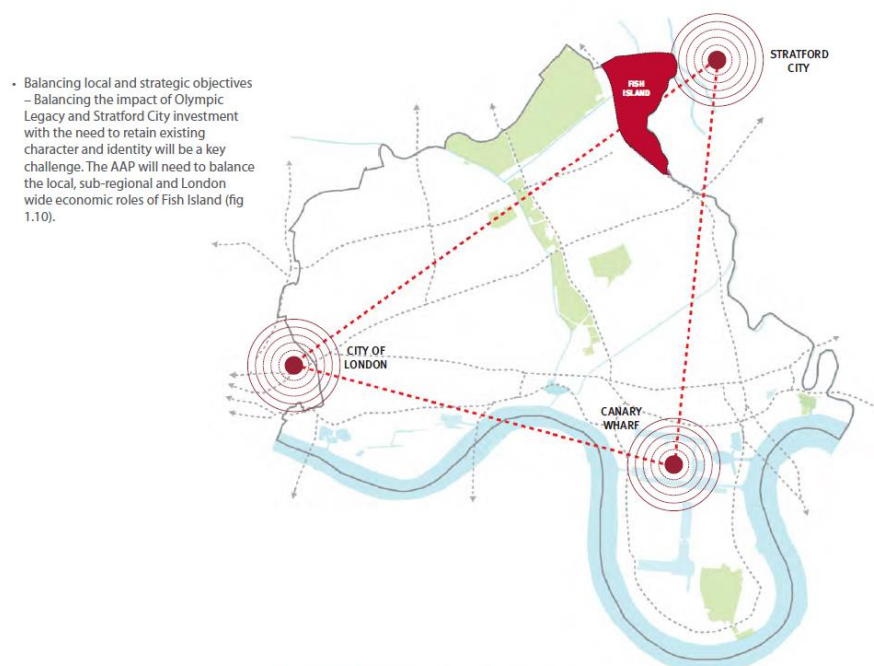


Figure 1.10: Fish Island and the major growth areas in east London

New Cross

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The Local development Framework includes 2 areas with a consequential impact on the New Cross supply area:

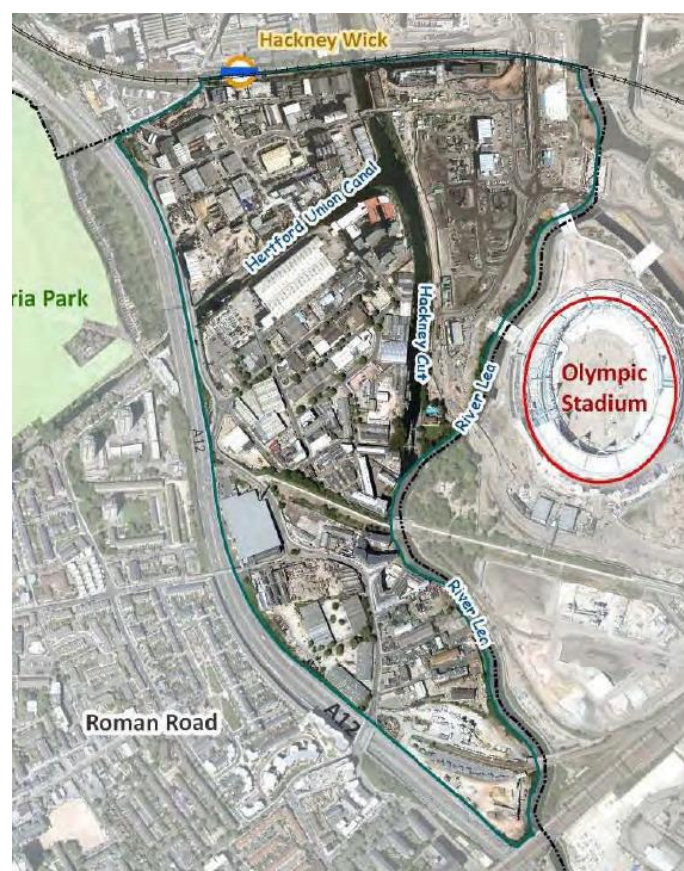
Fish Island: The development potential is described in the Fish Island Area Action Plan. The area is to the west of the Olympic park and is partly supplied from Glaucus Street substation.

Bromley by Bow Master Plan: Bromley by Bow includes significant increase in new homes and associated infrastructure.

FISH ISLAND AREA ACTION PLAN

Adopted

SEPTEMBER 2012



New Cross

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4.2 Asset Replacement

The existing and forecast health indices 2015 – 2023 without intervention are detailed below:

Table 3. HV Circuit breakers (11kV)

Substation	2015					2023				
	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
BANKSIDE B3 11KV	2	17				2	17			
BANKSIDE C 11KV	80					58	22			
CHARING CROSS 6.6KV		6						3	3	
DEPTFORD GRID 11KV	66						66			
NEWINGTON HOUSE	31					31				
NORTH CROSS RD			4	20						24
SOUTH BANK		20	8				1	23	2	2
TOOLEY ST 11KV	20	1				1	20			
VERNEY RD		33					9	24		
CLAPHAM PARK RD				14	12	26				
MONTFORD PL B	39					39				
BRIXTON B		30					30			
BENGWORTH RD 11kV		26					26			
NECKINGER		13	11					19	5	
OSBORN ST 132/11kV	69					69				

Table 4. EHV Circuit breakers

Substation	2015					2023				
	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
BANKSIDE D 20KV	28					28				
CANAL JUNCTION 33KV	4					4				
CHADWICK ROAD		17	4				1	19	1	
DEPTFORD WEST 22kV		10						10		
BENGWORTH RD 33kV	22					2	20			

Table 5. 66 and 132kV Circuit Breakers

Substation	2015					2023				
	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
BANKSIDE F 132KV	16					16				
BENGWORTH RD 132kV			2					2		
DEPTFORD GRID 132KV	1	1	2				2		1	1
NEW CROSS 132KV	16					11	5			
NEW CROSS SGRID 66KV		8	12				8	11	1	
OSBORN ST 132/11kV	13					13				

New Cross

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Table 6. Primary Transformers

Substation	2015					2023				
	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
BANKSIDE D 20KV			1		1				1	1
CHADWICK ROAD		2	1					2	1	
CHARING CROSS 6.6KV	2					2				
NEWINGTON HOUSE		2	1					2	1	
NORTH CROSS RD		3					2	1		
SOUTH BANK	2	1	1			2		2		
VERNEY RD		4					4			
NECKINGER		1	1	2			1		1	2
BRIXTON B		4					3	1		
BENGWORTH RD		4						4		
CLAPHAM PARK RD			3		1			3		1
MONTFORD PL B		3	1			2		4		

Table 7. Grid Transformers

Substation	2015					2023				
	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
BANKSIDE C 11KV	4					2	2			
BANKSIDE D 20KV	2					2				
BENGWORTH RD 33KV	2	1	1				2	2		
CANAL JUNCTION 33KV	2					2				
DEPTFORD GRID 11KV		3					3			
DEPTFORD WEST 22KV		2						2		
TOOLEY ST 11KV	2						2			
OSBORN ST 132/11KV	3					3				
FISHER ST 132/11KV	3					3				

New Cross

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4.3 Security of supply analysis

Table 8. P2/6 Assessment Table

Sub-station	Secondary Voltage	Firm Capacity (MW)	Transfer (MW)	P. F.	Winter 12/13 Summer 2012 (M W)	Winter 13/14 Summer 2013 (M W)	Winter 14/15 Summer 2014 (M W)	Winter 15/16 Summer 2015 (M W)	Winter 16/17 Summer 2016 (M W)	Winter 17/18 Summer 2017 (M W)	Winter 18/19 Summer 2018 (M W)	Winter 19/20 Summer 2019 (M W)	Winter 20/21 Summer 2020 (M W)	Winter 21/22 Summer 2021 (M W)	Winter 22/23 Summer 2022 (M W)
Bankside D TE TF	22kV	30.90		0.95	26.31	23.77	-0.88	-0.88	-0.88	-0.88	-0.88	-0.88	-0.88	-0.88	-0.88
Bankside D TE TF	22kV	23.00	14.50	0.92	23.45	21.31	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16	-0.16
Bengew orth Road	11kV	56.75	7.61	0.97	35.36	35.61	36.06	36.54	36.94	37.39	37.86	38.33	38.82	39.48	40.15
Bengew orth Road	11kV	40.50	9.37	0.9	24.80	24.97	25.27	25.60	25.87	26.17	26.48	26.80	27.13	27.58	28.03
Brixton	11kV	49.88	6.14	0.96	45.36	45.58	46.15	46.76	47.26	47.82	48.41	49.02	49.63	50.47	51.32
Brixton	11kV	42.75		0.95	30.67	30.88	31.25	31.65	31.97	32.34	32.73	33.12	33.52	34.07	34.62
Chadwick Road 33kV	33kV	109.50		0.94	101.98	102.70	103.98	105.36	106.51	107.81	109.16	110.54	111.96	113.89	115.84
Chadwick Road 33kV	33kV	87.76		0.96	65.89	66.34	67.13	67.99	68.70	69.51	70.34	71.20	72.08	73.27	74.48
Charing Cross 6.6kV	6.6kV	6.70		0.97	2.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Charing Cross 6.6kV	6.6kV	5.58		0.93	2.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
New Cross 66kV	66kV	583.20		0.9	318.76	317.50	295.12	297.57	229.22	231.50	233.87	236.27	238.74	242.06	245.44
New Cross 66kV	66kV	539.50		0.9	220.30	218.96	198.93	200.48	135.65	137.09	138.58	140.10	141.66	143.75	145.87
Newington House	11kV	37.83	15.03	0.97	24.46	24.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Newington House	11kV	27.90		0.93	21.31	21.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
North Cross Road	11kV	38.22	3.99	0.98	24.88	25.04	25.32	25.63	25.88	26.18	26.49	26.80	27.13	27.58	28.04
North Cross Road	11kV	27.90		0.93	15.37	15.46	15.63	15.81	15.97	16.14	16.33	16.52	16.71	16.98	17.25
South Bank	11kV	56.28	12.53	0.962	41.29	41.49	41.81	42.13	42.40	42.70	43.01	43.34	43.67	44.07	44.47
South Bank	11kV	42.21	28.74	0.938	37.96	38.14	38.42	38.72	38.96	39.23	39.52	39.81	40.11	40.47	40.84
Verney Road	11kV	85.12	16.49	0.97	72.32	72.72	73.45	74.25	74.90	75.63	76.39	77.15	77.93	79.01	80.11
Verney Road	11kV	64.80		0.96	48.27	48.53	49.00	49.52	49.94	50.41	50.90	51.39	51.90	52.60	53.31
Bankside C T1 T4	11kV	114.94		0.95	0.00	0.00	0.00	67.00	67.00	67.00	67.00	67.00	67.00	67.00	67.00
Bankside C T1 T4	11kV	111.30		0.92	0.00	0.00	0.00	84.00	84.00	84.00	84.00	84.00	84.00	84.00	84.00
Bankside D T1B	20kV	52.80		0.96	0.00	0.00	0.00	29.55	29.55	29.55	29.55	29.55	29.55	29.55	29.55
Bankside D T1B	20kV	50.60		0.92	0.00	0.00	0.00	30.50	30.50	30.50	30.50	30.50	30.50	30.50	30.50
Bengew orth Road 33kV	33kV	166.73		0.95	98.99	99.41	100.17	101.01	101.76	102.56	103.40	104.27	105.17	106.44	107.70
Bengew orth Road 33kV	33kV	122.85		0.91	75.98	76.30	76.87	77.50	78.07	78.66	79.30	79.94	80.61	81.55	82.49
Canal Junction	33kV	86.40		0.96	17.55	18.81	19.81	19.81	19.81	19.81	19.81	19.81	19.81	19.81	19.81
Canal Junction	33kV	57.60		0.96	18.52	20.82	20.82	20.82	20.82	20.82	20.82	20.82	20.82	20.82	20.82
Clapham Park Road	11kV	43.40	1.26	0.97	40.12	40.35	40.75	41.19	41.57	42.00	42.47	42.95	43.45	44.18	44.89
Clapham Park Road	11kV	39.70		0.96	26.25	26.39	26.65	26.93	27.18	27.45	27.75	28.06	28.38	28.85	29.30
Deptford 22kV	22kV	44.10		0.98	35.88	36.12	36.55	37.01	37.38	37.81	38.26	38.72	39.20	39.83	40.47
Deptford 22kV	22kV	43.65		0.97	25.54	25.71	26.00	26.32	26.58	26.87	27.18	27.50	27.83	28.26	28.70
Deptford Grid	11kV	149.45		0.95	82.59	83.04	83.80	84.61	85.28	86.03	86.82	87.62	88.45	89.53	90.63
Deptford Grid	11kV	119.62		0.89	70.49	70.85	71.46	72.12	72.66	73.27	73.90	74.55	75.22	76.09	76.97
Fisher Street 132/11	11kV	83.10		0.96	0.00	0.00	0.00	72.41	73.11	73.92	74.75	75.61	76.50	77.51	78.54
Fisher Street 132/11	11kV	79.70		0.92	0.00	0.00	0.00	74.26	74.97	75.77	76.61	77.47	78.36	79.37	80.40
Montford Place	11kV	47.00	1.45	0.92	59.21	59.41	59.77	60.17	60.55	60.92	61.31	61.70	62.10	62.66	63.23
Montford Place	11kV	40.95	4.04	0.91	55.27	55.47	55.84	56.24	56.61	56.98	57.37	57.76	58.17	58.73	59.29
Neckinger	11kV	45.90	19.61	0.97	35.91	36.16	36.58	37.04	37.42	37.85	38.30	38.76	39.23	39.87	40.51
Neckinger	11kV	42.20		0.97	25.50	25.67	25.97	26.28	26.54	26.83	27.14	27.46	27.79	28.22	28.66
NEW CROSS 132kV	132kV	276.50		0.96	76.59	79.06	79.53	309.96	311.40	313.05	343.82	345.81	397.67	400.09	402.56
NEW CROSS 132kV	132kV	244.20		0.96	67.41	69.74	70.12	327.47	328.77	330.26	363.37	365.18	399.16	401.35	403.58
Osborn Street (132/11)	11kV	166.23		0.96	0.00	0.00	0.00	38.76	39.11	39.51	39.92	40.35	40.78	41.28	41.79
Osborn Street (132/11)	11kV	159.30		0.92	0.00	0.00	0.00	42.36	42.71	43.10	43.52	43.94	44.38	44.88	45.39
Shorts Gardens 132/11	11kV	164.70		0.96	0.00	0.00	0.00	0.00	0.00	0.00	29.07	29.33	29.59	29.88	30.17
Shorts Gardens 132/11	11kV	126.70		0.92	0.00	0.00	0.00	0.00	0.00	0.00	31.60	31.85	32.11	32.40	32.69
Tooley Street Via New X	11kV	38.61		0.99	0.00	0.00	0.00	22.24	22.24	22.24	22.24	22.24	22.24	22.24	22.24
Tooley Street Via New X	11kV	28.80		0.96	0.00	0.00	0.00	25.94	25.94	25.94	25.94	25.94	25.94	25.94	25.94
Wellclose Square	11kV	82.37		0.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.80	49.80	49.80
Wellclose Square	11kV	63.36		0.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.12	32.12	32.12

New Cross

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

Table 9. Load Index Forecast (without investment)

Substation	Voltage kV	Load Index	
		2015	2023
New Cross 66kV			
Bankside D TE TF	66/22		
Bengeworth Road	33/11	1	1
Brixton	33/11	2	5
Chadwick Road 33kV	66/33	2	5
North Cross Road	33/11	1	1
South Bank	66/11	1	1
Verney Road	66/11	2	2
New Cross 132kV			
Bankside B1	66/11		
Bankside B3	66/11		
Newington House	22/11	1	2
Bengeworth Road 33kV	132/33	1	1
Clapham Park Road	33/11	2	5
Deptford 22kV	132/22	2	2
Deptford Grid	132/11	1	1
Montford Place	33/11	2	2
Neckinger	22/11	1	2

4.4 Operational and technical constraints

No issues have been identified.

4.5 National Grid

National Grid are currently rebuilding their New Cross 275kV substation converting the 4 switch mesh into a new double busbar switchboard. Associated works include the asset replacement of 3x 275/66kV super grid transformers and the construction of a new Network Rail 275/33kV traction supply point.

Dependent on demand growth a 4th 275/132kV New Cross SGT is forecast to be required circa 2021 which will be planned in accordance to the 'Modification Application' process.

4.6 Network Constraints

The New Cross network is composed entirely of underground cable.

The New Cross–Finsbury Market cable tunnel (under construction) is at risk to a high impact low probability (HILP) incident. Should this occur the interconnection to City Road GSP will be available to reduce the customer impact.

4.7 Demand Smart Response

One site has been identified as suitable for implementation of Demand Side Response (DSR) in ED1:

- South Bank: 5MVA of DSR will be used to create flexibility to defer potential reinforcement into ED2 due to risk of higher growth from connection activity and a range of developments in the local area, e.g. at Waterloo.

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

5 Recommended strategy

The network strategy is designed to promote flexible and timely response to customer requirements while ensuring:

- Continued adherence to the security of supply criteria defined in Engineering Recommendation P2/6
- Maintaining reliable network operation by asset replacement, or refurbishment, of poorly performing equipment identified through asset condition monitoring (HI) techniques

The construction of the new strategic deep cable tunnel between New Cross and Finsbury Market which establishes interconnection between GSP's to City Road provides the opportunity for efficient network development including a spur tunnel extension to the proposed new South Isle of Dogs substation, the establishment of a new Wellclose Square main substation and the redevelopment of the ageing Hearn Street substation which all lie along, or in close proximity to, the tunnel route

The proposals are summarised below:

5.1 Asset Replacement

5.1.1 Switchgear

In addition to the work already in progress at Bengeworth Road, Newington House, Clapham Park Road and New Cross 66kV one further site is predicted with switchgear that reaches an HI5 categorisation by 2023:

Deptford Grid 132kV

Provision has been made for the replacement of two of the four AIS open terminal circuit breakers with dead tank SF6 units.

5.1.2 Transformers

7863 - Chadwick Road: Refurbish Transformer (GT3)

The condition assessment of the 1989 GEC Grid Transformer with ATL AT tap changer installed at Chadwick Rd 66/33kV Grid Substation has shown that the probability of failure due to degradation will become unacceptable. It is not possible to keep this asset in use without compromising operational requirements; therefore this project recommends its refurbishment. Completion of the project will see 1 Grid Transformer refurbished.

7869 - Neckinger: Replace Primary Transformers & Replant substation

Provision has been included for the asset replacement of the four 22/11kV transformers. It is proposed to increase the capacity of the replacement transformers with the additional capacity available to supply the expected Canada Water developments. The reinforcement to include new 132kV cables from New Cross. This will allow the decommissioning of the ageing Deptford 22kV L42 switchboard and associated equipment.

5.1.3 Cables

Provision has been included for the selective replacement of cable sections on:

7953 - Deptford-Bengeworth Road No1

The condition assessment of the Deptford Grid 132kV-Bengeworth RD 132kV fluid filled cable has shown that the probability of failure due to degradation will become unacceptable. It is not possible to keep these assets in use without compromising CI and CML performance, therefore this project recommends their replacement. Completion of the project will see 2.7 km of 132kV fluid filled cable replaced.

New Cross

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

New Cross - South Bank circuits 1, 3 and 5

The condition assessment of the New Cross 66kV-South Bank 66kV fluid filled cable has shown that the probability of failure due to degradation will become unacceptable. It is not possible to keep these assets in use without compromising CI and CML performance, therefore this project recommends their replacement. Completion of the project will see 5.38 km of 66kV fluid filled cable replaced.

5.2 Reinforcement

6332 - Clapham Park Road 33/11kV: ITC (add 2x30MVA)

The site is forecast to reach the firm capacity and become LI5 by the end of the ED1 period. Asset replacement of the switchboard is programmed to commence in DPCR5 with reinforcement planned consecutively. The scope of work includes installation of 2 additional 30MVA transformers supplied by new transformer feeders from Bengeworth Road 33kV

8495 - Brixton B 33/11kV: ITC (add 1x15MVA)

The site is forecast to exceed the existing firm capacity from 2021/22 onwards. The scope of this project covers the installation of a fifth 15MVA 33/11kV transformer, its associated 33kV feeder cable from Bengeworth Road Grid and extension of the 11kV switchboard.

2635 - Shorts Gardens: Replant as 132/11kV substation (3x33.3MVA)

Shorts Gardens is currently out of firm capacity (see St. Johns Wood RDP) and relies on post fault transfers to maintain P2/6 compliance. This scheme proposes to replant the existing 22/11kV Shorts Gardens substation as a 132/11kV substation.

3657 - Hearn Street: Replant as 132kV substation (2x66.6MVA)

The forecast demand at Hearn Street substation will exceed the existing summer firm capacity from 2018 onwards and the site will rely on 11kV post fault transfers to remain P2/6 compliant. It is proposed to reinforce Hearn Street at 132kV and to supply it from New Cross 132kV (via Osborn Street). This upgrade to 132kV is part of an overall North London Strategy to decommission the 66kV network between Hackney-Holloway-Shoreditch (as it is made of poorly performing fluid filled and gas cables which would otherwise need to be replaced) while reinforcing all overloaded substations by upgrading them from 66kV to 132kV.

Chadwick Road

The site is identified as LI5 however, Licence compliance is maintained by post fault transfers to Bengeworth Road 33kV via the four interconnecting circuits and no intervention is therefore proposed at this site.

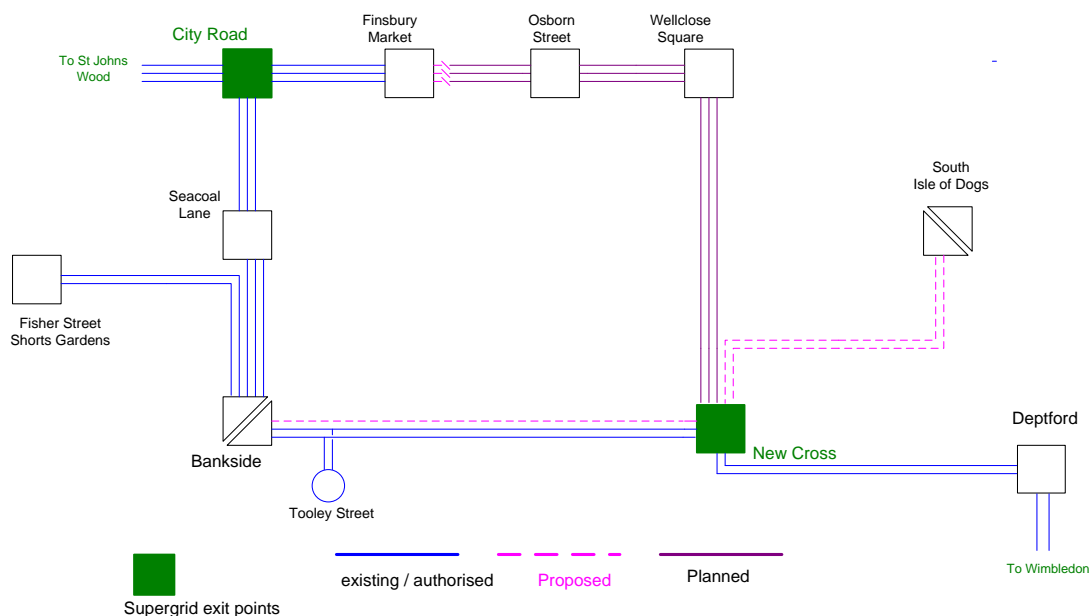
8371 - New Cross- Bankside 3rd 132kV Circuit

Provision has been made for the installation of a 3rd 132kV circuit between New Cross and Bankside illustrated in Figure 6 below. This project is an (N-2) scheme.

New Cross

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

Figure 6. City Road - New Cross 132kV Interconnected Network



The New Cross to Finsbury Market tunnel facilitates the 3x132kV cable interconnection between New Cross and City Road via Osborn Street significantly increasing resilience and allowing optimisation of network capacity to the City of London during normal and abnormal operating conditions.

Interconnection offers similar benefits to the strategic Bankside substation which is supplied from City Road via 3x132kV cables installed in the existing deep cable tunnel and 2x 132kV open-cut circuits from New Cross. Condition assessment has identified the need to asset replace the existing 66kV cables to South Bank which are routed through the Bankside basement. It is therefore proposed to harmonise the reinforcement with the asset replacement of the 66kV cables to achieve efficient delivery and reduce disruption to the local community during open-cut installation.

Installing a 3rd 132kV cable from New Cross will increase the resilience at Bankside and cater for future demand growth in the South Bank area which is supplied by the local 11kV Network and the 20kV network including the high profile developments of the London Bridge Shard and St Thomas's Hospital. The additional capacity will also cater for demand growth in the Covent Garden and Holborn areas which are supplied from Shorts Gardens and Fisher Street substations.

3668 - Wellclose Square new 132/11kV substation (Tower Hamlets)

The intermediate shaft on this UK Power Network's owned site significantly reduces the complexity and risks of establishing a new main substation in close proximity to the City of London and it is proposed to establish a combined new 132/11kV and 132/33kV substation on the site.

The justification for the 33kV capacity is described in the 33kV Network RDP and will be dependent on new customer connection activity in the City/Tower Hamlets Fringe area.

The new 11kV capacity will facilitate network reconfiguration to create capacity headroom and, importantly, spare switch positions at the adjacent space constrained sites of Simpsons Road, Devonshire Square and West Ferry Circus where the inability to install additional 11kV panels is constraining the reinforcement of interconnected groups, Figure 6 refers.

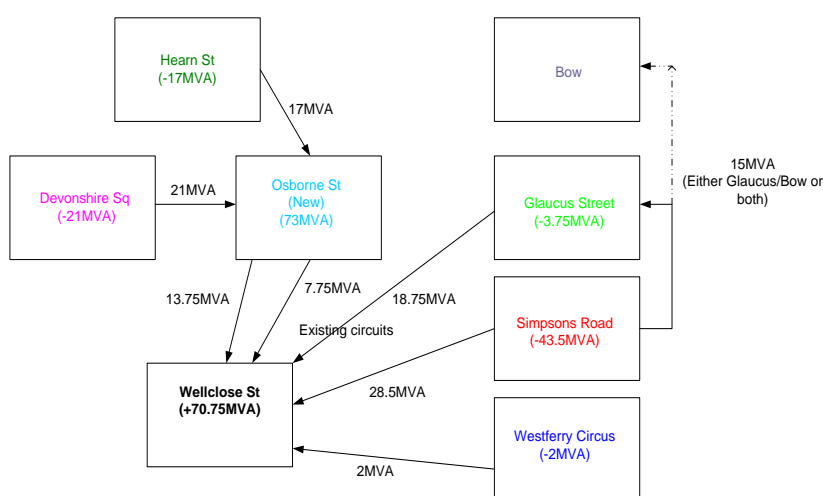
New Cross

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

Figure 7 shows that Wellclose Square is located in the centre of the Glaucus Street NW Group a distance of circa 5km from the main substation. These relatively long cable runs through densely developed urban areas results in difficulty sustaining incremental load growth with increased risk of 3rd party cable damage. Transferring demand from Glaucus Street will defer reinforcement at this site as the expected developments in the Fish Island and Bromley by Bow areas proceed.

The new 11kV capacity will additionally facilitate the expected overall increase in demand in central Tower Hamlets as envisaged in the Local Development Plan and enquiries for point loads of up to 10MW have been received for sites close to Whitechapel Hospital.

Figure 7. **Proposed 11kV Load Transfers to Wellclose Square**



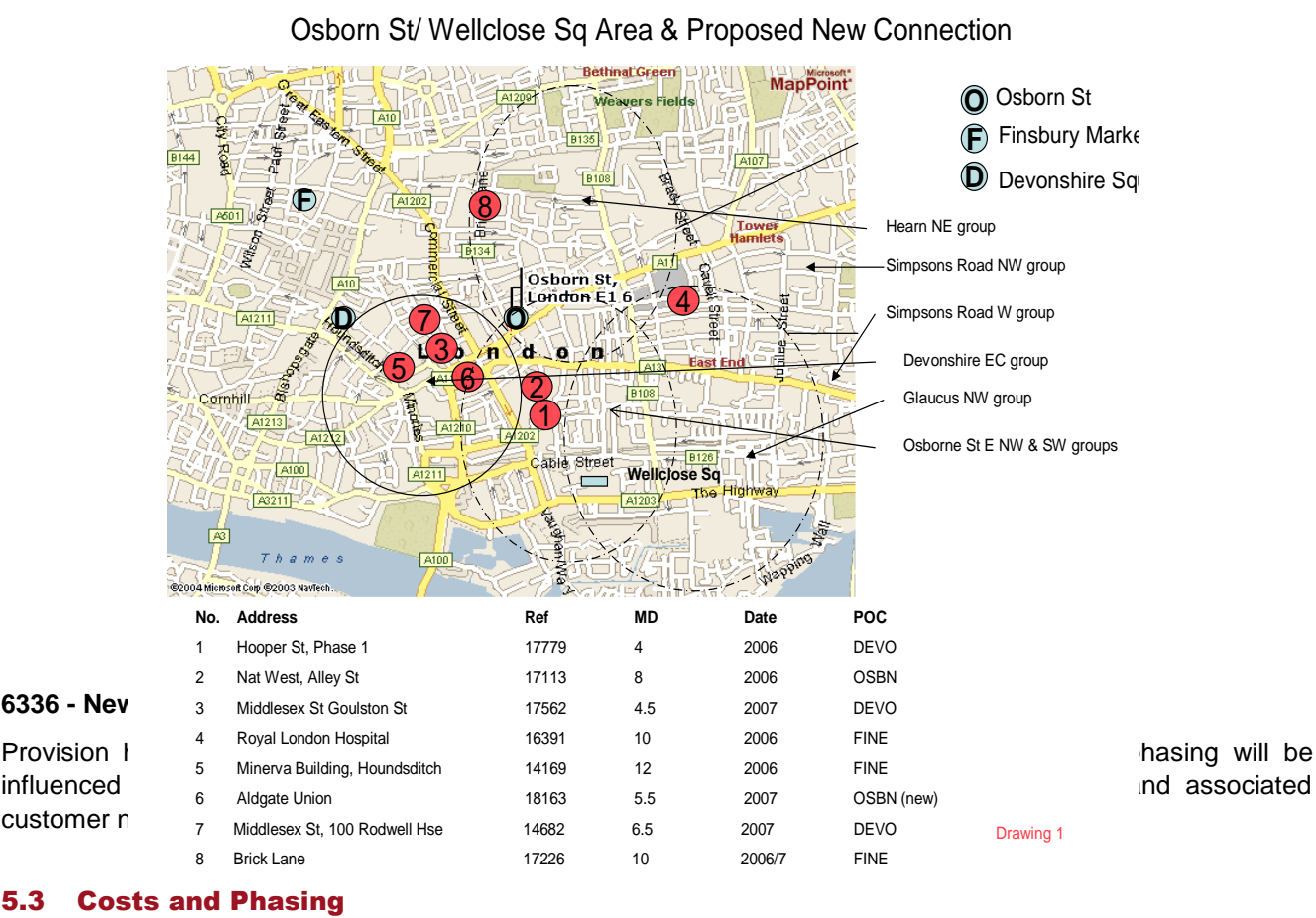
Possible Load Transfers to New MSS Wellclose Square and re-planted Osborn Street. Does not include new connections.

Drawing 2

New Cross

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

Figure 8. Local 11kV Interconnected Groups Orientation



All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

Table 10. NAMP Extract (19th February 2014)

Cat.	Reference	Description	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
A	1.48.01.7780	Deptford Grid - Replace 132kV Switchgear	0	0	0	0	147	295	0	0	0	0
A	1.51.01.8964	Deptford 22kV - decommissioning of transformers and switchgear	0	0	0	0	0	0	0	29	87	0
A	1.51.03.7869	Neckinger - Replace Primary Transformers and Replant Substation	0	0	0	0	14	1,035	5,927	3,875	2,692	0
A	1.51.11.7863	Chadwick Road - Refurbish Transformer (GT3)	0	0	0	0	0	0	120	69	0	0
H	1.29.01.7951	New Cross- South Bank (Circuit 3B & Circuit 1A) - 66kV FFC Replacement	0	0	0	0	0	0	1,702	4,954	0	0
H	1.29.01.7958	New Cross 66kV-South Bank (Circuit 1B) - 66kV FFC Replacement	0	0	1,408	1,408	0	0	0	0	0	0
H	1.29.02.7953	Deptford Grid 132kV-Bengeworth RD 33kV(Circuit 1-F) - 132kV FFC Replacement	0	0	0	3,746	0	0	0	0	0	0
R	1.33.01.4322	Verney Rd 66/11kV - ITC (add 2x22.5MVA)	0	0	0	0	0	0	0	0	668	3,241
R	1.33.01.6332	Clapham Park Rd 33/11kV - ITC (add 2x30MVA)	0	0	302	2,122	1,882	1,721	0	0	0	0
R	1.33.01.8495	Brixton B 33/11kV - ITC (add 1x15MVA)	0	0	0	0	0	0	0	49	620	767
R	1.33.03.6337	Verney Rd 66/11kV - Reactor Installation (Fault Level)	0	0	302	13	0	0	0	0	0	0
R	1.34.02.4318	Deptford 11kV Load Transfers	0	0	0	0	209	836	627	0	0	0
R	1.35.05.8562	Demand Side Response at South Bank	0	0	0	0	0	0	75	75	75	75
R	1.35.07.3657	Hearn Street - Replant as 132/11kV substation (2x66.6MVA)	0	0	0	0	47	1,238	5,627	4,689	1,247	0
R	1.35.07.3668	Wellclose Square New 132/11kV Substation - (3x33.3MVA)	0	0	0	124	5,409	5,942	4,400	1,836	0	0
R	1.36.01.6336	New Cross 132kV GSP - 4th SGT (240MVA) (N-2)	0	0	0	0	0	0	0	432	183	0
R	1.37.06.5591	Finsbury Market: Establish 132kV Interconnection to Osborn Street	0	0	159	1,334	2,778	624	0	0	0	0
R	1.37.06.8371	New Cross to Bankside - Third 132kV Circuit	0	0	0	0	0	0	0	0	120	1,606
R	1.34.02.4410	City of London: 11kV Load Transfers Devonshire Sq/Hearn St/Osborn St Permanent Transfers	0	0	408	541	0	0	0	0	0	0
R	1.34.02.8428	Osborn St 11kV Feeder Transfers to New Switchboard	0	103	103	0	0	0	0	0	0	0
R	1.35.07.2635	Shorts Gardens - Replant as 132/11kV Substation (3x33.3MVA)	0	0	0	0	0	1,064	4,257	3,676	1,354	0
R	1.37.09.1270	New Cross - Wellclose Square Cable Tunnel Construction JN Feb 2013 (ED1 Costs Only)	0	0	2,640	0	0	0	0	0	0	0
R	1.37.09.6106	New Cross-Osborn Street - Install 3x132kV Circuits (ED1 costs)	0	0	1,524	0	0	0	0	0	0	0

5.4 HI / LI improvement

Projected Asset Health Indices (With Investment)

Health indices for all network equipment covered in this RDP with investments are listed in red font in Table 14 to Table 19 below. The equipment groups covered include HV circuit breakers (6.6kV and 11kV), EHV circuit breakers (22 and 33kV), 66kV&132kV circuit breakers, primary transformers (EHV/11kV and EHV/6.6kV), grid transformers (132/33kV) and underground cables (33kV, 66kV and 132kV).

New Cross

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

Table 11. HV Circuit breakers (11kV)

Substation	2015					2023				
	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
BANKSIDE B3 11KV	2	17				2	17			
BANKSIDE C 11KV	80					58	22			
CHARING CROSS 6.6KV		6						3	3	
DEPTFORD GRID 11KV	66						66			
NEWINGTON HOUSE	31					31				
NORTH CROSS RD			4	20						24
SOUTH BANK		20	8				1	23	2	2
TOOLEY ST 11KV	20	1				1	20			
VERNEY RD		33				2	9	24		
CLAPHAM PARK RD				14	12	44				
MONTFORD PL B	39					39				
BRIXTON B		30					30			
BENGWORTH RD 11kV		26					26			
NECKINGER		13	11			28				
OSBORN ST 132/11kV	69					69				
WELLCLOSE SQUARE 132/11			n/a			58				
HEARN STREET 132/11kV			n/a			36				
SHORTS GARDENS 132/11kV			n/a			38				

Table 12. EHV Circuit breakers

Substation	2015					2023				
	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
BANKSIDE D 20KV	28					28				
CANAL JUNCTION 33KV	4					4				
CHADWICK ROAD		17	4				1	19	1	
DEPTFORD WEST 22kV		10						n/a		
BENGWORTH RD 33kV	22					4	20			

Table 13. 66 and 132kV Circuit Breakers

Substation	2015					2023				
	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
BANKSIDE F 132KV	16					16				
BENGWORTH RD 132kV			2					2		
DEPTFORD GRID 132KV	1	1	2			2	2			
NEW CROSS 132KV	16					11	5			
NEW CROSS SGRID 66KV		8	12				8	11	1	
OSBORN ST 132/11kV	13					13				
WELLCLOSE SQUARE 132/11kV			n/a			3				

Table 14. Primary Transformers

Substation	2015					2023				
	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
BANKSIDE D 20KV			1		1				1	1
CHADWICK ROAD		2	1					2	1	
CHARING CROSS 6.6KV	2					2				

New Cross

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

NEWINGTON HOUSE	2	1		2	1
NORTH CROSS RD	3			2	1
SOUTH BANK	2	1	1	2	2
VERNEY RD	4			4	
NECKINGER	1	1	2		n/a
BRIXTON B	4			3	1
BENGWORTH RD	4				4
CLAPHAM PARK RD		3	1	2	3
MONTFORD PL B	3	1		2	4

Table 15. Grid Transformers

Substation	2015					2023				
	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
BANKSIDE C 11KV	4					2	2			
BANKSIDE D 20KV	2					2				
BENGWORTH RD 33kV	2	1	1				2	2		
CANAL JUNCTION 33KV	2					2				
DEPTFORD GRID 11KV		3					3			
DEPTFORD WEST 22kV		2						n/a		
TOOLEY ST 11KV	2						2			
OSBORN ST 132/11kV	3					3				
FISHER ST 132/11kV	3					3				
NECKINGER 132/11kV			n/a			3				
WELLCLOSE SQUARE 132/11			n/a			3				
HEARN STREET 132/11kV			n/a			2				
SHORTS GARDENS 132/11kV			n/a			3				

New Cross

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

Table 16. Projected Load Indices (With Investment)

Substation	Voltage kV	2023 Load Index	
		Without Investment	With Investment
New Cross 66kV			
Bankside D TE TF	66/22	n/a	n/a
Bengeworth Road	33/11	1	1
Brixton	33/11	5	5
Chadwick Road 33kV	66/33	5	5
North Cross Road	33/11	1	1
South Bank	66/11	1	1
Verney Road	66/11	2	2
New Cross 132kV			
Newington House	22/11	2	2
Bengeworth Road 33kV	132/33	1	1
Clapham Park Road	33/11	5	1
Deptford 22kV	132/22	2	n/a
Deptford Grid	132/11	1	1
Montford Place	33/11	2	2
Neckinger	22/11	2	n/a
Osborn Street 132/11	132/11	1	1
Wellclose Square 132/11	132/11	n/a	1
Fisher Street 132/11	132/11	4	4
Neckinger 132/11	132/11	n/a	1
Hearn Street 132/11kV	132/11	n/a	1
Shorts Gardens 132/11	132/11	n/a	1

Following the reinforcement Clapham Park Road is re-classified as LI1 with Chadwick Road remaining at LI5 with P2/6 compliance maintained by load transfers. Deptford 22kV has been removed following the reinforcement of Neckinger fed from New Cross 132kV.

6 Alternative Strategies

Bengeworth Road 132/33kV substation is supplied by 19km (route) of double circuit fluid filled cables from New Cross and Wimbledon.

Provision for the asset replacement of selective sections of these routes has been made in the Plan. An alternative to the approach was to harmonise with National Grid's south London 275kV cable replacement project which includes a deep cable tunnel between the two grid supply points. An intermediate shaft is required and provisional design work was undertaken to locate the shaft at Bengeworth Road and establish a new Supergrid exit point thereby reinforcing the network and overcoming the need to asset replace the long cable lengths.

National Grid's timescales for the project have now been postponed until mid to late 2020's and this project cannot therefore be considered viable until ED2.

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

7 References

References	Description
Reference 1	Planning Load Estimates LPN Area 2011 – 2023 (February 2013, Element Energy)
Reference 2	Primary Distribution Systems Standard Running Arrangements 2012 Overview Diagrams
Reference 3	NAMP LPN Table J less Ind 19 th February 2014

7.1 Appendices

Appendix	Description
Appendix A	Geographical Aerial: New Cross Substation
Appendix B	Single Line Diagrams – Existing 66kV Network (part 1)
Appendix C	Single Line Diagram – Existing 132kV Network (part 2)

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

8 Document Approval

Recommended by:

Name	Role	Signature	Date
Chris Winch	Infrastructure Planner		
Sophie Motte	IDP Coordinator LPN		
Chris Winch	Infrastructure Planning Manager-South		

Approval by:

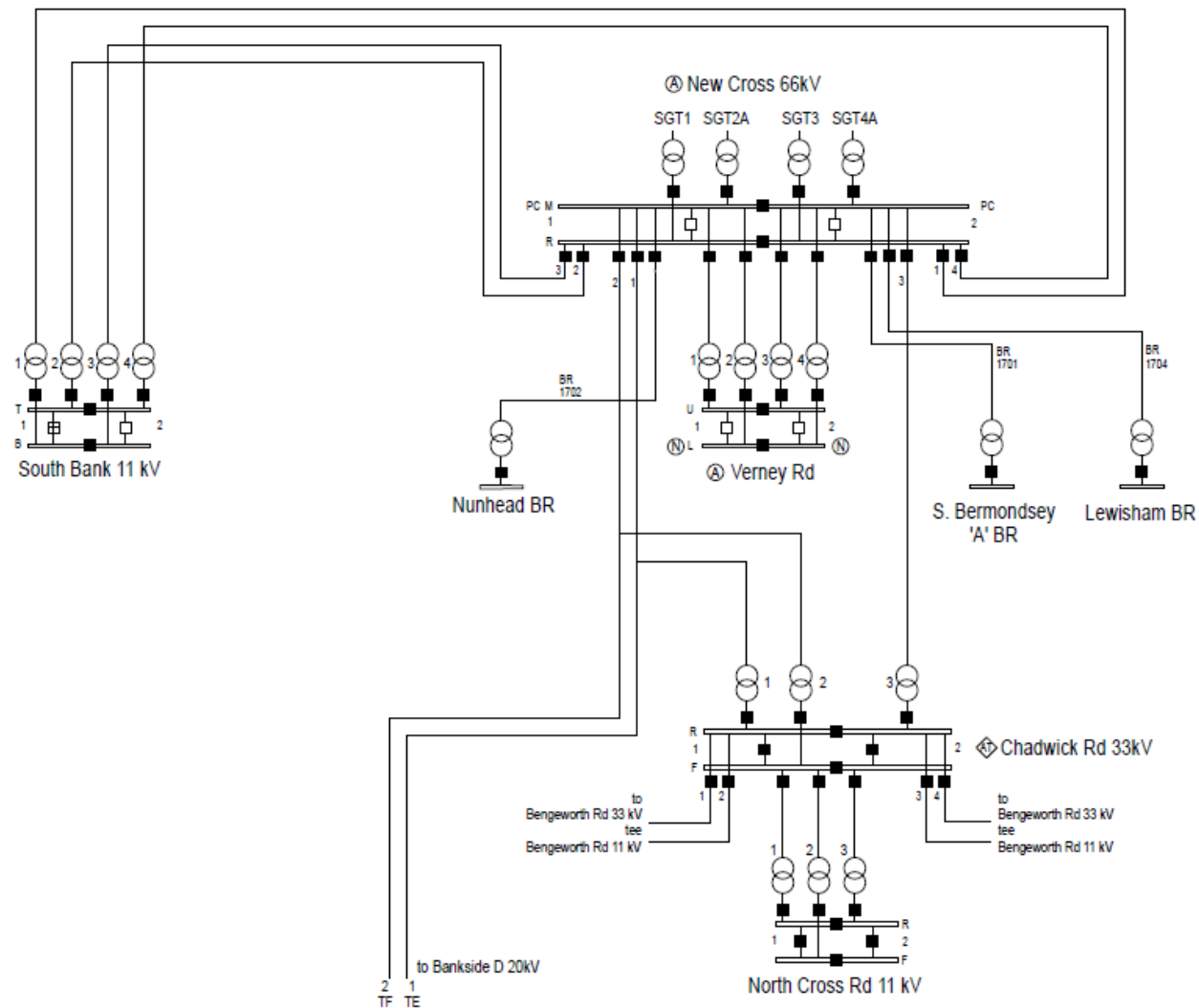
Name	Role	Signature	Date
Robert Kemp	Head of System Development	Robert Kemp	
Barry Hatton	Director of Asset Management		

APPENDIX A: AERIAL VIEW OF NEW CROSS SUBSTATION



New Cross

APPENDIX B: SINGLE LINE DIAGRAM (PART 1) EXISTING 66KV NETWORK



New Cross

APPENDIX C: SINGLE LINE DIAGRAM (PART 2) EXISTING 132KV NETWORK

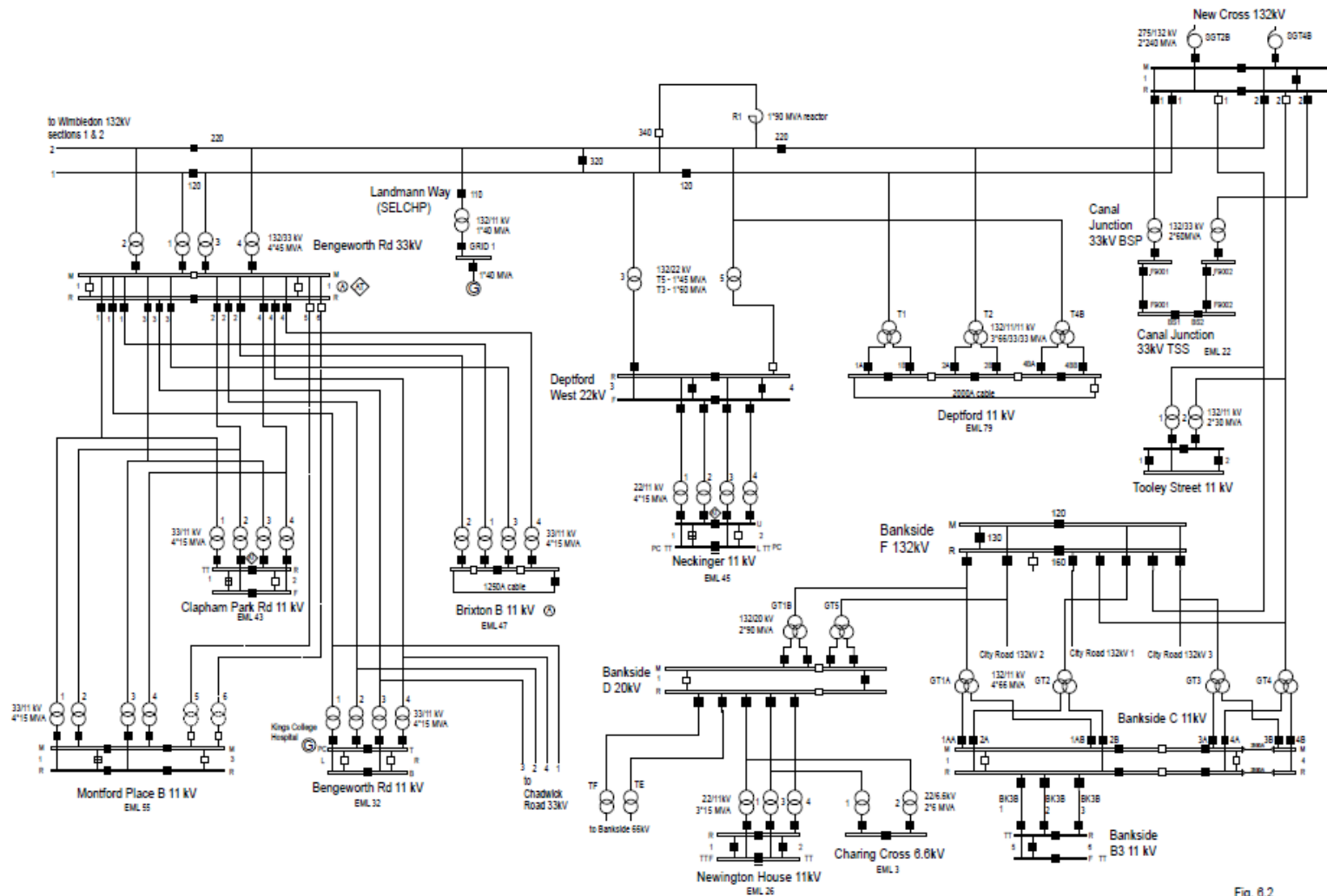


Fig. 6.2

Regional Development Plan

New Cross

