Title: St. John's Wood

LPN Regional Development Plan

Version: 2.2

Date: March 2014

Document History

Version	Date	Revision Class	Originator	Section Update	Details
1.0	June 2013		Itayi Utah / Sophie Motte		First Submission
2.0	21/02/2014	Minor	Panagiotis Xenos	Contents	Updated table of contents
2.0	21/02/2014	Minor	Panagiotis Xenos	1 Executive Summary	Revised and edited the text/content/wording
2.0	21/02/2014	Major	Panagiotis Xenos	1 Executive Summary	Updated proposed projects and costs
2.0	21/02/2014	Major	Panagiotis Xenos	1 Executive Summary	Updated NAMP costs summary table
2.0	21/02/2014	Major	Panagiotis Xenos	1 Executive Summary	Updated LI figure
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2.0	21/02/2014	Minor	Panagiotis Xenos	2 Network Configuration	Revised and edited the text/content/wording
2.0	21/02/2014	Major	Panagiotis Xenos	2.1 Existing Network	Updated description of substations
2.0	21/02/2014	Major	Panagiotis Xenos	2.3 Projects in Progress	Updated costs and list/description of projects (text and NAMP table)
2.0	21/02/2014	Minor	Panagiotis Xenos	3 Network Development Considerations	Revised and edited the text/content/wording
2.0	21/02/2014	Major	Panagiotis Xenos	3.2 Asset Health	Updated HI tables pre-intervention
2.0	21/02/2014	Major	Panagiotis Xenos	3.3 Security of Supply and Load Index Analysis	Updated P2/6 analysis table and LI table pre-intervention
2.0	21/02/2014	Minor	Panagiotis Xenos	4 Recommended Strategy	Revised and edited the text/content/wording
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2.0	21/02/2014	Major	Panagiotis Xenos	4.3 Costs and Phasing	Updated costs and list/description of projects (NAMP table)
2.0	21/02/2014	Major	Panagiotis Xenos	4.4 HI / LI Improvement	Updated HI / LI tables post-intervention
2.0	21/02/2014	Minor	Panagiotis Xenos	5 Rejected Alternatives	Revised and edited the text/content/wording
2.0	21/02/2014	Minor	Panagiotis	6 References	Updated references table

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

Version	Date	Revision Class	Originator	Section Update	Details
			Xenos		
2.1	21/03/2014	Major	Panagiotis Xenos	3.6 Pinch Points	Removed section
2.1	21/03/2014	Minor	Panagiotis Xenos	Contents	Updated table of contents
2.2	27/03/2014	Minor	Regulation	All	Final publication

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Contents

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Executive Summary

This development plan reviews the LPN EHV network supplied from St. John's Wood 132 kV Grid Supply Point (GSP). St. John's Wood and City Road GSP's are interconnected via 3x132kV circuits, which are normally open at circuit breakers located at Back Hill to prevent the parallel operation of two GSP's. In normal operation the majority of loads at Back Hill 33kV and 11kV substations are supplied from St. John's Wood GSP except transformers 4A and 4B, which are fed from City Road 400/132kV. The recorded aggregate group peak demand is 812MVA (Winter) and 787MVA (Summer) which is forecast to increase to 1,028MVA (W) and 986MVA (S) by the end of ED1 following the proposed introduction of Amberley Road substation and Chapel Street (London Underground) substation loads. Geographically, the network footprint covers the London Boroughs of Westminster and parts of Kensington and Chelsea as illustrated in Figure 1 below. This area is home to some of the major and most significant sites of London, which include Buckingham Palace, Houses of Parliament, 10 Downing St, Victoria Station, Leicester Square and Oxford Circus.

The recommended strategy in ED1 includes the upgrade of Shorts Gardens from 22/11kV to 132/11kV and its transfer to Bankside (New Cross RDP). This new substation provides a range of benefits: In the short-term it supports (via the 11kV interconnection) Leicester Square substation during the asset replacement of the transformers during long outages. In the medium term this substation will pick up demand growth associated with known connection applications, and will relieve the emerging constraints at Leicester Square where there is no spare space to expand – not doing this would require future organic local load growth to be supplied from distant substations. Shorts Gardens is currently operated at 22kV, with long cables from St. John's Wood. Eliminating these long feeders will provide a more reliable service to our customers.

Local ITC and 11kV load transfers schemes at Old Brompton Rd, Back Hill 11kV and Aberdeen Place B are also covered in this RDP. Their purpose is to maintain compliance at these sites.

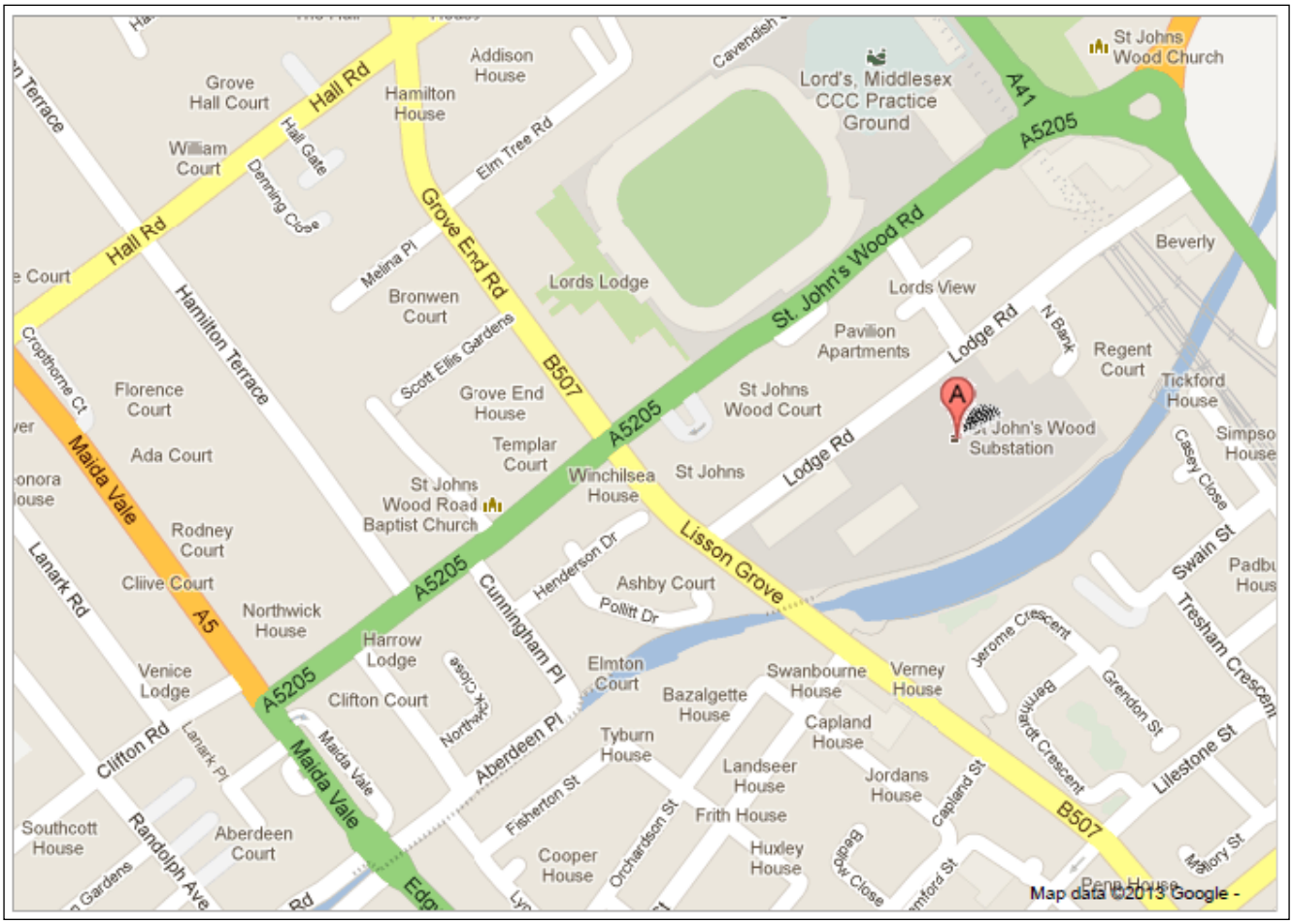
Selective and targeted asset replacement schemes are proposed to maintain the reliability of switchgear, transformers and cables.

Figure 1 - London Borough Map

Source - www.london.gov.uk

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

Figure 2 – St. John's Wood GSP Location



Source - http://maps.google.co.uk/maps?hl=en&tab=ll

Proposed Projects >£1M

Reinforcement Schemes

- Aberdeen Place B 132/11kV - ITC (add 1x30MVA) £1.3M
- Shorts Gardens - Replant as 132/11kV Substation (3x33.3MVA) £10.4M

Asset Replacement Schemes

- Aberdeen Place A 11kV - Replace 11kV Switchgear £1.9M
- Back Hill 33kV - Replace Grid Transformers (GT4B) £1.4M
- Kingsway 11kV - Replace 11kV Switchgear £1.9M
- Leicester Square - Provision to Replace Grid Transformers (GT1, GT2, GT3) £6.2M

Costs profile

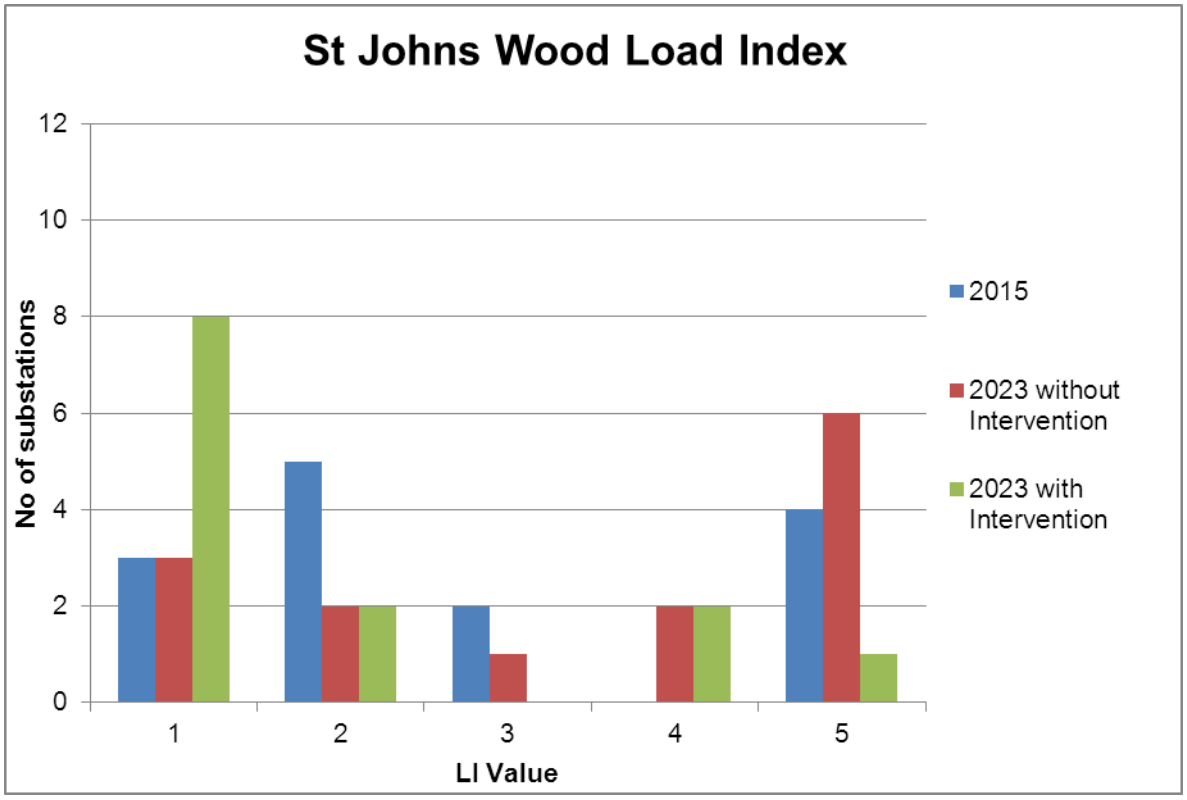
Table 1. Proposed Interventions (NAMP Costs Summary 19th February 2014)

Cat.	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	448,581	184,556	828,589	1,022,374	0	793,846	6,252,346	3,461,930
R	Total Reinforcement	0	0	325,302	0	0	0	0	392,897	611,173	305,586
	Grand Total	0	0	773,883	184,556	828,589	1,022,374	0	1,186,743	6,863,519	3,767,517

Table 1 above provides the forecast aggregate NAMP cost for proposed network expenditure under this RDP during the ED1 period subject to project feasibility studies and final approval.

Output Measures - Load Index

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

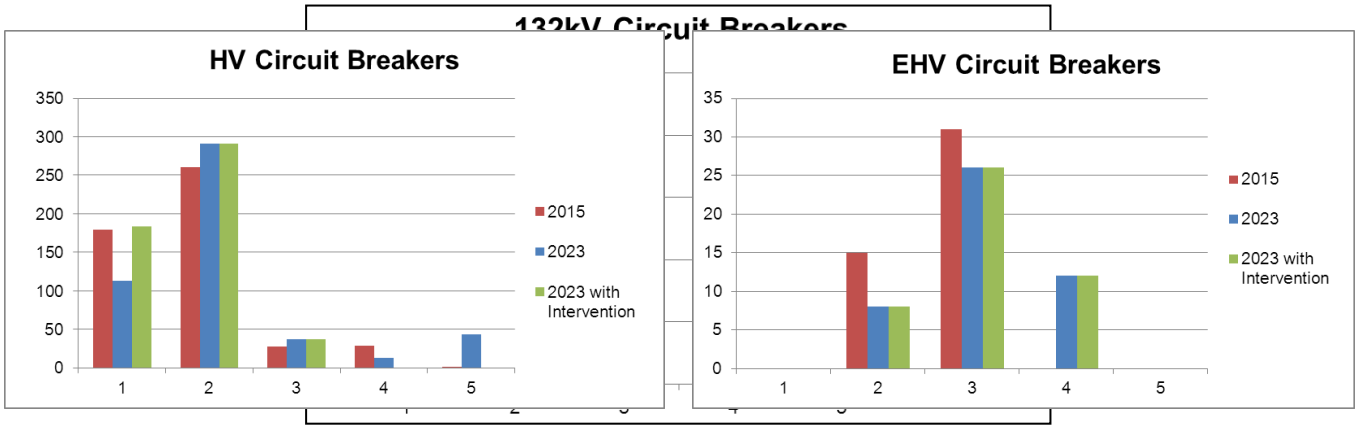


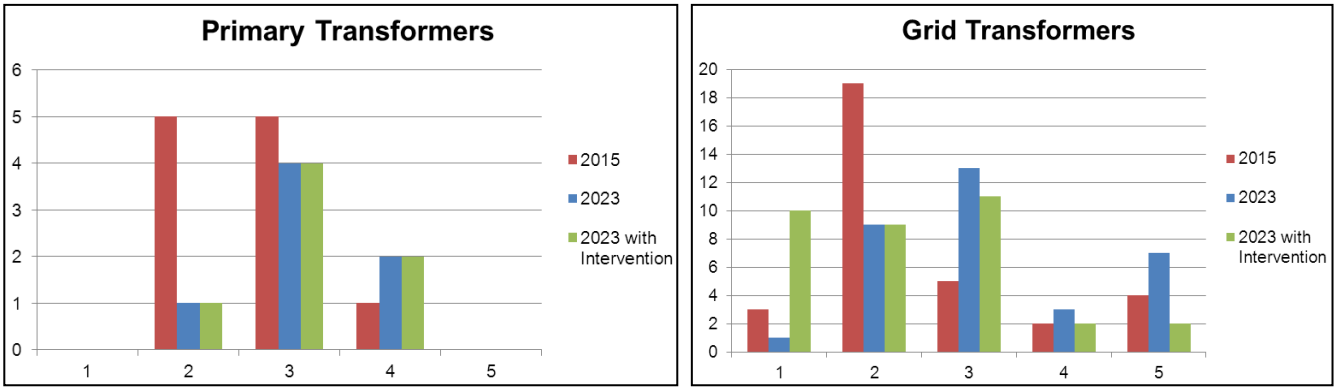
The chart provides an illustration of load indices before and after proposed investment and intervention strategies for all substations covered in this RDP. The substation projected to be LI5 at the end of the period is Shorts Gardens which will be replanted at 132kV by 2021 (the new Shorts Gardens 132/11kV substation will be LI1 at the end of ED1 – RDP10).

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

Output Measures - Health Index

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





The charts above provide projected health indices for network assets considered under this RDP during the ED1 period with and without investment.

Principal Risks, Dependencies and Assumptions

It is assumed that all on-going projects will be completed which will result in the following changes:

- Fisher Street substation will be uprated and circa 49MVA of demand will be transferred to Bankside.
- Circa 40MVA load from Ebury Bridge will be transferred to Moreton Street once the proposed ITC project at Moreton Street is completed.
- Circa 25MVA from Back Hill T4 will be transferred to the new proposed Fisher Street substation.
- The new proposed substation at Calshot Street will receive roughly 22MVA from Longford Street substation while approximately 17.5MVA from Back Hill 11kV North Group will be transferred to Longford Street.

The schemes covered in this RDP have been planned based on the planning load estimates dated 27/02/2013 taking into account the 2011/12 maximum demand figures. The load forecasts are based on the Element Energy model. If the economic situation improves there is a risk that there will be 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.

2 Network Configuration

2.1 Existing Network

This Development Plan reviews the LPN EHV network supplied by St. John's Wood GSP which comprises; 2x 240MVA 275/132kV plus 4x 240MVA 400/132kV super grid transformers (SGT's) connected to two separate 132kV switchboards. The aggregated group peak demand is 812MVA and 787MVA during winter and summer respectively. The GSP is located at the corner of Lisson Grove and Lodge Road, London NW8, adjacent to the National Grid's St. John's Wood Super Grid substation as illustrated in figure 3 below.

A Geographical Layout of the network can be found in Appendix A;

A Single Line Diagram of the existing network can be found in Appendix B;

A Single Line Diagram of the proposed network intervention can be found in Appendix C.

Figure 3 – Aerial View of St. John's Wood GSP

Source - http://maps.google.co.uk/maps?hl=en&tab=ll

St. John's Wood GSP supplies 15 grid and primary substations as listed below:

Aberdeen Place A 132/11kV – The site has 4x15MVA 132/11kV transformers installed with a winter and summer firm capacity of 57MVA and 45MVA respectively.

Aberdeen Place B 132/11kV – The site has 2x30MVA 132/11kV transformers installed with a winter and summer firm capacity of 38.1MVA and 30MVA respectively. The current summer load is already above firm capacity. The substation relies on post fault transfers to Aberdeen Place A for P2/6 compliance.

Amberley Road 132/11kV – This newly developed site has 2x 66/33/33MVA 132/11kV transformers installed with a winter and summer firm capacity of 86MVA and 66MVA respectively. The majority of the load previously fed by Amberley Rd 6.6kV has been transferred to this site.

Back Hill 132/11kV – The site has 1x30MVA (fed from City Rd) and 3x15MVA 132/11kV transformers installed with a winter and summer firm capacity of 57MVA and 45MVA respectively.

Back Hill 132/33kV – This site is covered in the 33kV network RDP.

Chapel Street 132/22kV – This a new London Underground customer site installed with 2x120MVA 132/22kV with a winter and summer firm capacity of 156MVA and 120MVA respectively.

Duke Street 132/11kV – The site has 3x60MVA 132/11kV transformers installed with a winter and summer firm capacity of 157MVA and 134MVA respectively.

Ebury Bridge 132/11kV – The site has 3x60MVA 132/11kV transformers installed with a winter and summer firm capacity of 157MVA and 134MVA respectively. However, the limiting factor is constituted by the three 132kV circuits St John's Wood-Ebury Bridge-Old Brompton Road. Ebury Bridge was covered by a derogation from ER P2/6 until the end of 2013 when load was transferred to the newly commissioned 11kV switchboard at Moreton Street C substation (see Wimbledon RDP).

Fisher Street 33/11kV – The site has 4x15MVA 33/11kV transformers installed with a winter and summer firm capacity of 58MVA and 45MVA respectively. There is currently an on-going project to upgrade Fisher Street MSS to 3x 33.3MVA 132/11kV transformers in order to free up capacity at Back Hill 33kV (33kV network RDP) and establish a 33kV network to connect high demand customers in central London. After completion of this project, Fisher Street 132/11kV will be part of the New Cross RDP.

Kingsway 33/11kV – The site has 4x15MVA 33/11kV transformers installed with a winter and summer firm capacity of 58.5MVA and 45MVA respectively.

Leicester Square 132/11kV – The site has 3x60MVA 132/11kV transformers installed with a winter and summer firm capacity of 157MVA and 134MVA respectively. The substation is entirely underground with no possibility for expansion.

Longford Street 132/11kV – The site has 3x60MVA 132/11kV transformers installed with a winter and summer firm capacity of 157MVA and 134MVA respectively.

Old Brompton Road 132/11kV – The site has 3x60MVA 132/11kV transformers installed with a winter and summer firm capacity of 120MVA. The site is located opposite the Earls Court Exhibition Centre and is expected to face a high load increase due to the significant redevelopment of the area which will drive the substation to LI5 by the end of ED1. Therefore it is proposed to replace the 11kV transformer tails at Old Brompton Road in order to fully utilise the transformer cyclic rating hence increase the site winter firm capacity to 157.3MVA.

St. John's Wood 132/22kV – The site has 2x45MVA 132/22kV transformers installed with a winter and summer firm capacity of 58.5MVA and 45MVA respectively. This grid site only supplies Shorts Gardens substation.

Shorts Gardens 22/11kV – The site has 3x15MVA 22/11kV transformers installed with a winter and summer firm capacity of 37MVA and 30MVA respectively.

2.2 Embedded Generation

Table 2 below details the generating plants used in the analysis for the St. John's Wood Network. The total installed capacity of G59/2 embedded generation under this RDP is 63MW with Imperial College generation contributing the highest output at 7.1MW from its gas turbine.

Table 2. Embedded Generation (G59/2)

GSP	Main Substatio	Generation Plants	Type	DNC (MVA)	DG Output		Mode of Operation
					MW	MVAr	
St Johns Wood 132kV	Aberdeen Place A	BNP PARIBAS	Diesel	7.5	0	0	Short Term Parallel
St Johns Wood 132kV	Aberdeen Place A	BRITISH TELECOMMUNICATIONS PLC	Diesel	1.1	0	0	Short Term Parallel
St Johns Wood 132kV	Aberdeen Place A	THE HOSPITAL OF ST JOHN AND ST ELIZABETH	Diesel	0.15	0	0	Standby
St Johns Wood 132kV	Back Hill	ROYAL MAIL GROUP PLC	CHP	0.095	0.05035	0	Long Term Parallel
St Johns Wood 132kV	Back Hill	GOLDMAN SACHS PROPERTY MANAGEMENT	Diesel	6	0	0	Standby
St Johns Wood 132kV	Back Hill	SIR ROBERT MCALPINE	Diesel	2.5	0	0	Standby
St Johns Wood 132kV	Duke Street	GROSVENOR HOUSE (PARK LANE LTD) - (IN ADMINIS	CHP	1.2	0.636	0	Long Term Parallel
St Johns Wood 132kV	Duke Street	IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY	GAS	9.5	7.125	0	Long Term Parallel
St Johns Wood 132kV	Duke Street	SELFRIDGES	Diesel	4	0	0	Standby
St Johns Wood 132kV	Duke Street	ID ASSOCIATES	CHP	0.282	0.14946	0	Long Term Parallel
St Johns Wood 132kV	Ebury Bridge	MANDARIN ORIENTAL LONDON LIMITED	CHP	0.135	0.08775	0	Long Term Parallel
St Johns Wood 132kV	Ebury Bridge	DEPT OF TRANSPORT LONDON & REGIONS	CHP	0.735	0.38955	0	Long Term Parallel
St Johns Wood 132kV	Ebury Bridge	WESTMINSTER CITY COUNCIL	CHP	4	2.6	0	Long Term Parallel
St Johns Wood 132kV	Ebury Bridge	JOHN LEWIS PLC.	Diesel	0.15	0	0	Short Term Parallel
St Johns Wood 132kV	Ebury Bridge	HARRODS LIMITED	Diesel	4.5	0	0	Standby
St Johns Wood 132kV	Fisher Street	BLOOMSBURY HEAT & POWER LTD	CHP	1.812	0.96036	0	Long Term Parallel
St Johns Wood 132kV	Leicester Square	THE SAVOY HOTEL LIMITED	Diesel	1	0	0	Short Term Parallel
St Johns Wood 132kV	Leicester Square	DEVERE HOTEL & LEISURE LTD	CHP	0.11	0.0671	0	Long Term Parallel
St Johns Wood 132kV	Leicester Square	THE NATIONAL GALLERY	CHP	0.325	0.21775	0	Long Term Parallel
St Johns Wood 132kV	Leicester Square	MINSITRY OF DEFENCE	Diesel	0.5	0	0	Standby
St Johns Wood 132kV	Leicester Square	THE NATIONAL GALLERY	CHP	0.23	0.1403	0	Long Term Parallel
St Johns Wood 132kV	Longford Street	THE WELLCOME TRUST	PV	0.05	0	0	Long Term Parallel
St Johns Wood 132kV	Longford Street	BRITISH TELECOMMUNICATIONS PLC	Diesel	5.499	0	0	Short Term Parallel
St Johns Wood 132kV	Longford Street	JP MORGAN CHASE BANK	Diesel	8	0	0	Short Term Parallel
St Johns Wood 132kV	Longford Street	GREAT ORMOND STREET HOSPITAL FOR CHILDREN N	CHP	1.75	0.9275	0	Long Term Parallel
St Johns Wood 132kV	Longford Street	UNIVERSITY COLLEGE LONDON HOSPITALS NHS FOUI	Diesel	2	0	0	Short Term Parallel

2.3 Projects in Progress

Table 3. Ongoing projects (NAMP 19th February 2014)

Cat.	Reference	Description	2013/14	2014/15	2015/16	2016/17
A	1.48.01.5749	St Johns Wd 132kV: Switchgear Replacement Phase 2	203,442	869,891	778,693	0
A	1.51.01.7861	Old Brompton Rd 11kV - Replace Grid Transformers (GT2)	0	78,060	1,524,695	0
A	1.51.11.5679	Leicester Square - Installation of Enhanced Monitoring Equipment	360,000	0	0	0
A	1.51.11.5680	Duke Street-Replacement of Failed Hydrans and Drycol Units	58,614	422,021	0	0
R	1.33.03.5655	Fisher Street 11kV Switchboard Extension	24,866	159,142	253,632	0
R	1.33.06.8641	Duke Street: Replacement of Coolers	340,732	123,903	0	0
R	1.34.02.5722	Old Brompton Rd South Grp Radialisation and Automation	70,155	420,926	631,387	0
R	1.34.02.5882	Old Brompton Road 11kV: Transfer all Feeders from the Old Switchboard to the New Switchboard	141,700	106,275	0	0
R	1.35.05.2941	Old Brompton Rd Change 11kV Switchboard	1,607,665	290,338	0	0

Table 3 above lists all the currently ongoing projects.

Ongoing works:

5749: This scheme completes the final phase of the St. John's Wood substation 132kV AIS replacement which has been delayed by the absence of new transformer capacity at Moreton Street due to 3rd party property issues. The additional Moreton Street capacity is required to provide risk mitigation should a fault occur during the transfer of the Old Brompton Road/Ebury Bridge circuits to the new GIS switchboard. No assets are involved as they have already been installed during the 1st phase of the switchgear replacement and this project only covers the transfer of the Old Brompton Rd/Ebury Bridge 132kV circuits onto the new GIS board.

7861: The condition assessment of the 1980 Ferranti Grid Transformer (GT2) with Ferranti FC6 tap changer installed at Old Brompton Rd 132/11kV 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 replacement. The scope of works also involves the uprate of the 11kV tails in order to match the cyclic rating of the new transformer.

5679: Leicester Square – Installation of Enhanced Monitoring Equipment.

5680: Duke Street – Replacement of failed Hydrans and Drycol units.

5655: Fisher Street switchboard extension is in progress to accommodate proposed load transfers from Back Hill 11kV substation via 8 new 11kV feeder breakers.

8641: Duke Street – Replacement of coolers. The cyclic rating of the transformers at Duke Street is less than previously indicated due to the size of the coolers. It is necessary to replace the coolers to increase the site firm capacity.

5722: The South Group at Old Brompton Road is an interconnected group. This group is close to N-1 capacity and needs reinforcing. This project will radialise and automate the group (convert it to system 6 design). The additional benefit is that this project will greatly assist the switchboard replacement at Old Brompton Road.

5882: Old Brompton Road – transfer all feeders to the new switchboard. This will be undertaken at the end of the project 2941. Both projects are expected to be completed and commissioned by the end of 2014.

2941: Old Brompton Road 11kV switchboard replacement is currently in progress. The switchboard is to be replaced as part of the strategy for the replacement of obsolete and poorly performing plant. This project will also address point bar loading issues at the site.

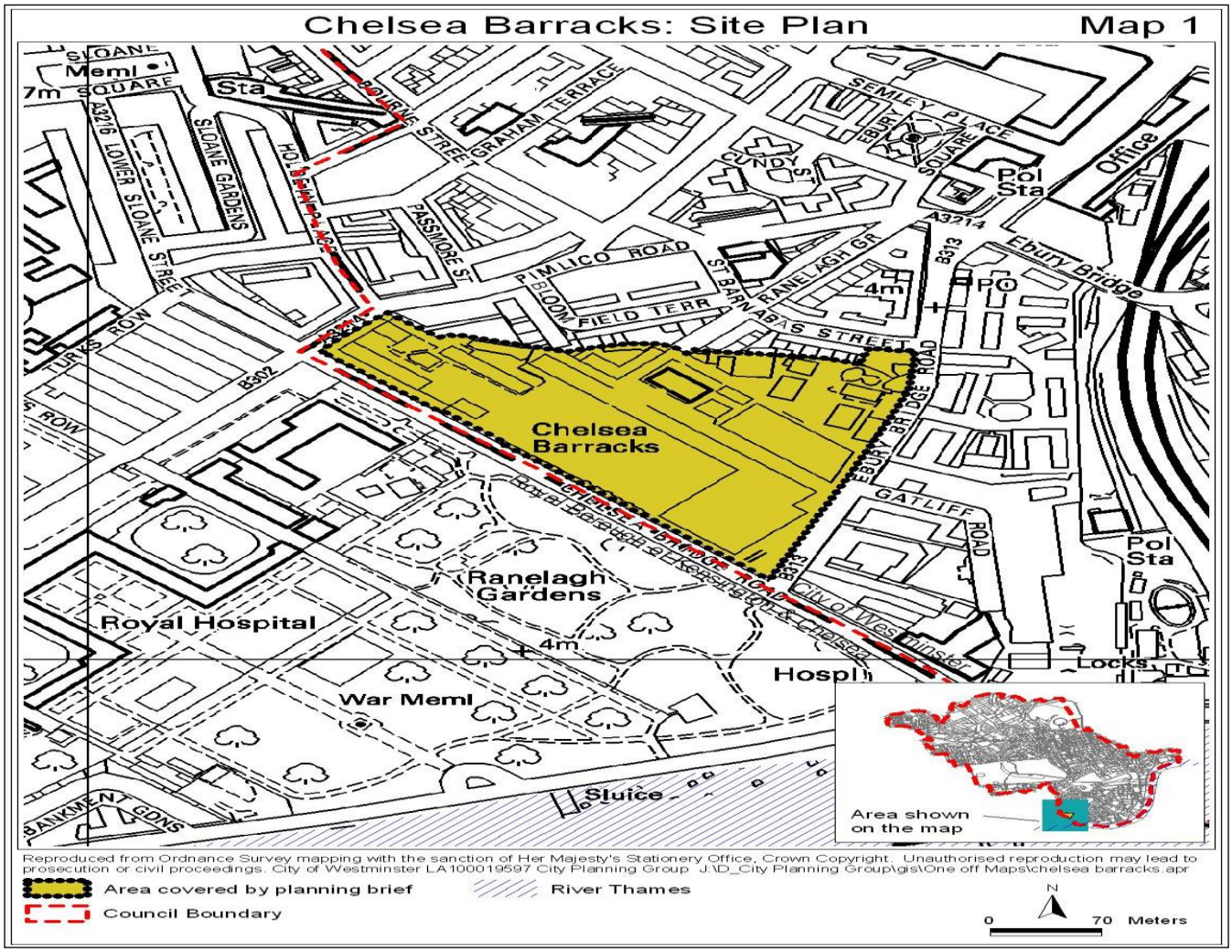
3 Network Development Considerations

3.1 Development Areas

3.1.1 Chelsea Barracks

Chelsea Barracks development involves the demolition of former army barracks buildings and warehouse in connection with the redevelopment of the 5.18ha site for mixed use purposes comprising residential (a maximum of 448 units), sports centre 5,000m^2 (Class D2), retail 1,500m^2 (flexible use within Class A1/A2/A3), health centre 850m^2 (Class D1), non-residential institution/leisure uses (flexible use within Classes D1 and/or D2).

Figure 5 – Chelsea Barracks Development Site



Source – www.westminster.gov.uk

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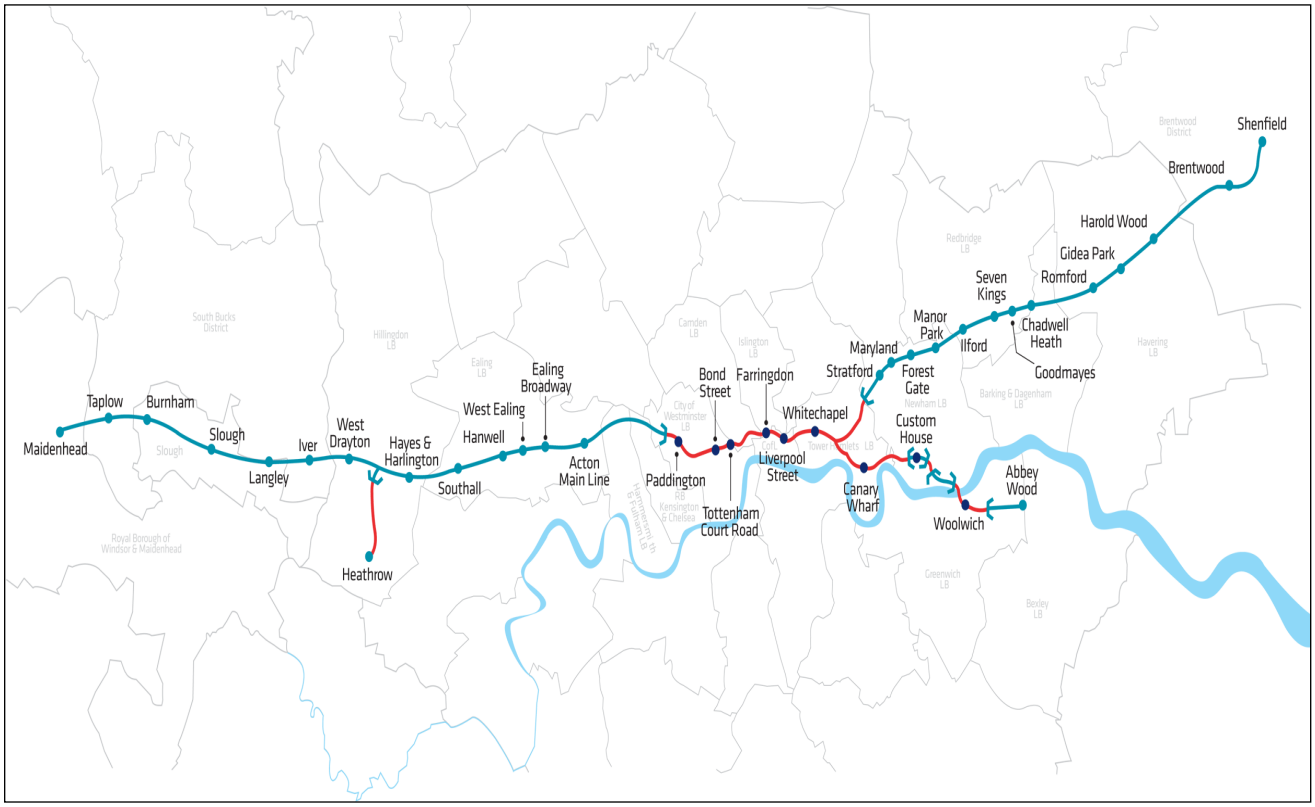
3.1.2 Crossrail Line 1

Figure 6 – Proposed Crossrail line



Source – www.westminster.gov.uk

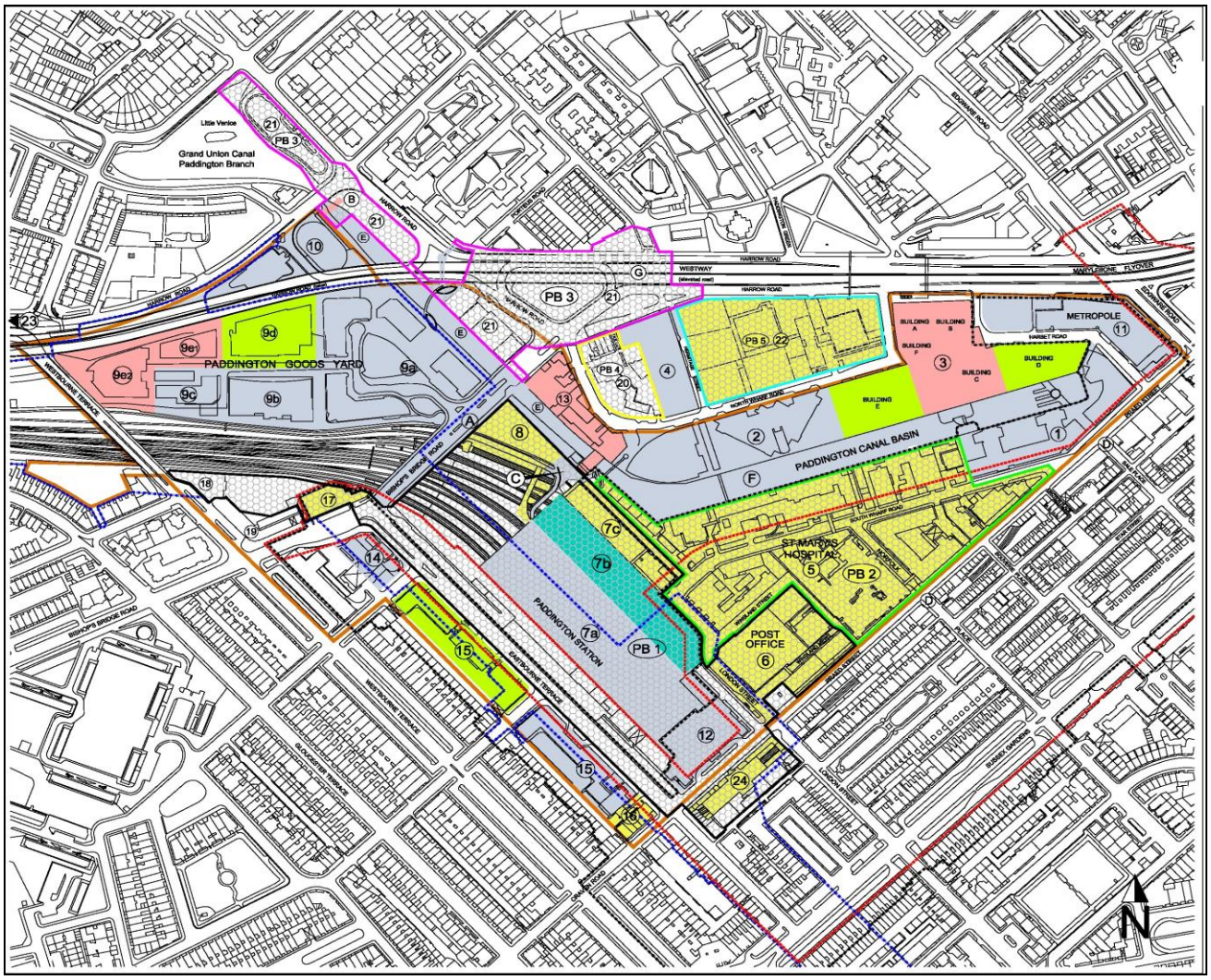
Figure 6 above details the proposed Crossrail Line 1 project, which is a new rail scheme promoted by the Secretary of State for Transport through Cross London Rail Links (CLRL), now operating as Crossrail Ltd under the Transport for London umbrella. Crossrail will deliver a high frequency, high capacity service to 37 stations linking Maidenhead and Heathrow in the west, to Shenfield and Abbey Wood in the east via 21 km of new twin-bore tunnels under central London. New Crossrail stations will be constructed along the central route at Paddington, Tottenham Court Road, Bond Street, Farringdon, Liverpool Street, Whitechapel and Canary Wharf which is expected to add more load to several of our substations.

3.1.3 Paddington Waterside

The Paddington Special Policy Area (PSPA), now known as Paddington Waterside, is centred on Paddington Station and the canal basin. It contains several large sites which together make up the largest development area within Westminster as illustrated in figure 7 below.

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

Figure 7 - Paddington Waterside Developments



Developments completed	Applications being implemented	Applications approved	Applications being considered	Applications expected

Paddington Waterside Development Sites:

1. Paddington Basin (Phase I) West End Quay 2. Paddington Basin, Blocks A,B and C 3. Paddington Basin, Merchant Square (Buildings A-F) 4. Hermitage Street Site 5. St. Mary's Hospital Site 6. Post Office 7a. Paddington station Phase I 7b. Paddington Station Span 4 Refurbishment 7c. Paddington station Taxi Deck 8. Paddington Triangle and associated ramp to deck	9a. Paddington Central Phase I (Sheldon Square) 9b. 1 Kingdom Street 9c. 3 Kingdom Street (hotel) 9d. 2 Kingdom street 9e1. 4 Kingdom Street 9e2. 5 Kingdom Street 10. 179 Harrow Road 11. Hilton London Metropole Hotel 12. Hilton London Paddington Hotel 13. 567 North Wharf Read 14. Telstar House	15. 10-30 and 40 Eastboume Terrace 16. Craven Reed I Eastboume Terrace 17. 4-18 Bishop's Bridge Read 18. Enterprise House 19. Brewers Court 20. Dudley House (13 147 Harrow Reed) 21. 14 157 Harrow Road (Travis Perkins) plus adjacent highway/open space 22. North Westminster Community School 23. Westboume Green (outside map area) 24. Paddington LUL Station (District & Circle Lines)

Source – www.westminster.gov.uk

3.1.4 Others

3.1.4.1 Housing

Westminster Borough proposes to develop 680 new housing units annually between 2008 and 2027, which converts to 9,520 houses over a period of 14 years. Approximately 20MW of new capacity will be required to support the proposed housing developments.

3.2 Asset Health

Health indices for all network equipment covered in this RDP before any further ED1 investment are listed in Table 4. to 9 below. The equipment groups covered include HV circuit breakers (6.6kV and 11kV), EHV circuit breakers (33kV), 66kV&132kV circuit breakers, primary transformers (22/11kV and 33/11kV), grid transformers (132/11kV, 132/33kV and 132/22kV) and underground cables (33kV and 132kV).

Table 4. HV Circuit Breakers

	2015					2023				
Substation	**No. HI1**	**No. HI2**	**No. HI3**	**No. HI4**	**No. HI5**	**No. HI1**	**No. HI2**	**No. HI3**	**No. HI4**	**No. HI5**
ABERDEEN PL B 11KV		15					15			
ABERDEEN PLACE A 11KV			13	15					8	20
AMBERLEY RD B 11KV	52	1				52	1			
BACK HILL A 11KV		25	2				14	13		
DUKE ST B 11KV		56					56			
EBURY BRIDGE 11KV		60					60			
FISHER ST	27						27			
KINGSWAY 11KV			13	14	1				5	23
LEICESTER SQ 11KV		56					56			
LONGFORD ST B 11KV	39	23					62			
OLD BROMPTON RD 11KV	61					61				
SHORTS GDNS 11KV		24						24		

Table 5. EHV Circuit Breakers

	2015					2023				
Substation	**No. HI1**	**No. HI2**	**No. HI3**	**No. HI4**	**No. HI5**	**No. HI1**	**No. HI2**	**No. HI3**	**No. HI4**	**No. HI5**
BACK HILL 33KV		8	12				1	19		
SHORTS GDNS 22KV			19					7	12	
ST JOHNS WOOD 22KV		7					7			

Table 6. 66 and 132kV Circuit Breakers

	2015					2023				
Substation	**No. HI1**	**No. HI2**	**No. HI3**	**No. HI4**	**No. HI5**	**No. HI1**	**No. HI2**	**No. HI3**	**No. HI4**	**No. HI5**
BACK HILL 132KV			3							3
ST JOHNS WOOD 132KV		4	4							
ST JOHNS WOOD B 132KV	21					11	10			

Table 7. 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
FISHER ST		2	1	1						
KINGSWAY 11KV		2	2					3	1	
SHORTS GDNS 11KV		1	2				1	1	1	

Note: Fisher Street primary transformers are already programmed to be removed as part of an ongoing project, and the new 132/11kV transformers which will replace them are part of the New Cross RDP.

Table 8. 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
ABERDEEN PLACE B 11KV		2					2			
ABERDEEN PLACE A 11KV		4						4		
AMBERLEY RD B 11KV	2					1	1			
BACK HILL 33KV		2	1	1				2	1	1
BACK HILL 11KV		2	2					3	1	
DUKE ST B 11KV			1	1	1				1	2
EBURY BRIDGE 11KV		3					3			
LEICESTER SQ 11KV					3					3
LONGFORD ST B 11KV	1	2					3			
OLD BROMPTON RD 11KV		2	1					2		1
ST JOHNS WOOD 22KV		2						2		

Table 9. Fluid Filled Cables

Section (Route)	Cable Section	Voltage	HI in 2015	HI in 2023
BACK HILL 33KV-KINGSWAY 11KV	CABLE SECTION: 32040248-1-A	33	3	4
BACK HILL 33KV-KINGSWAY 11KV	CABLE SECTION: 32040248-3-A	33	4	5
BACK HILL 33KV-FISHER ST	CABLE SECTION: 32040227-1-A	33	3	3
ST JOHNS WOOD 132KV-ABERDEEN PL B 11KV	CABLE SECTION: 33850302-5-A	132	5	5
ST JOHNS WOOD 132KV-OLD BROMPTON RD 11KV	CABLE SECTION: 33850173-2-C	132	3	4
ST JOHNS WOOD 132KV-OLD BROMPTON RD 11KV	CABLE SECTION: 33850173-3-A	132	3	4
ST JOHNS WOOD 132KV-ABERDEEN PL B 11KV	CABLE SECTION: 33850302-5-B	132	3	3
BACK HILL 33KV-FISHER ST	CABLE SECTION: 32040227-2-A	33	2	3
BACK HILL 33KV-FISHER ST	CABLE SECTION: 32040227-3-A	33	2	3
BACK HILL 33KV-FISHER ST	CABLE SECTION: 32040227-4-A	33	2	3
BACK HILL 33KV-FISHER ST	CABLE SECTION: 32040227-B-A	33	2	3

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

BACK HILL 33KV-KINGSWAY 11KV	CABLE SECTION: 32040248-2-A	33	2	2
BACK HILL 33KV-KINGSWAY 11KV	CABLE SECTION: 32040248-4-A	33	2	2
ST JOHNS WOOD 132KV-BACK HILL 33KV	CABLE SECTION: 33853204-1-A	132	2	3
ST JOHNS WOOD 132KV-BACK HILL 33KV	CABLE SECTION: 33853204-1-B	132	2	2
ST JOHNS WOOD 132KV-BACK HILL 33KV	CABLE SECTION: 33853204-2-A	132	2	2
ST JOHNS WOOD 132KV-OLD BROMPTON RD 11KV	CABLE SECTION: 33850173-2-A	132	2	3
ST JOHNS WOOD 132KV-OLD BROMPTON RD 11KV	CABLE SECTION: 33850173-2-B	132	2	3
ST JOHNS WOOD 132KV-OLD BROMPTON RD 11KV	CABLE SECTION: 33850173-3-B	132	2	3
ST JOHNS WOOD 132KV-OLD BROMPTON RD 11KV	CABLE SECTION: 33850173-3-C	132	2	3

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

3.3 Security of Supply and Load Index Analysis

Table 10. P2/6 Analysis

Sub-station	P2/6	Type of substation	Secondary Voltage	Firm Capacity (MW)	Transfer (MW)	P. F.	Winter 13/14 Summer 2013 (MW)	Winter 14/15 Summer 2014 (MW)	Winter 15/16 Summer 2015 (MW)	Winter 16/17 Summer 2016 (MW)	Winter 17/18 Summer 2017 (MW)	Winter 18/19 Summer 2018 (MW)	Winter 19/20 Summer 2019 (MW)	Winter 20/21 Summer 2020 (MW)	Winter 21/22 Summer 2021 (MW)	Winter 22/23 Summer 2022 (MW)
33kV Ring Group A	YES	Group Load	33kV	57.00		0.95	25.20	37.60	41.20	45.20	45.20	45.20	45.20	45.20	45.20	45.20
33kV Ring Group A	YES	Group Load	33kV	57.00		0.95	25.20	37.60	41.20	45.20	45.20	45.20	45.20	45.20	45.20	45.20
33kV Ring Group B	YES	Group Load	33kV	57.00		0.95	14.64	21.36	32.80	35.36	36.16	38.56	38.56	38.56	38.56	38.56
33kV Ring Group B	YES	Group Load	33kV	57.00		0.95	14.64	21.36	32.80	35.36	36.16	38.56	38.56	38.56	38.56	38.56
33kV Ring Group B Total	NO	Group Load	33kV	0.00		0.96	9.76	14.24	21.87	44.18	44.84	46.57	46.70	46.83	46.98	47.13
33kV Ring Group B Total	NO	Group Load	33kV	0.00		0.96	9.76	14.24	21.87	44.94	45.59	47.32	47.45	47.58	47.73	47.88
Aberdeen Place A	YES	Grid	11kV	54.70	1.97	0.96	39.20	39.66	40.14	40.54	40.99	41.46	41.95	42.46	43.08	43.72
Aberdeen Place A	YES	Grid	11kV	40.50		0.90	34.39	34.77	35.18	35.51	35.88	36.28	36.69	37.11	37.63	38.16
Aberdeen Place B	YES	Grid	11kV	37.00	8.00	0.97	36.11	36.79	37.50	38.08	38.74	39.43	40.15	40.89	41.79	42.70
Aberdeen Place B	YES	Grid	11kV	27.90	8.00	0.93	30.04	30.58	31.14	31.60	32.13	32.68	33.25	33.84	34.56	35.28
Amberley Road 11kV	YES	Grid	11kV	82.37		0.96	42.75	43.61	44.51	45.25	46.10	46.98	47.88	48.81	49.99	51.18
Amberley Road 11kV	YES	Grid	11kV	60.72		0.92	32.13	32.98	33.88	34.63	35.47	36.35	37.25	38.18	39.36	40.55
Back Hill	YES	Grid	11kV	54.90		0.96	43.49	44.14	20.56	3.83	4.13	4.45	4.78	5.11	5.49	5.89
Back Hill	NO	Grid	11kV	42.75	1.26	0.95	44.64	45.27	20.46	3.72	4.01	4.31	4.62	4.93	5.30	5.67
Back Hill 33kV	YES	Grid	33kV	149.90		0.94	107.90	125.77	89.86	116.58	117.72	119.94	120.58	121.25	121.98	122.73
Back Hill 33kV	YES	Grid	33kV	116.10	21.38	0.86	109.56	127.45	90.91	118.39	119.52	121.73	122.36	123.01	123.72	124.45
Back Hill 33kV T1,2,3	NO	Grid	33kV	112.40		0.94	107.90	125.77	89.86	116.58	117.72	119.94	120.59	121.25	121.98	122.73
Back Hill 33kV T1,2,3	NO	Grid	33kV	87.72	21.38	0.86	109.56	127.45	90.91	118.39	119.52	121.73	122.36	123.01	123.72	124.45
Back Hill T1,2,3	YES	Grid	11kV	32.70		0.97	19.90	20.23	20.56	3.83	4.13	4.45	4.78	5.11	5.49	5.89
Back Hill T1,2,3	YES	Grid	11kV	25.65		0.95	19.84	20.15	20.46	3.72	4.01	4.31	4.62	4.93	5.30	5.67
Beech Street A.	YES	Primary	11kV	18.70		0.96	0.00	0.00	0.00	9.42	9.60	9.79	9.98	10.19	10.40	10.63
Beech Street A.	YES	Primary	11kV	14.10		0.94	0.00	0.00	0.00	10.17	10.35	10.54	10.73	10.94	11.15	11.38
Chapel Street (LUL)	NO	Customer	22kV	112.30		0.96	83.00	104.00	104.00	104.00	119.00	119.00	119.00	119.00	119.00	119.00
Chapel Street (LUL)	NO	Customer	22kV	86.40		0.96	83.00	104.00	104.00	104.00	119.00	119.00	119.00	119.00	119.00	119.00
Charterhouse Street Citigen.	YES			40.00		0.96	0.00	0.00	0.00	12.41	12.41	12.41	12.41	12.41	12.41	12.41
Charterhouse Street Citigen.	YES			40.00		0.92	0.00	0.00	0.00	12.41	12.41	12.41	12.41	12.41	12.41	12.41
Duke Street	YES	Grid	11kV	147.88		0.94	99.34	100.58	101.84	102.85	104.00	105.20	106.43	107.70	109.10	110.54
Duke Street	YES	Grid	11kV	122.30		0.91	107.78	109.06	110.35	111.39	112.58	113.82	115.08	116.39	117.84	119.32
Duke/Leic Branch	YES	Group Load	132kV	421.40		0.96	204.74	212.85	215.48	217.61	220.04	222.55	225.14	227.81	230.75	233.78
Duke/Leic Branch	YES	Group Load	132kV	315.50		0.92	224.10	232.64	235.38	237.59	240.13	242.74	245.43	248.21	251.28	254.43
Ebury Bridge	YES	Grid	11kV	152.60		0.97	135.59	98.53	100.31	101.76	103.41	105.14	106.91	108.74	110.92	113.12
Ebury Bridge	NO	Grid	11kV	124.99	1.78	0.93	138.88	101.16	102.89	104.31	105.92	107.60	109.33	111.12	113.24	115.39
Fisher Street	YES	Primary	11kV	56.57		0.967	47.09	47.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fisher Street	YES	Primary	11kV	42.21	21.38	0.938	47.76	48.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kingsway	YES	Primary	11kV	55.58		0.95	26.40	26.93	27.46	27.88	28.37	28.87	29.39	29.92	30.50	31.11
Kingsway	YES	Primary	11kV	40.95		0.91	26.87	27.38	27.89	28.30	28.77	29.26	29.76	30.27	30.84	31.42
Leicester Square	YES	Grid	11kV	151.03	17.34	0.96	105.39	112.26	113.64	114.76	116.04	117.35	118.71	120.11	121.66	123.24
Leicester Square	YES	Grid	11kV	123.65	18.00	0.92	116.36	123.61	125.06	126.23	127.57	128.96	130.38	131.85	133.47	135.14
Longford Street	YES	Grid	11kV	152.60		0.97	108.20	109.36	110.55	107.61	108.71	109.85	111.02	112.23	113.63	115.05
Longford Street	YES	Grid	11kV	127.68	73.37	0.95	114.52	115.69	116.89	115.66	116.76	117.91	119.09	120.32	121.72	123.16
OBRD/EBBR Branch	YES	Group Load	132kV	288.00		0.96	235.10	199.40	202.61	205.26	208.28	211.45	214.71	218.09	222.24	226.43
OBRD/EBBR Branch	YES	Group Load	132kV	255.80		0.92	222.86	186.24	189.13	191.51	194.22	197.06	199.99	203.02	206.73	210.48
OBRD/EBBR/SJW/ABBB Branch	YES	Group Load	kV	351.20		0.96	297.49	262.69	266.84	270.25	274.14	249.15	253.11	257.22	262.25	267.32
OBRD/EBBR/SJW/ABBB Branch	YES	Group Load	kV	351.20		0.96	282.55	246.72	250.42	253.46	256.92	228.96	232.45	236.06	240.48	244.94
Old Brompton Road	YES	Grid	11kV	116.40	1.00	0.97	99.66	101.03	102.48	103.68	105.05	106.50	108.00	109.56	111.55	113.55
Old Brompton Road	YES	Grid	11kV	112.80		0.94	84.17	85.27	86.43	87.40	88.50	89.66	90.86	92.11	93.71	95.31
Shorts Gardens	YES	Primary	11kV	35.90		0.97	27.91	28.15	28.40	28.60	28.83	0.00	0.00	0.00	0.00	0.00
Shorts Gardens	YES	Primary	11kV	27.60	13.48	0.92	30.39	30.65	30.90	31.11	31.35	0.00	0.00	0.00	0.00	0.00
Shorts Gardens 22kV	YES		22kV	34.40		0.93	27.91	28.15	28.40	28.60	28.83	0.00	0.00	0.00	0.00	0.00
Shorts Gardens 22kV	YES		22kV	31.80		0.93	30.39	30.65	30.90	31.11	31.35	0.00	0.00	0.00	0.00	0.00
St Johns Wood 132kV	YES	GSP	132kV	1105.90		0.96	932.14	947.04	920.77	934.47	959.58	942.11	952.18	962.58	974.84	987.31
St Johns Wood 132kV	YES	GSP	132kV	976.90		0.96	897.08	911.23	883.87	899.65	924.30	903.85	913.44	923.33	934.96	946.79
St Johns Wood 22kV	YES	Grid	22kV	55.58		0.95	27.91	28.15	28.40	28.60	28.83	0.00	0.00	0.00	0.00	0.00
St Johns Wood 22kV	YES	Grid	22kV	42.30		0.94	30.39	30.65	30.90	31.11	31.35	0.00	0.00	0.00	0.00	0.00

Table 10 above shows the load growth predicted on the St. John's Wood network, where loads exceeding the substation firm capacity plus available post-fault transfer capability are shown in orange. With the exception of Back Hill 11kV, all sites that face firm capacity issues due to projected load growth or other local factors are currently/will remain P2/6 compliant within ED1 via the available 11kV post-fault transfers or the proposed interventions covered in this RDP. The summer maximum demand at Back Hill 11kV substation will be exceeding the site firm capacity until 2015, when Fisher Street will be replanted at 132kV enabling Back Hill 11kV to be deloaded. It is recommended that an 'At Risk' study is carried out to determine the summer cyclic

capability of the Back Hill transformers and if necessary a derogation application submitted to Ofgem on the grounds that any interim investment to deal with this issue would be an inefficient use of capital.

Note: Ebury Bridge was under a derogation from P2/6 until December 2013 when load was transferred to the newly commissioned 11kV switchboard at Moreton Street C substation (see Wimbledon RDP).

Table 11. LI Table Without Intervention

Substation	Voltage kV	Load Index	
		2015	2023
Aberdeen Place A	132/11	2.00	2.00
Aberdeen Place B	132/11	5.00	5.00
Back Hill	132/11	5.00	5.00
Back Hill 33kV	132/33	2.00	5.00
Duke Street	132/11	2.00	4.00
Ebury Bridge	132/11	2.00	2.00
Fisher Street	33/11	5.00	5.00
Kingsway	33/11	1.00	1.00
Leicester Square	132/11	3.00	5.00
Longford Street	132/11	3.00	4.00
Old Brompton Road	132/11	2.00	3.00
Shorts Gardens	22/11	5.00	5.00
St Johns Wood 22kV	132/22	1.00	1.00
Amberley Road 11kV	132/11	1.00	1.00

3.4 Operational and Technical Constraints

Operational Constraints

The following operational constraints have been identified for the St. John's Wood network:

- Under normal operating conditions, Back Hill 11kV transformers 1-3 and Back Hill 33 kV transformers 1-3 are supplied from St. John's Wood GSP, whereas Back Hill 11 kV transformer 4 and Back Hill 33 kV transformer 4 are supplied from City Road GSP.
- Any fault on cable circuits 1, 2 or 3 between St. John's Wood GSP and Duke Street 132/11kV will affect both Duke Street and Leicester Square substations.
- Any fault on cable circuits 1, 2 or 3 between St. John's Wood GSP and Old Brompton Road 132/11kV will affect both Old Brompton Road and Ebury Bridge substations.

Technical Constraints

The busbar sections at Back Hill 11kV are such that section 2, containing the 3x15MVA transformers, is rated at 1000A and section 1, containing the 30MVA transformer, is rated at 1600A. The busbar rating of section 2 poses a bottleneck for the switchboard.

The 11kV busbars for switchgear at Old Brompton substation are not rated for the full point bar loading of the site. Project 2941 to replace the switchboard is currently in progress.

3.5 National Grid

UKPN has expressed its desire to retain the space currently occupied by the old switchgear for future reinforcement of Aberdeen Place and Hyde Park. NG originally wanted this space to extend the 400kV substation, but they now feel that they have sufficient space in the existing 400kV substation.

3.6 Smart Demand Response

Studies have been undertaken to identify suitable sites for participation in smart demand response to reduce peak load with a view to delay proposed reinforcement work. However, the studies did not identify any suitable sites.

4 Recommended Strategy

The network strategy for St. John's Wood network is designed to ensure:

- 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 proposals are summarised below.

4.1 Asset Replacement

The following projects are identified in this RDP as interventions to address assets with poor health indices.

7778 – Back Hill 132kV – Replace 132kV Switchgear (2016 – 2017)

The condition assessment of the 1961/63 REY OB14 Air Blast CBs installed at Back Hill 132kV has shown that the Circuit Breakers will be HI5 by the end of ED1 and that the probability of failure due to degradation will become unacceptable. It is not possible to keep these assets in use without compromising operational requirements; therefore this project recommends their replacement. Completion of the project will see 3x132kV circuit breakers replaced with 3 new circuit breakers.

7796 – Aberdeen Place A 11kV – Replace 11kV Switchgear (2020 – 2022)

The condition assessment of the 1966 AEI QF Oil Switchgear installed at Aberdeen Place A 11kV has shown that it is not possible to keep these assets in use without compromising operational requirements; therefore this project recommends their replacement. Completion of the project will see 28x11kV circuit breakers replaced with 28 new circuit breakers.

7800 – Kingsway 11kV – Replace 11kV Switchgear (2020 – 2022)

The condition assessment of the 1964-68 AEI QF Oil Switchgear installed at Kingsway 11kV has shown that it is not possible to keep these assets in use without compromising operational requirements; therefore this project recommends their replacement. Completion of the project will see 28x11kV circuit breakers replaced with 28 new circuit breakers.

7854 – Back Hill 33kV – Replace Grid Transformers (GT4B) (2017 – 2018)

The condition assessment of the 1961 Brush Grid Transformer 4B (45MVA) with Brush HSRSD tap changer installed at Back Hill 132/33kV 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 replacement. Completion of the project will see the 45MVA Grid Transformer replaced with a new 60MVA Grid Transformer (the increased rating is to standardise all transformers on site and to increase the available capacity to allow for future load growth). The remaining three transformers on site will be changed under a reinforcement project (linked to the 33kV network and covered in the corresponding RDP).

7872 – Leicester Square – Provision to Replace Grid Transformers (GT1, GT2, GT3) (2020 – 2023)

The condition assessment of the 1991 Peebles Grid Transformers with ATL AMD tap changers installed at Leicester Square 132/11kV substation 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 operational requirements;

therefore this project recommends their replacement. Completion of the project will see 3 Grid Transformers replaced with 3 new Grid Transformers.

7947 – Back Hill-Kingsway Street (Circuit 1A & Circuit 3A) - 33kV FFC Replacement (2015)

Completion of the project will see 1.26 km of 33kV fluid filled cable replaced.

7952 – St. John's Wood 132kV-Aberdeen Place B (Circuit 5A & Circuit 5B) - 132kV Fluid Filled Cable Replacement (2020 – 2021)

Completion of the project will see 0.306 km of 132kV fluid filled cable replaced.

4.2 Reinforcement

5824 – Old Brompton Road 132/11kV - ITC (replace 11kV tails) (2015)

The demand at Old Brompton Road is projected to exceed the site firm capacity by winter 2019/2020 due to the re-development of the Earls Court area which is currently not captured in the load growth forecast for this site (circa 7MVA of expected additional demand by 2016 increasing to 21MVA in ED2 according to the council's development plans). This scheme proposes the uprate of the 11kV tails, cable end boxes and transformer bushings on two of the three 60MVA 132/11/11kV units in order to facilitate utilisation of the cyclic rating of 78MVA per transformer. Moreover, following the commissioning of the new 11kV switchboard at Old Brompton Road, replacing the 11kV tails will remove the need for permanently maintaining joints in the cable basement; the latter raises operational and safety concerns.

This project will be optimised with the NLRE scheme of replacing the 11kV switchboard at Old Brompton Road (project 2941) which will minimise the necessary outages as well as the required mobilisation period.

8490 – Aberdeen Place B 132/11kV - ITC (add 1x30MVA) (2020 – 2022)

Aberdeen Place B is currently out of firm in summer and relies on 8MVA 11kV post-fault transfers to Aberdeen Place A for P2/6 compliance. Due to the demand increasing in the area, Aberdeen Place A substation will no longer be able to accept all the necessary transfers from Aberdeen Place B beyond 2022 which drives the phasing of this project. It is proposed to reinforce Aberdeen Place B to address any issues under (N-1) conditions at peak periods. The scope of this project covers the installation of a third 132/11kV transformer fed from St. John's Wood via a new 132kV underground circuit and a third single busbar section. The existing switchgear is fully rated for this increased load. The new underground circuit supplying the transformer will be rated to at least match the emergency rating of the new transformer.

Completion of this project will see an additional transformer and its associated underground feeder cable.

Table 12. Increased Transformer Capacity Summary

Substation	Commissioning Year	Scope of works	New Firm Capacity (W)
Old Brompton Road	2019	Uprate LV tails, cable end box and transformer bushings	157.3MVA
Aberdeen Place B	2015	Install additional 30MVA transformer	60MVA

Table 12 above provides a list of transformer reinforcement projects identified for implementation under this RDP.

Related Projects

2635 (New Cross RDP) – Shorts Gardens - Replant as 132/11kV Substation (3x33.3MVA) (2018 – 2021)

This scheme proposes to replant the existing 22/11kV Shorts Gardens substation as a 132/11kV substation. The scope of works includes installation of 3x33.3MVA 132/11kV transformers supplied from the Bankside F 132kV switchboard. Three new cables are to be installed in the existing Bankside-Kingsway-Shorts Gardens deep cable tunnel to supply the replanted Fisher Street substation (projects 5578 and 5582). Shorts Gardens will be teed off these circuits.

The additional transformer capacity is to be used to support local demand (Shorts Gardens is currently out of firm) and enable 11kV network reconfiguration to facilitate load transfers from adjacent heavily loaded substations such as Leicester Square (that supplies the top end of Whitehall) and Fisher Street.

5578 (New Cross RDP) – Fisher Street 132/11kV Reinforcement: ITC (ongoing project; 2011 – 2015)

A distribution voltage higher than 11kV is required in Central London to cater for large point load growth. The 33kV network is designed to be a highly resilient distribution network supplying point loads between 8-15MVA in the City of London for which 11kV capacity is either unavailable or impractical to connect to. The capacity created will facilitate the development of 3x33kV feeder groups installed in the square mile. Two of the feeders groups will run between Back Hill 33kV and Finsbury Market C 33kV substations. In order to release capacity at Back Hill, this scheme proposes the upgrade of Fisher Street 33/11kV to a 132/11kV substation for which a customer contribution will offset part of the cost. The replanted substation will be supplied from Bankside F via 3x132kV circuits in the existing Bankside-Shorts Gardens tunnel (project 5582). The 132kV switchboard at Bankside F has been extended (project 5581).

Completion of this project will see 3x33.3MVA 132/11kV transformers commissioned at Fisher Street that will be specified with a 130% summer cyclic rating. This will increase the firm capacity at Fisher Street by 41.6MVA which is currently LI5. The 11kV switchboard has been replaced as part of a customer funded scheme to avoid potential ground subsidence due to Cross Rail.

8435 (City Road RDP) – 11kV Load Transfers to Calshot Street MSS (2017 – 2018)

These are planned 11kV load transfers from City Rd B (NW group) to the new Calshot Street substation. The scope also includes the transfer of the Longford St E group to Calshot Street followed by the Back Hill N group transfer to Longford St. Post completion, both City Rd and Back Hill will be within compliance and will have available capacity and 11kV panels to connect future load.

4.3 Costs and Phasing

Table 13. Proposed ED1 Projects (19th February 2014 NAMP; 2013-2023)

Cat.	Reference	Description	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
A	1.48.01.7778	Back Hill 132kV - Replace 132kV Switchgear	0	0	0	184,556	409,514	0	0	0	0	0
A	1.50.01.7796	Aberdeen Place A 11kV - Replace 11kV Switchgear	0	0	0	0	0	0	0	275,173	945,413	709,060
A	1.50.01.7800	Kingsway 11kV - Replace 11kV Switchgear	0	0	0	0	0	0	0	275,173	945,413	709,060
A	1.51.01.7854	Back Hill 33kV - Replace Grid Transformers (GT4B)	0	0	0	0	419,075	1,022,374	0	0	0	0
A	1.51.01.7872	Leicester Square - Provision to Replace Grid Transformers (GT1, GT2, GT3)	0	0	0	0	0	0	0	101,184	4,087,627	2,043,811
H	1.29.01.7947	Backhill-Kingsway St (Circuit 1A & Circuit 3A) - 33kV FFC Replacement	0	0	448,581	0	0	0	0	0	0	0
H	1.29.02.7952	St Johns Wood 132kV-Aberdeen Place-B (Circuit 5A & Circuit 5B) - 132kV Fluid Filled Cable Replacement	0	0	0	0	0	0	0	142,318	273,893	0
R	1.35.01.5824	Old Brompton Road 132/11kV - ITC (replace 11kV tails)	0	0	325,302	0	0	0	0	0	0	0
R	1.35.01.8490	Aberdeen Place B 132/11kV - ITC (add 1x30MVA)	0	0	0	0	0	0	0	392,897	611,173	305,586

4.4 HI / LI Improvement

Projected Asset Health Indices (With Investment)

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

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 (33kV), 66kV&132kV circuit breakers, primary transformers (33/11/6.6kV), grid transformers (132/33/11kV) and underground cables (33kV and 132kV).

Table 14. HV Circuit Breakers

	2015					2023				
Substation	**No. HI1**	**No. HI2**	**No. HI3**	**No. HI4**	**No. HI5**	**No. HI1**	**No. HI2**	**No. HI3**	**No. HI4**	**No. HI5**
ABERDEEN PL B 11KV		15				2	15			
ABERDEEN PLACE A 11KV			13	15		28				
AMBERLEY RD B 11KV	52	1				52	1			
BACK HILL A 11KV		25	2				14	13		
DUKE ST B 11KV		56					56			
EBURY BRIDGE 11KV		60					60			
FISHER ST	27					12*	27			
KINGSWAY 11KV			13	14	1	28				
LEICESTER SQ 11KV		56					56			
LONGFORD ST B 11KV	39	23					62			
OLD BROMPTON RD 11KV	61					61				
SHORTS GDNS 11KV		24						24		

* Note: 12 new 11kV circuit breakers will be installed at Fisher Street as part of the ongoing 11kV switchboard extension scheme (project 5655).

Table 15. EHV Circuit Breakers

	2015					2023				
Substation	**No. HI1**	**No. HI2**	**No. HI3**	**No. HI4**	**No. HI5**	**No. HI1**	**No. HI2**	**No. HI3**	**No. HI4**	**No. HI5**
BACK HILL 33KV		8	12				1	19		
SHORTS GDNS 22KV			19					7	12	
ST JOHNS WOOD 22KV		7					7			

Table 16. 66 and 132kV Circuit Breakers

	2015					2023				
Substation	**No. HI1**	**No. HI2**	**No. HI3**	**No. HI4**	**No. HI5**	**No. HI1**	**No. HI2**	**No. HI3**	**No. HI4**	**No. HI5**
BACK HILL 132KV			3			3				
ST JOHNS WOOD 132KV		4	4							
ST JOHNS WOOD B 132KV	21					11	10			

Table 17. Primary Transformers

	2015	2023

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

Substation	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
FISHER ST		2	1	1						
KINGSWAY 11KV		2	2					3	1	
SHORTS GDNS 11KV		1	2				1	1	1	

Table 18. Grid Transformers

	2015					2023				
Substation	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5	No. HI1	No. HI2	No. HI3	No. HI4	No. HI5
ABERDEEN PLACE B 11KV		2				1	2			
ABERDEEN PLACE A 11KV		4						4		
AMBERLEY RD B 11KV	2					1	1			
BACK HILL 33KV		2	1	1		4*				
BACK HILL 11KV		2	2					3	1	
DUKE ST B 11KV			1	1	1				1	2
EBURY BRIDGE 11KV		3					3			
LEICESTER SQ 11KV					3	3				
LONGFORD ST B 11KV	1	2					3			
OLD BROMPTON RD 11KV		2	1			1		2		
ST JOHNS WOOD 22KV		2						2		

* Note: Three transformers at Back Hill 33kV will be replaced during the proposed 33kV network ITC project (6112), whilst one of them will be replaced under an HI driven project (7854).

Table 19. Fluid Filled Cables

Section (Route)	Cable Section	Voltage	HI in 2015	HI in 2023
BACK HILL 33KV-KINGSWAY 11KV	CABLE SECTION: 32040248-1-A	33	3	N/A*
BACK HILL 33KV-KINGSWAY 11KV	CABLE SECTION: 32040248-3-A	33	4	N/A*
BACK HILL 33KV-FISHER ST	CABLE SECTION: 32040227-1-A	33	3	3
ST. JOHNS WOOD 132KV-ABERDEEN PL B 11KV	CABLE SECTION: 33850302-5-A	132	5	N/A*
ST. JOHNS WOOD 132KV-OLD BROMPTON RD 11KV	CABLE SECTION: 33850173-2-C	132	3	4
ST. JOHNS WOOD 132KV-OLD BROMPTON RD 11KV	CABLE SECTION: 33850173-3-A	132	3	4
ST. JOHNS WOOD 132KV-ABERDEEN PL B 11KV	CABLE SECTION: 33850302-5-B	132	3	3
BACK HILL 33KV-FISHER ST	CABLE SECTION: 32040227-2-A	33	2	N/A*
BACK HILL 33KV-FISHER ST	CABLE SECTION: 32040227-3-A	33	2	N/A*
BACK HILL 33KV-FISHER ST	CABLE SECTION: 32040227-4-A	33	2	N/A*
BACK HILL 33KV-FISHER ST	CABLE SECTION: 32040227-B-A	33	2	N/A*
BACK HILL 33KV-KINGSWAY 11KV	CABLE SECTION: 32040248-2-A	33	2	2

BACK HILL 33KV-KINGSWAY 11KV	CABLE SECTION: 32040248-4-A	33	2	2
ST. JOHNS WOOD 132KV-BACK HILL 33KV	CABLE SECTION: 33853204-1-A	132	2	3
ST. JOHNS WOOD 132KV-BACK HILL 33KV	CABLE SECTION: 33853204-1-B	132	2	2
ST. JOHNS WOOD 132KV-BACK HILL 33KV	CABLE SECTION: 33853204-2-A	132	2	2
ST. JOHNS WOOD 132KV-OLD BROMPTON RD 11KV	CABLE SECTION: 33850173-2-A	132	2	3
ST. JOHNS WOOD 132KV-OLD BROMPTON RD 11KV	CABLE SECTION: 33850173-2-B	132	2	3
ST. JOHNS WOOD 132KV-OLD BROMPTON RD 11KV	CABLE SECTION: 33850173-3-B	132	2	3
ST. JOHNS WOOD 132KV-OLD BROMPTON RD 11KV	CABLE SECTION: 33850173-3-C	132	2	3

* Notes: 1) As aforementioned, three FFC sections will be asset replaced with solid cables within ED1 (there are no HI's for solid cables); 2) The four Back Hill-Fisher Street 33kV FFC's will be decommissioned as part of the upgrade of Fisher Street to a 132/11kV substation (project 5578; covered in the New Cross RDP).

Projected Load Indices (With Investment)

Table 20. Projected Load Indices (With Investment)

Substation	Voltage kV	2023 Load Index	
		Without Investment	With Investment
Aberdeen Place A	132/11	2.00	2.00
Aberdeen Place B	132/11	5.00	1.00
Back Hill	132/11	5.00	1.00
Back Hill 33kV	132/33	5.00	1.00
Duke Street	132/11	4.00	4.00
Ebury Bridge	132/11	2.00	1.00
Fisher Street	33/11	5.00	N/A*
Kingsway	33/11	1.00	1.00
Leicester Square	132/11	5.00	2.00
Longford Street	132/11	4.00	4.00
Old Brompton Road	132/11	3.00	1.00
Shorts Gardens	22/11	5.00	N/A*
St. John's Wood 22kV	132/22	1.00	1.00
Amberley Road 11kV	132/11	1.00	1.00

* Note: Fisher Street and Shorts Gardens Substations will be replanted at 132kV within ED1. These projects (5578 and 2635 respectively) are detailed in the New Cross RDP.

5 Rejected Alternatives

5.1 Transformer Cooling Enhancement

This strategy is rejected because the benefits from transformer cooling enhancement are insufficient to provide a long lasting solution to most of the sites affected with firm capacity and loading issues.

5.2 11kV Load Transfers To Adjacent Substations

Use of existing 11kV interconnections or developing new interconnections to permanently transfer part load to adjacent substations is rejected as a permanent solution because most Central London substations are currently heavily loaded, which requires a long lasting solution to reinforce the whole network. However, transfers from Back Hill 11kV to the proposed new substation at Fisher Street is the preferred option, since new capacity is being created at Fisher Street substation while the new capacity headroom created at Back Hill will be used to accommodate new connections as part of the City of London network reinforcement.

6 References

References	Description
Reference 1	Planning Load Estimates LPN Area - 2011 – 2023 (13 Feb 2013, Element Energy)
Reference 2	Primary Distribution Systems Standard Running Arrangements 2012 Overview Diagrams
Reference 3	NAMP LPN Table J Less Ind. 19th February 2014
Reference 4	Asset Condition Reports June 2013

6.1 Appendices

Appendix	Description
Appendix A	Geographical diagram
Appendix B	Single Line Diagram – Existing Network
Appendix C	Single Line Diagram – Recommended Strategy

6.2 Document History

Version	Date of Issue	Author	Details
1.0	June 2013	Itayi Utah / Sophie Motte	ED1 Plan Initial Submission
2.0	March 2014	Panagiotis Xenos	ED1 Plan Resubmission
2.1	March 2014	Panagiotis Xenos	Final Amendments for ED1 Plan Resubmission

7 Document Sign Off

Sign-off of this Mandate certifies that the Sponsor has ratified the above and approval is sought to proceed to the development of the necessary PG&C Gate B documentation.

Recommended by:

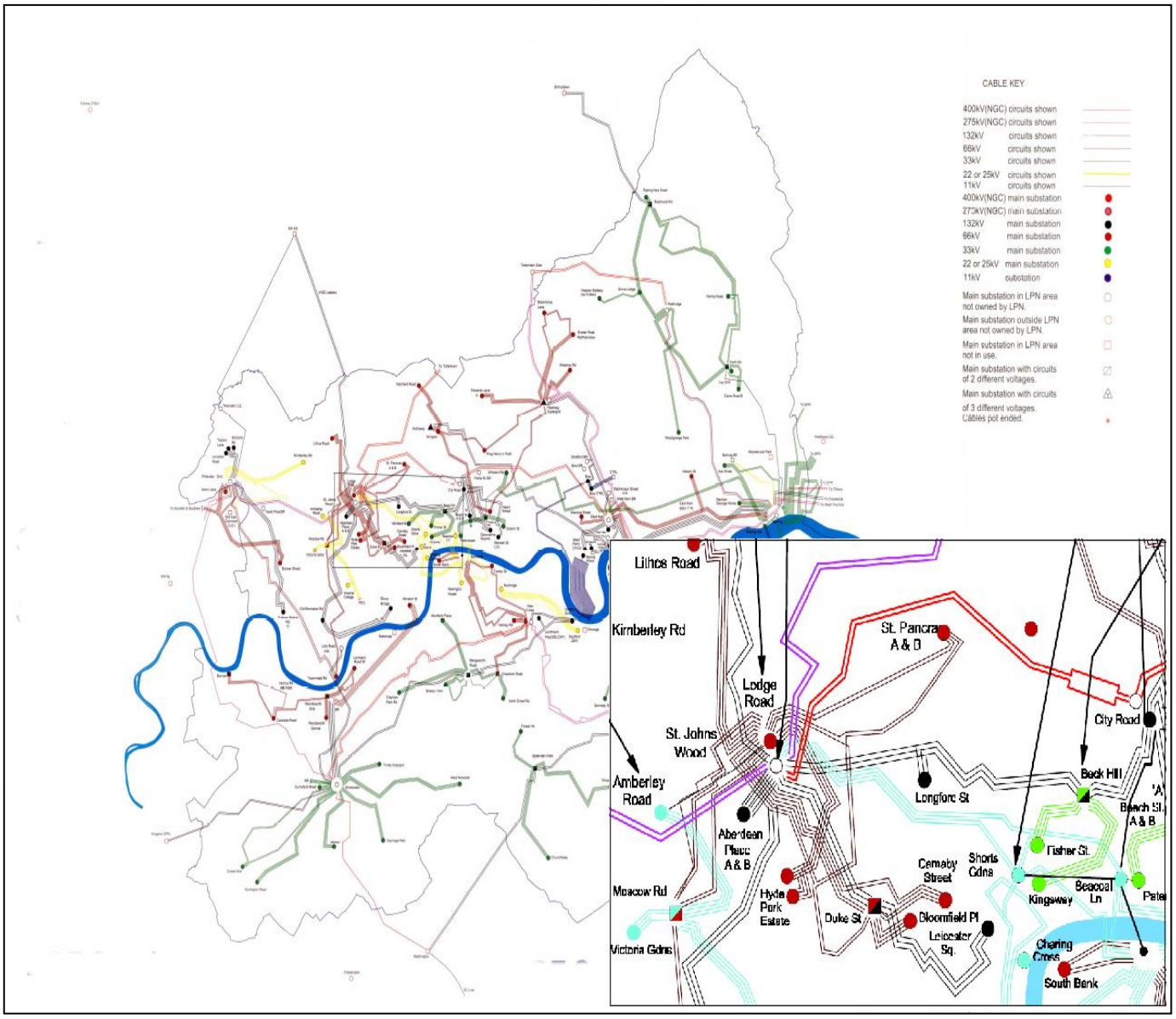
Name	Role	Signature	Date
Panagiotis Xenos	Infrastructure Planner		
Sophie Motte	IDP Coordinator (EPN/LPN/SPN)		
Chris Winch	Planning Manager (North/South)		

Approval by:

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

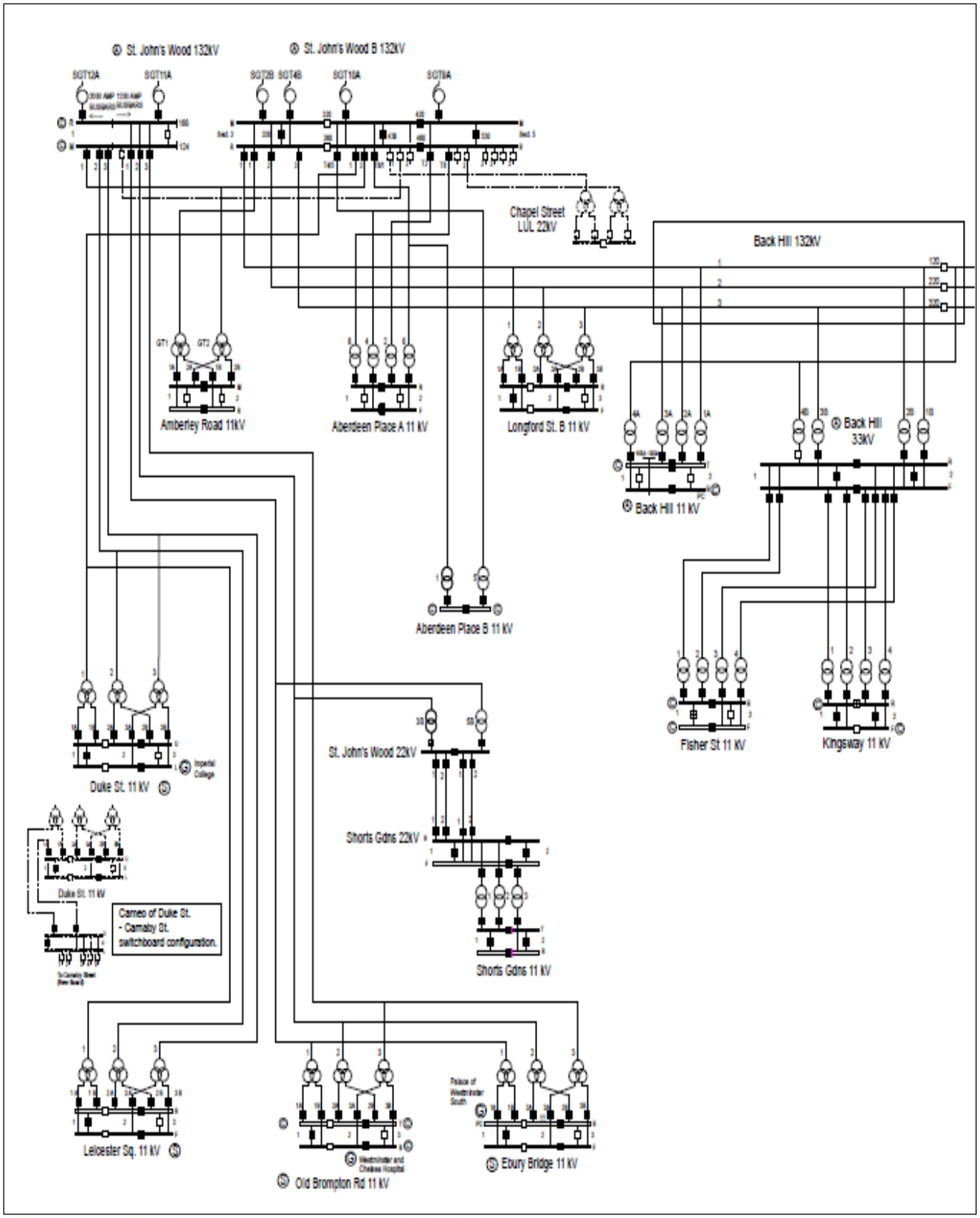
Appendix A: Geographical Diagram

Figure 8 – Geographical Diagram



Appendix B: Single Line Diagram – Existing Network

Figure 9 – Existing Network Diagram



Appendix C: Single Line Diagram – Recommended Strategy

Figure 10 – Recommended Network Changes

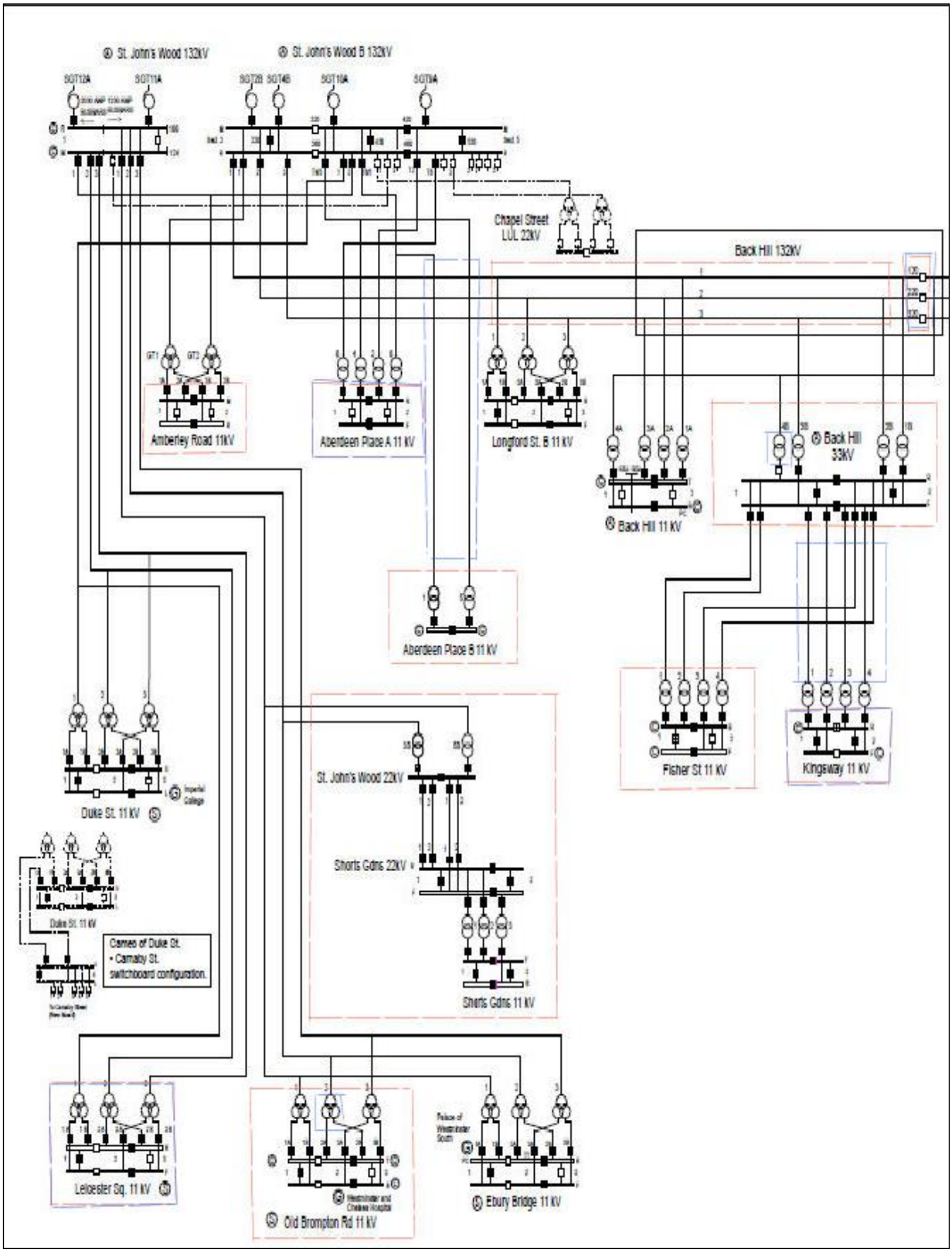


Figure 10 above illustrates proposed network investments marked in red and blue depicting reinforcement works and asset health driven works respectively.