Network Development Report

East Midlands

April 2022

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Introduction

The Network Development Reports cover targeted areas of the extra high voltage (EHV) and 132 kV distribution networks where developments are expected on the 0-10 year window. For information on the methodology used to undertake the studies and how stakeholder feedback is taken into account, please refer to the Network Development Plan Methodology Report. Each section follows a consistent format, as outlined below.

Network Overview

A summary of the network area studied. This includes geographic area, load composition and schematic diagrams of the area of network supplied.

Network Operability Modelling

As part of the network analysis, actions undertaken by network automation schemes and manual switching schemes are modelled. This ensures that following any outage combination which could occur, the subsequent topology of the network most closely represents how the distribution network is operated in real time. The network operability actions are written as a series of Python scripts, and triggered as part of the load flow routine either as a pre-emptive action (i.e. prior to load flow calculation) or as a remedial action (i.e. post load flow calculation).

This section summarises the network automation and manual switching schemes that are modelled.

Network constraint summary

Constraints identified on the area of network in focus are summarised in a concise way. Where a Bulk Supply Point or Grid Supply Point group is studied as a whole, each constraint within the group is captured as part of the same network group.

Constraint summary

Table which includes information about the nature of the constraint, including:

- **Constrained assets -** for the area in focus, this encompasses multiple parts of the network which are affected by the same underlying outage conditions. This could be summarised for multiple sections of a circuit or transformers operating as part of a group.
- **Type of constraint -** this could include thermal overloading of assets, voltages outside of statutory limits or demand disconnected for security of supply assessment;
- **Constrained condition** - prevailing load conditions whereby the constraint occurs, relating to the representative study periods which WPD cover in the Network Development Plan;
- **Limiting factor of constrained assets** – the rating of the asset which triggers the constraint; and
- **Outage combination which causes the constraint –** the combination of intact, first or second circuit outages that trigger the constraint. In areas of network with complex running arrangements the most critical outage combination is not evident, which necessitates the analysis methodology as outlined in the NDP Methodology Report.

Scenario identification

A table to outline the trigger years for constraints on the network area studied. This captures the earliest year that a network investment decision needs to be taken.

Solution options

A summary of the solutions which have been considered to alleviate the projected constraint. These are modelled for their technical suitability and are summarised in a table under the following categories:

- Reinforcement, covering new-build solutions to increase the capacity of the network in focus. This could include new assets or the removal of ancillary rating limitations on existing assets. In addition, the Network Development Plan analysis can highlight where additional substations could be established as an alternative solution for load growth as a more coordinated solution.
- Operational mitigation covers actions which WPD can take to mitigate constraints without the requirement for additional network capacity. This could include proposals to change running arrangements or limit access windows where arranged outages can be taken.
- Load Management Schemes cover plant, equipment and software systems that together manage network loading and voltages. This is achieved by either controlling demand and/or generation connected to the network, operating switchgear to change the topology of the network and/or controlling the settings of tap-change controllers, reactive compensation equipment and flexible power links. Load management schemes can be utilised to manage both demand and generation driven constraints, however this is dependent on the technical/contractual ability for customers to accept curtailment.
- Flexibility covers actions by network users (through contracts with the DNO) to reduce network loading for a given condition by increasing, reducing or shifting their net import or export.

Not all solution options are mutually exclusive to one another, a combination of different solutions can be utilised to undertake low regret investment. The appraisal of different solution options allows for a more coordinated assessment of future network developments to accommodate scenario projections.

Further optioneering will be carried out for all schemes, including a full cost benefit analysis using the Common Evaluation Methodology (CEM) tool as part of the Distribution Network Options Assessment (DNOA) process to assess the use of flexibility against conventional reinforcement (where flexibility is deemed a viable option). These decisions will be published in the next iteration of the DNOA.

Warwick BSP and Harbury BSP

Network Overview

Berkswell Grid Supply Point (GSP) is a substation in WPD's East Midlands licence area which supplies load to five Bulk Supply Points (BSPs). It is supplied via three 275/132 kV 240 MVA Super Grid Transformers (SGTs), supplying a 132 kV double busbar. A fourth 240 MVA SGT and additional bus coupler is due to be commissioned in September 2022. This will result in each busbar being supplied by two SGTs.

Warwick and Harbury are two of the BSPs fed from Berkswell GSP. Warwick BSP is fed directly from Berkswell GSP via two 132 kV circuits known as the CX-route. Harbury BSP is fed from Berkswell GSP via two 132 kV circuits (the DK-route) to Warwick BSP.

Under a Second Circuit Outage (SCO) condition for the loss of both 132 kV circuits from Berkswell GSP to Warwick BSP around 40 MVA of demand can be restored to the Warwick-Harbury group.

Figure 1 Warwick BSP and Harbury BSP geographic network coverage

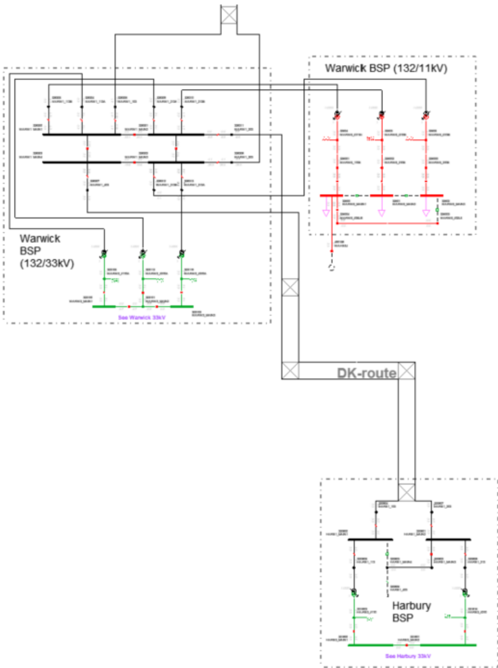

Figure 2 Warwick BSP and Harbury BSP 132 kV network schematic

Constraint summary

Generation Demand

The table below outlines the nature of the second circuit outage constraint for the Warwick-Harbury group identified in the network analysis.

Constrained assets	Warwick/Harbury BSP group	
Type(s) of constraint	Demand security of supply	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Demand	
Limiting factor of constrained assets	40 MW transfer capacity to neighbouring 33 kV networks	
Outage combination which causes the constraint	Second Circuit Outage	An arranged outage of one of the Berkswell – Warwick 132 kV circuits, followed by a fault outage of the remaining circuit

Scenario identification

The table below highlights when the 40 MW transfer becomes insufficient to meet the group's Engineering Recommendation P2/7 obligations for restoration of supply following a second circuit outage during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation			✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View			✓	✓

Solution options

The following solution options could resolve the constraint described above. Any final solution will be subject to a cost benefit analysis.

Solution option	**Summary**
Reinforcement	Construct a 132 kV circuit between Harbury BSP and Banbury BSP to support the group under SCO conditions. This would alleviate the constraint and ensure continued P2/7 compliance and has the added benefit of supporting the Banbury-Brackley group.
Operational mitigation	For the second circuit outage constraint, load transfers out of the group are available during the arranged outage. These load transfers are not sufficient to manage the constraint in the long term as outlined above.
Load Management Schemes	Very limited due to the potential Engineering Recommendation P2/7 non-compliance for a Class D group demand.
Flexibility services	Generation turn up and/or demand turn down via the 'Dynamic' product.

Alfreton BSP

Network Overview

Wessington, Ambergate and Ravensdale Park are a group of Primary substations fed from Alfreton BSP via two 33 kV circuits. The two 33 kV circuits are made up of various overhead and underground sections with different ratings. Two customers are connected on the 33 kV network off Ravensdale Park Primary.

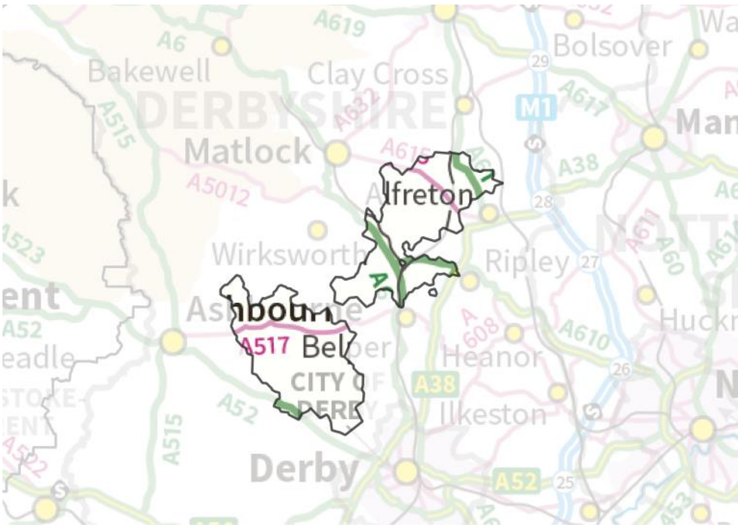

Figure 3 Wessington Primary, Ambergate Primary and Ravensdale Park Primary geographic network coverage

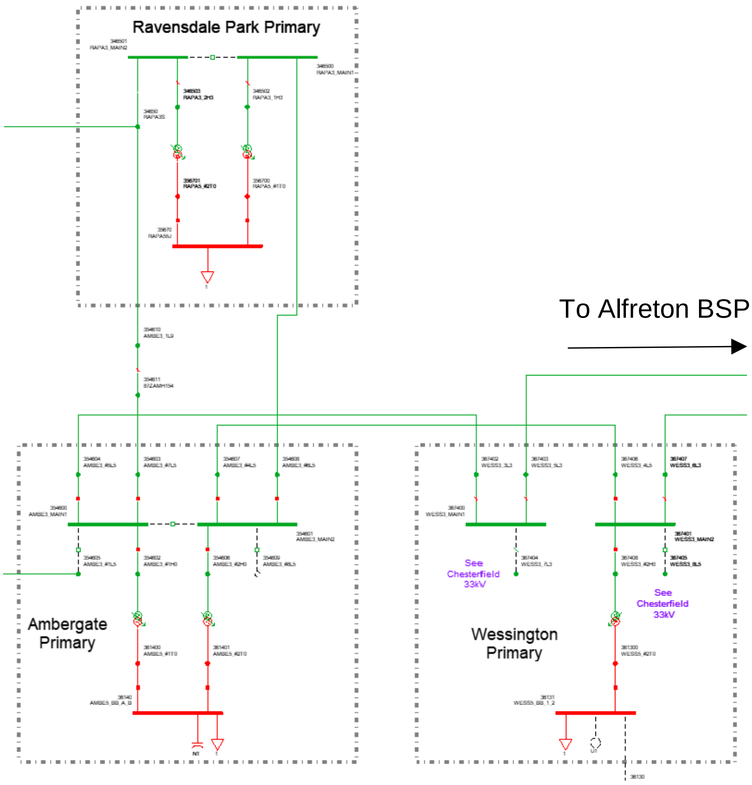

Figure 4 Wessington Primary, Ambergate Primary and Ravensdale Park Primary 33 kV network schematic

Constraint summary

The table below outlines the nature of the network constraint on the 33 kV circuits between Wessington, Ambergate and Ravensdale Park Primaries identified in the network analysis.

Constrained assets	33 kV circuits from Alfreton BSP to Wessington, Ambergate and Ravensdale Park	
Type(s) of constraint	Thermal overload and voltages outside of statutory limits	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Demand	
Limiting factor of constrained assets	Rating of 33 kV circuits and voltage regulation	
Outage combination which causes the constraint	First Circuit Outage	Arranged or fault outage on either 33 kV circuit

Scenario identification

The table below highlights when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

Scenario	**Study year**			
	Baseline	**2025**	**2028**	**2032**
Steady Progression			✓	✓
System Transformation			✓	✓
Consumer Transformation			✓	✓
Leading the Way		✓	✓	✓
WPD Best View			✓	✓

Solution options

The following solution options could resolve the constraint described above. Any final solution will be subject to a cost benefit analysis.

Solution option	**Summary**
Reinforcement	Overlay/reconductor the restrictively rated sections of the 33 kV circuits between Alfreton BSP & Wessington, Ambergate and Ravensdale Park Primaries.
Operational mitigation	Very limited due to the First Circuit Outage constraint and the potential Engineering Recommendation P2/7 non-compliance for a Class C group demand.
Load Management Schemes	Very limited due to the potential Engineering Recommendation P2/7 non-compliance for a Class C group demand.
Flexibility services	Generation turn up and/or demand turn down via the ‘Secure’ product. Dispatch of services may be required for an extended period of time given the constraint is present under a First Circuit Outage and across multiple seasons.

Grassmoor Primary

Network Overview

Grassmoor Primary is a 33/11 kV substation connected via two 33 kV circuits from Chesterfield BSP within the Chesterfield GSP group. It consists of two transformers, each rated 12/24 MVA.

The site runs closed at 11 kV and each transformer supplies the entire site demand following a fault or arranged outage on the other.

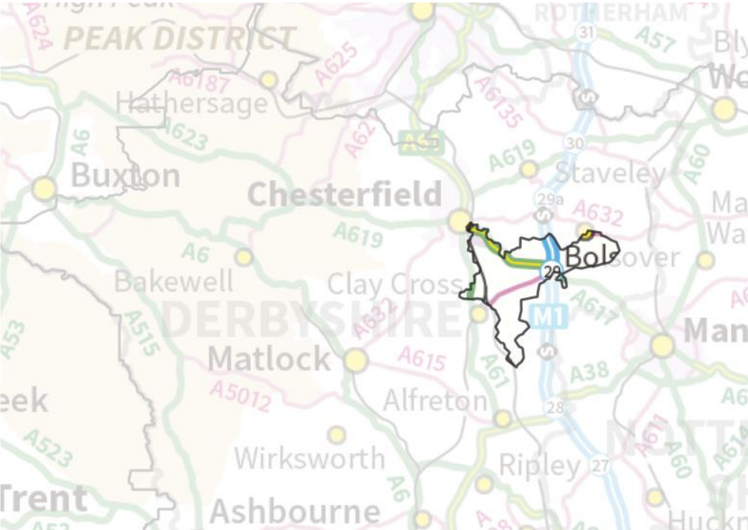

Figure 5 Grassmoor Primary geographic network coverage

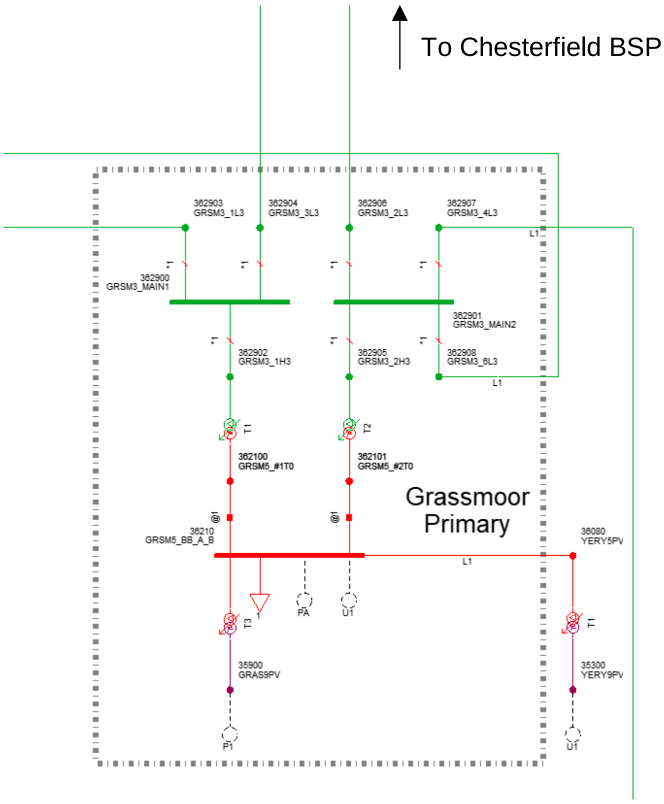

Figure 6 Grassmoor Primary 33 kV network schematic

Constraint summary

The table below outlines the nature of the network constraints at Grassmoor Primary identified in the network analysis.

Constrained assets	Grassmoor 33/11 kV transformers & incoming 33 kV circuits from Chesterfield BSP	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	12/24 MVA rating of the 33/11 kV transformers	
Outage combination which causes the constraint	First Circuit Outage	Arranged or fault outage on either 33/11 kV transformer or 33 kV incoming circuit

Scenario identification

The table below highlights when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation			✓	✓
Consumer Transformation			✓	✓
Leading the Way		✓	✓	✓
WPD Best View			✓	✓

Solution options

The following solution options could resolve the constraint described above. Any final solution will be subject to a cost benefit analysis.

Solution option	Summary
Reinforcement	Replace both transformers with 20/40 MVA units and install two new circuits from Chesterfield BSP. These new 33 kV circuits would feed Grassmoor Primary and Wingerworth Primary, with the existing circuits being used to feed Biwater and Danesmoor Primaries. This has the added benefit of freeing up capacity at Biwater and Danesmoor Primaries.
Operational mitigation	Very limited due to the First Circuit Outage constraint and the potential Engineering Recommendation P2/7 non-compliance for a Class C group demand.
Load Management Schemes	Very limited due to the potential Engineering Recommendation P2/7 non-compliance for a Class C group demand.
Flexibility services	Generation turn up and/or demand turn down via the ‘Secure’ product. Dispatch of services may be required for an extended period of time given the constraint is present under a First Circuit Outage and across multiple seasons.

Holme Carr Primary

Holme Carr Overview

Holme Carr Primary is a 33/11 kV substation connected via two 33 kV circuits from Whitwell BSP within the Chesterfield GSP group. It consists of two transformers, each rated 10 MVA.

The site runs closed at 11 kV and each transformer supplies the entire site demand following a fault or arranged outage on the other.

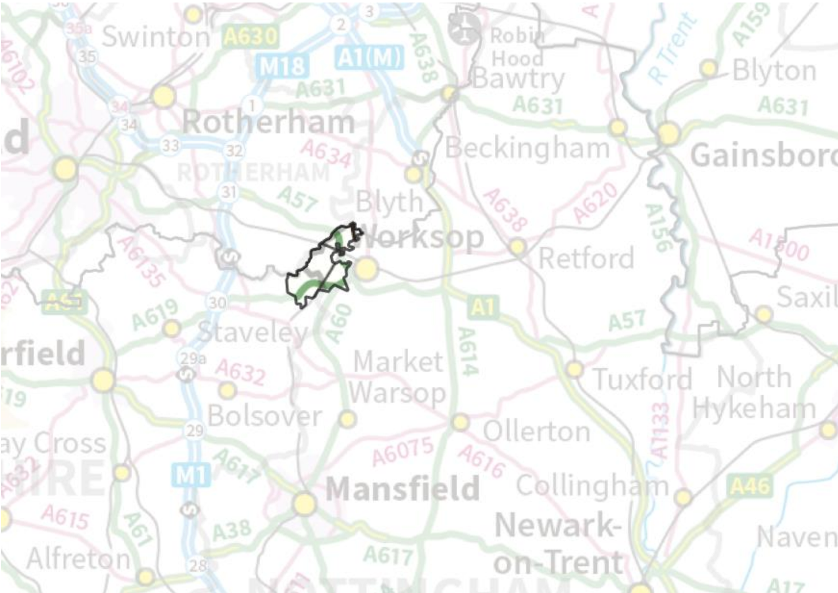

Figure 7 Holme Carr Primary geographic network coverage

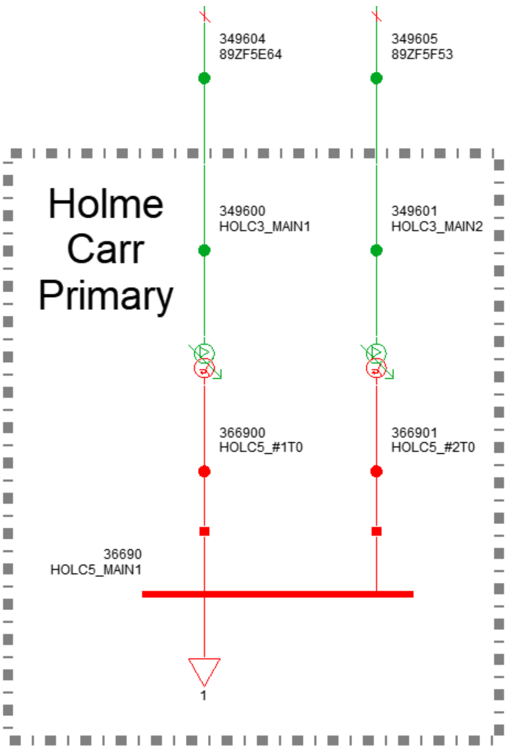

Figure 8 Holme Carr Primary 33 kV network schematic

Constraint summary

The table below outlines the nature of the network constraints at Holme Carr Primary identified in the network analysis.

Constrained assets	Holme Carr 33/11 kV transformers	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Demand	
Limiting factor of constrained assets	10 MVA rating of the 33/11 kV transformers	
Outage combination which causes the constraint	First Circuit Outage	Arranged or fault outage on either 33/11 kV transformer or 33 kV infeed

Scenario identification

The table below highlights when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation			✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

The following solution options could resolve the constraint described above. Any final solution will be subject to a cost benefit analysis.

Solution option	Summary
Reinforcement	Replace both transformers with 20/40 MVA units. This would alleviate the constraint and provide headroom for future load growth in the area.
Operational mitigation	Very limited due to the First Circuit Outage constraint and the potential Engineering Recommendation P2/7 non-compliance for a Class C group demand.
Load Management Schemes	Very limited due to the potential Engineering Recommendation P2/7 non-compliance for a Class C group demand.
Flexibility services	Generation turn up and/or demand turn down via the ‘Secure’ product. Dispatch of services may be required for an extended period of time given the constraint is present under a First Circuit Outage and across multiple seasons.

Wingerworth Primary

Network Overview

Wingerworth Primary is a single 33/11 kV transformer site fed via a 33 kV circuit from Goitside BSP via Walton Primary. There is 33 kV interconnection to Chesterfield BSP via Grassmoor Primary which is normally run open.

The site relies on 11 kV interconnections for the loss of supply to its transformer, which is a 6/12 MVA unit.

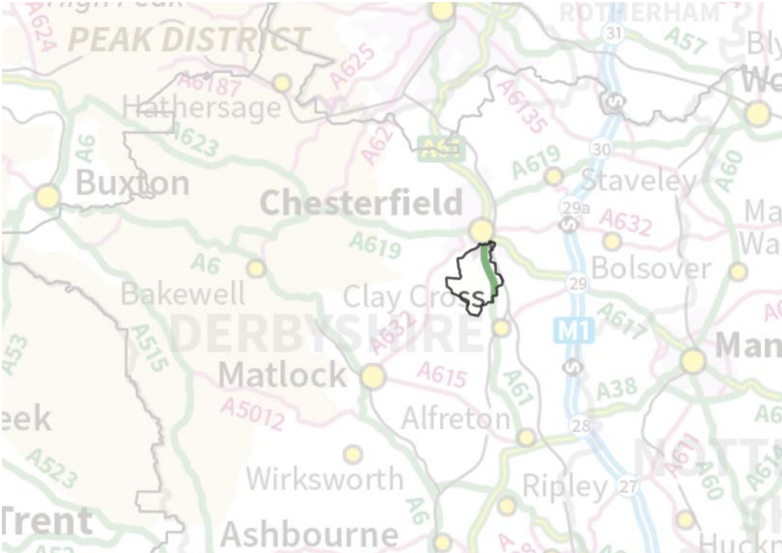

Figure 9 Wingerworth Primary geographic network coverage

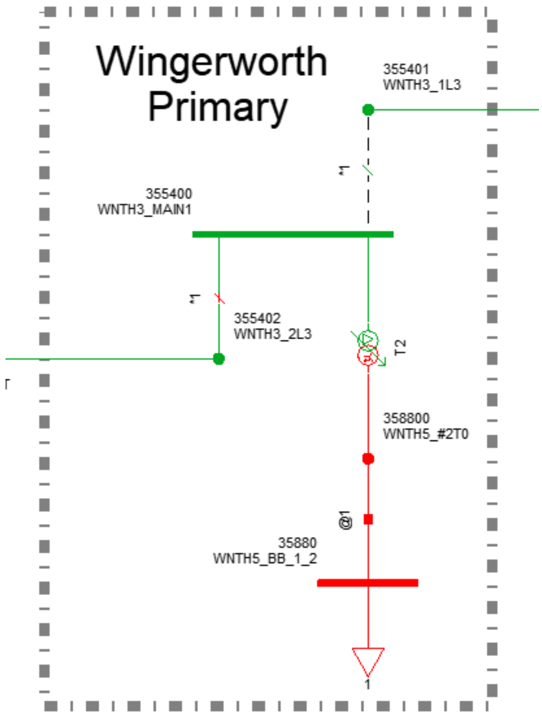

Figure 10 Wingerworth Primary 33 kV network schematic

Constraint summary

The table below outlines the nature of the network constraints at Wingerworth Primary identified in the network analysis.

Constrained assets	11 kV interconnections between Wingerworth and neighbouring Primaries	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	Rating of the 11 kV interconnecting circuits	
Outage combination which causes the constraint	First Circuit Outage	Arranged or fault outage on the 33/11 kV transformer or 33 kV incoming circuit

Scenario identification

The table below highlights when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

The following solution options could resolve the constraint described above. Any final solution will be subject to a cost benefit analysis.

Solution option	**Summary**
Reinforcement	Replace the existing transformer with a 12/24 MVA unit, install a second transformer also rated to 12/24 MVA and install a second 33 kV circuit from Grassmoor Primary to feed the new transformer. This will move Wingerworth Primary from Goitside BSP into Chesterfield BSP, which will benefit Goitside BSP which has lower headroom than Chesterfield BSP.
Operational mitigation	Very limited due to the First Circuit Outage constraint and the potential Engineering Recommendation P2/7 non-compliance for a Class B group demand.
Load Management Schemes	Very limited due to the potential Engineering Recommendation P2/7 non-compliance for a Class B group demand.
Flexibility services	Generation turn up and/or demand turn down via the 'Secure' product.

Bugbrooke Primary

Network Overview

Bugbrooke Primary is a 33/11 kV substation fed directly from Northampton West BSP via a single 33 kV circuit. The site has one 33/11 kV transformer rated at 12 MVA. The site also has a 33 kV interconnector to Banbury Lane Primary.

Under an FCO condition for the loss of the transformer at Bugbrooke Primary, the group is back fed on the 11 kV network via Weedon Primary. The firm capacity of the site is therefore limited by the 11 kV back feed capacity to approximately 8 MVA.

Figure 11 Bugbrooke Primary geographic network coverage

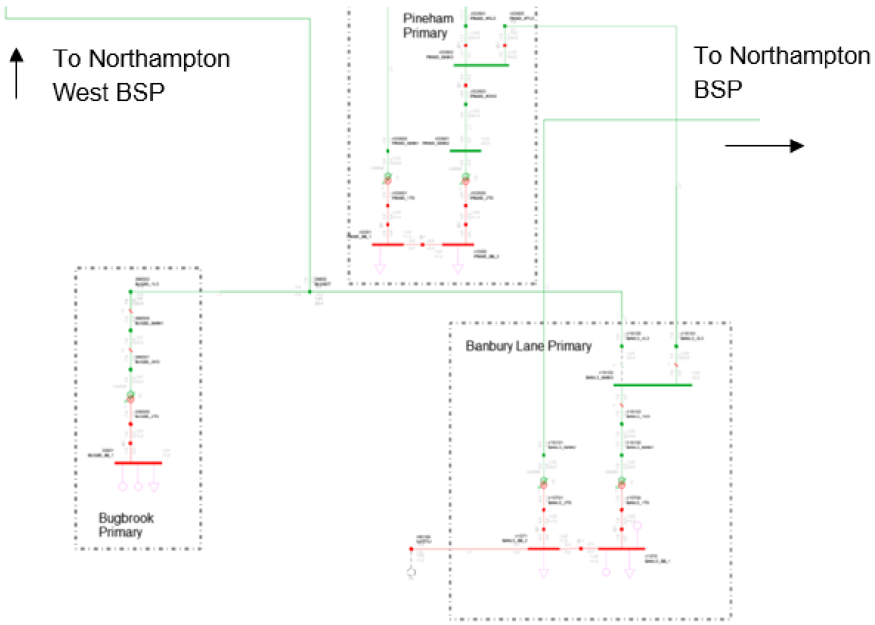

Figure 12 Bugbrooke Primary 33 kV network schematic

Constraint summary

Generation | Demand

The table below outlines the nature of the network constraint at Bugbrooke Primary identified in the network analysis.

Constrained assets	11 kV interconnections between Bugbrooke Primary and Weedon Primary	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	11 kV interconnecting circuits to neighbouring Primary substations	
Outage combination which causes the constraint	First Circuit Outage	Arranged or fault outage of the 33/11 kV transformer at Bugbrooke

Scenario identification

The table below highlights when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

The following solution options could resolve the constraint described above. Any final solution will be subject to a cost benefit analysis.

Solution option	**Summary**
Reinforcement	Install a second 33/11 kV transformer at Bugbrooke Primary, along with a new 33 kV circuit to the Bugbrooke tee. The normally open 33 kV interconnecting circuit to Banbury Lane could then be used to feed the new transformer. This would mean that for an outage on one of the transformers at Bugbrooke Primary the load could be supplied by the remaining transformer, without relying on back feeds at 11 kV to Weedon Primary, alleviating the constraint.
Operational mitigation	Load could be moved on the 11 kV network to other Primaries in the area under outage conditions. To fully assess the viability of this option a more in depth study looking at the 11 kV network is required.
Load Management Schemes	Very limited due to the potential Engineering Recommendation P2/7 non-compliance for a Class B group demand.
Flexibility services	Generation turn up / demand turn down flexibility contracts could benefit this area and defer conventional reinforcement in the short-medium term, but this will become less effective and economical as the demand grows in the area.

Ellesmere Avenue Primary

Network Overview

Ellesmere Avenue Primary is a 33/11 kV substation fed from Northampton West BSP via two 33 kV cable circuits. The two 33/11 kV transformers at Ellesmere Avenue are 12/19/24 MVA units.

Under a FCO condition for the loss of one of the transformers at Ellesmere Avenue Primary the remaining transformer in service supplies the entire site demand. The firm capacity of the site is therefore limited by the rating of one of the transformers.

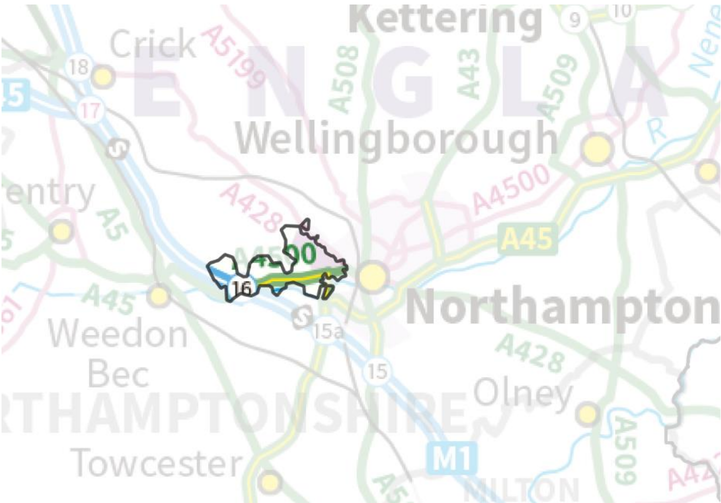

Figure 13 Ellesmere Avenue Primary geographic network coverage

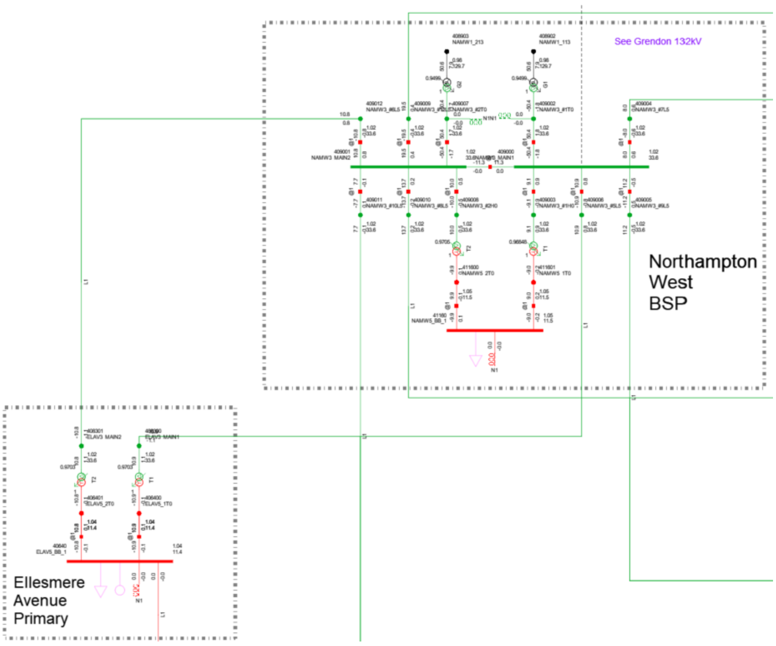

Figure 14 Ellesmere Avenue Primary 33 kV network schematic

Constraint summary

Generation | Demand

The table below outlines the nature of the network constraint on the transformers at Ellesmere Avenue Primary identified in the network analysis. In 2025 the constraint only occurs under an arranged outage (for WPD Best View and Leading the Way). By 2028 the constraint is also an issue for fault conditions. The constraint only occurs in 2032 for Steady Progression (arranged outages at intermediate warm peak only) and System Transformation (arranged at intermediate warm peak and winter peak and fault outages at winter peak).

Constrained assets	Ellesmere Avenue 33/11 kV transformers	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand (from 2028 onwards in BV and LW) Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Rating of the 33/11 kV transformers and 33 kV circuits	
Outage combination which causes the constraint	First Circuit Outage	Outage on either 33/11 kV transformer, either feeder circuit or either busbar at Northampton West BSP

Scenario identification

The table below highlights when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				✓
System Transformation				✓
Consumer Transformation			✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

The following solution options could resolve the constraint described above. Any final solution will be subject to a cost benefit analysis.

Solution option	Summary
Reinforcement	Replace the existing transformers with 20/40 MVA units. To release significant capacity the 33 kV circuits from Northampton West BSP would also need to be uprated. This would alleviate the constraint and provide ample headroom for future load growth in the area.
Operational mitigation	This constraint could be managed by restricting arranged outages to the summer period, but this is not an enduring solution as the constraint is an issue for fault conditions by 2028 under some scenarios as described above.
Load Management Schemes	Any additional connections into this group may be included in an Active Network Management (ANM) scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up / demand turn down flexibility contracts could benefit this area and defer conventional reinforcement in the short-medium term, but this will become less effective and economical as the demand grows in the area.

Northampton Group 132 kV

Network Overview

The Northampton Group is made up of three BSPs, all of which are fed from Grendon GSP. The three BSPs are Northampton, Northampton East and Northampton West. Each of the three BSPs in the Northampton Group has two Grid Transformers, all of which are rated to 45/90/117 MVA.

There are three 132 kV circuits into the Northampton Group (all from Grendon GSP). Two of these are a dual overhead line circuit called the CK-route which feeds Northampton BSP. The other 132 kV circuit into the group is from Grendon GSP to Northampton East BSP, which is known as the DL-route. There is also a 132 kV circuit connecting Northampton BSP and Northampton East BSP. Northampton West BSP is fed via two 132 kV circuits from Northampton BSP.

For the loss of a Grid Transformer at any of the BSPs the remaining transformer at that BSP picks up the remaining load of the BSP. For an arranged outage on one of the CK-route circuits Northampton East BSP is split from the other two BSPs to prevent overloads under the most onerous next outage (the loss of the other CK-route circuit). For an arranged outage on the DL-route circuit the group can be split and various 33 kV transfers made to reduce the risk of overloads for the next credible outage.

Figure 15 Northampton Group geographic network coverage

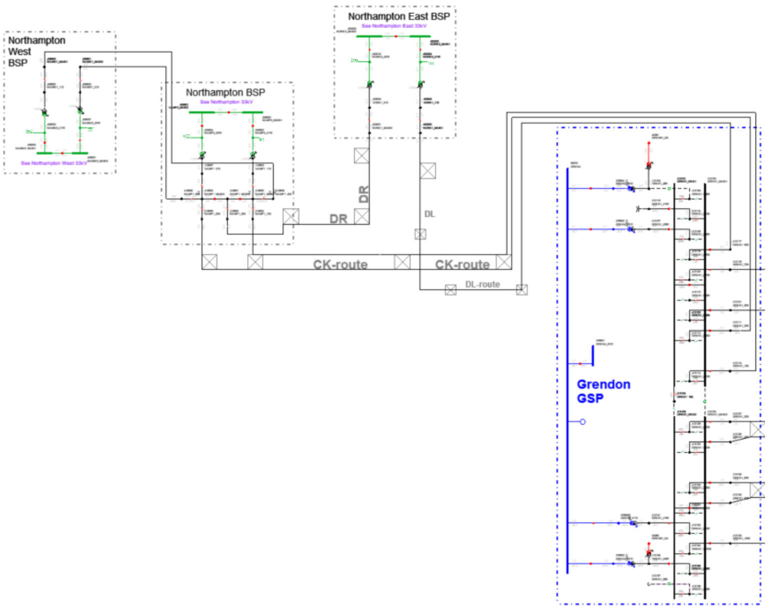

Figure 16 Northampton Group 132 kV network schematic

Northampton East 132/33 kV Grid Transformer Capacity

Constraint summary

Generation | **Demand**

The table below outlines the nature of the network constraint on the Grid Transformers at Northampton East BSP identified in the network analysis. In 2025 the constraint is only an issue under arranged outages, but from 2028 under Best View, Consumer Transformation and Leading the Way and from 2032 under System Transformation becomes an issue under fault outages. The two 132 kV feeder circuits have similar ratings to the two Grid Transformers, and are thus constrained in the same years, scenarios and seasons as the two Grid Transformers.

Constrained assets	132/33 kV transformers and 132 kV feeder circuits at Northampton East BSP	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand (from 2025 in BV/ST/CT/LTW and 2028 in SP) Intermediate Warm Peak Demand (from 2025 in BV/ST/CT/LTW and 2028 in SP) Summer Peak Demand (from 2028 in BV/CT/LTW and from 2032 in SP/ST)	
Limiting factor of constrained assets	Rating of the 132/33 kV transformers and 132 kV feeder circuits	
Outage combination which causes the constraint	First Circuit Outage	Outage on either 132/33 kV transformer, feeder circuit or 33 kV busbar

Scenario identification

The tables below highlight when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

Scenario	Study year			
	Baseline	**2025**	**2028**	**2032**
Steady Progression			✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

The following solution options could resolve the constraint described above. Any final solution will be subject to a cost benefit analysis.

Solution option	Summary
Reinforcement	The Grid Transformers at Northampton East BSP are rated to 45/90/117 MVA which is the largest size WPD installs as standard. The two 132 kV circuits also limit the firm capacity, so to increase the firm capacity of the site a third Grid Transformer would need to be installed along with a new 132 kV feeder circuit. This is not possible due to space constraints at the BSP. Instead a third Grid Transformer could be installed at Northampton BSP which does have space, and load shifted between the two BSPs on the downstream network.
Operational mitigation	This constraint could be managed by only taking outages in the summer, but this is not an enduring solution as the constraint becomes an issue for fault conditions and under arranged outages even in summer by 2028 under some scenarios as described above.
Load Management Schemes	Any additional connections into this group may be included in an Active Network Management (ANM) scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down 'Secure' flexibility contracts could benefit this area and defer conventional reinforcement in the short-medium term, but this will become less effective and economical as the demand grows in the area.

Northampton West 132/33 kV Grid Transformer Capacity

Constraint summary

Generation **Demand**

The table below outlines the nature of the network constraint on the Grid Transformers at Northampton West BSP identified in the network analysis. In 2028 the constraint is only an issue under arranged outages in Consumer Transformation, but by 2032 it becomes an issue under fault outages as well (the constraint is an issue under both arranged and fault outages from 2028 under Best View and Leading the Way). The two 132 kV feeder circuits to Northampton West BSP are rated significantly higher than the two Grid Transformers and therefore do not overload in the 0-10 year study period.

Constrained assets	132/33 kV transformers at Northampton West BSP	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand (from 2028 in BV/CT/LTW) Intermediate Warm Peak Demand (from 2028 in LTW and from 2032 in BV/CT)	
Limiting factor of constrained assets	Rating of the 132/33 kV transformers	
Outage combination which causes the constraint	First Circuit Outage	Outage on either 132/33 kV transformer, feeder circuit or 33 kV busbar

Scenario identification

The tables below highlight when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

The following solution options could resolve the constraint described above. Any final solution will be subject to a cost benefit analysis.

Solution option	Summary
Reinforcement	The Grid Transformers at Northampton West BSP are rated to 45/90/117 MVA which is the largest size WPD installs as standard. To increase the firm capacity of the site a third Grid Transformer would need to be installed along with a new 132 kV feeder circuit. This is not possible due to space constraints at the BSP. Instead a third Grid Transformer could be installed at Northampton BSP which does have space, and load shifted between the two BSPs on the downstream network.
Operational mitigation	This constraint could be managed by only taking outages in the summer, but this is not an enduring solution as the constraint is an issue for fault conditions by 2028 under Leading the Way and by 2032 under Best View and Consumer Transformation.
Load Management Schemes	Any additional connections into this group may be included in an Active Network Management (ANM) scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down 'Secure' flexibility contracts could benefit this area and defer conventional reinforcement in the short-medium term, but this will become less effective and economical as the demand grows in the area.

Northampton 132/33 kV Grid Transformer Capacity

Constraint summary

Generation | **Demand**

The table below outlines the nature of the network constraint on the Grid Transformers at Northampton BSP identified in the network analysis. In 2028 the constraint only occurs for arranged outages, whereas by 2032 the constraint is an issue for fault outages as well. The two 132 kV feeder circuits to Northampton BSP are rated significantly higher than the two Grid Transformers and are therefore do not overload in the 0-10 year study period.

Constrained assets	132/33 kV transformers at Northampton BSP	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand (from 2028 in BV/CT/LTW) Intermediate Warm Peak Demand (from 2020 in BV/LTW and 2032 in CT)	
Limiting factor of constrained assets	Rating of the 132/33 kV transformers	
Outage combination which causes the constraint	First Circuit Outage	Outage on either 132/33 kV transformer, feeder circuit or 33 kV busbar

Scenario identification

The tables below highlight when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

The following solution options could resolve the constraint described above. Any final solution will be subject to a cost benefit analysis.

Solution option	Summary
Reinforcement	The Grid Transformers at Northampton BSP are rated to 45/90/117 MVA which is the largest size WPD installs as standard. To increase the firm capacity of the site a third Grid Transformer would need to be installed. Installing a third Grid Transformer at Northampton BSP would have the added benefit of being able to support additional load from the other two BSPs in the group.
Operational mitigation	This constraint could be managed by only taking outages in the summer, but this is not an enduring solution as the constraint is an issue for fault conditions by 2032 under some scenarios as described above.
Load Management Schemes	Any additional connections into this group may be included in an Active Network Management (ANM) scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up / demand turn down 'Secure' flexibility contracts could benefit this area and defer conventional reinforcement in the short-medium term, but this will become less effective and economical as the demand grows in the area.

Northampton Group Capacity

Constraint summary

Generation | **Demand**

The table below outlines the nature of the network constraint on the Northampton Group under SCO conditions identified in the network analysis. As outlined in the network overview the group can be split and various 33 kV transfers made to protect against overloads during arranged outages on the three 132 kV circuits into the group. These strategies however create a risk of significant lost load for a subsequent fault which once the group enters class of supply E under the ENA's Engineering Recommendation P2/7 (over 300 MW group demand) would result in group non-compliance as at that point there is a requirement to instantly restore all customers at 2/3 group demand.

Constrained assets	132 kV circuits into the Northampton Group	
Type(s) of constraint	Demand security of supply	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Demand	
Limiting factor of constrained assets	Requirement to restore group demand following a second circuit outage	
Outage combination which causes the constraint	Second Circuit Outage	Arranged followed by fault outages on two of the 132 kV circuits into the Northampton Group

Scenario identification

The tables below highlight when the group exceeds 300 MW of demand during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				✓
System Transformation				✓
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

The following solution options could resolve the constraint described above. Any final solution will be subject to a cost benefit analysis.

Solution option	Summary
Reinforcement	Installing a fourth 132 kV circuit into the group would ensure security of supply is maintained and provide ample headroom for future load growth in the area. This fourth circuit could be from Grendon GSP to Northampton East BSP.
Operational mitigation	The only operational solution would be to transfer some substations out of the group at 33 kV under normal running arrangements to keep the group demand below 300 MW, but this would not be an enduring solution and may require reinforcement to facilitate.
Load Management Schemes	Any additional connections into this group may be included in an Active Network Management (ANM) scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Flexibility cannot be used to lower the class of supply of a group under Engineering Recommendation P2/7 and is therefore unsuitable for dealing with this constraint.

Grendon GSP Main 1 Busbar Fault

Constraint summary

Generation Demand

The table below outlines the nature of the network constraint on 132 kV circuit from the Reserve 1 busbar at Grendon GSP to Northampton BSP (on the CK-route) identified in the network analysis. The constraint only occurs for fault outages, as for arranged outages of the busbar the circuits would be transferred to the Reserve 1 busbar at Grendon GSP.

Constrained assets	132 kV circuit into the Northampton Group (CK-route)	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand (from 2025 in BV/CT/LTW and from 2028 in ST/SP) Intermediate Warm Peak Demand (from 2025 in LTW, from 2028 in BV/CT and from 2032 in ST/SP) Summer Peak Demand (from 2032 in BV/CT/LTW)	
Limiting factor of constrained assets	Thermal rating	
Outage combination which causes the constraint	First Circuit Outage	Fault outage on the Main 1 busbar at Grendon GSP

Scenario identification

The tables below highlight when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression			✓	✓
System Transformation			✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

The following solution options could resolve the constraint described above. Any final solution will be subject to a cost benefit analysis.

Solution option	Summary
Reinforcement	There are currently plans to reconductor the CK-route, increasing the rating of both of these circuits, which will reduce but not completely alleviate the constraint. Moving one of the three 132 kV circuits to a different busbar (either Main 2 or Reserve 2) would alleviate the constraint, but this might not be possible due to space constraints at Grendon GSP. Installing a fourth 132 kV circuit would also alleviate the constraint.
Operational mitigation	Transferring some substations out of the group at 33 kV under normal running arrangements or considering alternative running arrangements could be used to manage the risk of overloads for a busbar fault until the new 132 kV circuit can be built.
Load Management Schemes	Any additional connections into this group may be included in an Active Network Management (ANM) scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down 'Secure' flexibility contracts could benefit this area but would likely not be economical due to the high loads being considered.

Sharnbrook Primary

Network Overview

Sharnbrook Primary is a 33/11 kV substation fed via a single 33 kV circuit from Little Irchester Primary, which is in turn fed via two 33 kV circuits from Wellingborough BSP. The site has a single 33/11 kV transformer rated to 12/19/24 MVA.

Under a FCO condition for the loss of the transformer the load is back fed on the 11 kV network via Harrold Primary. The firm capacity of the site is therefore limited by the 11 kV back feed capacity to around 9 MVA.

Figure 17 Sharnbrook Primary geographic network coverage

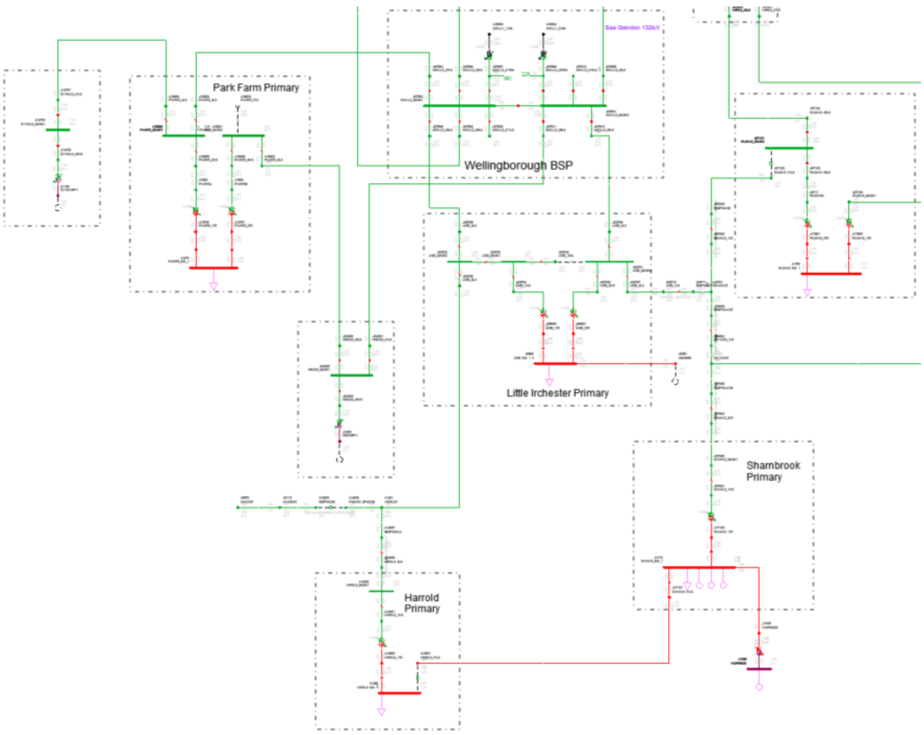

Figure 18 Sharnbrook Primary 33 kV network schematic

Constraint summary

Generation | **Demand**

The table below outlines the nature of the network constraint at Sharnbrook Primary identified in the network analysis.

Constrained assets	11 kV interconnections between Sharnbrook Primary and Harrold Primary	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	11 kV interconnecting circuits to neighbouring Primary substations	
Outage combination which causes the constraint	First Circuit Outage	Arranged or fault outage of the 33/11 kV transformer at Sharnbrook

Scenario identification

The table below highlights when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

The following solution options could resolve the constraint described above. Any final solution will be subject to a cost benefit analysis.

Solution option	**Summary**
Reinforcement	Install a second 33/11 kV transformer at Sharnbrook Primary, along with a new 33 kV feeder circuit from Little Irchester Primary or Wellingborough BSP. This would mean that for an outage on one of the transformers at Sharnbrook Primary the load could be supplied by the remaining transformer, without relying on back feeds at 11 kV to Harrold Primary, alleviating the constraint.
Operational mitigation	Load could be moved on the 11 kV network to other Primaries in the area under outage conditions. To fully assess the viability of this option a more in depth study looking at the 11 kV network is required, which is outside of the scope of this report.
Load Management Schemes	Very limited due to the potential Engineering Recommendation P2/7 non-compliance for a Class B group demand.
Flexibility services	Generation turn up / demand turn down flexibility contracts could benefit this area and defer conventional reinforcement in the short-medium term, but this will become less effective and economical as the demand grows in the area.

Atherstone Primary

Network Overview

Atherstone Primary is a 33/11 kV substation fed from Tamworth BSP via two 33 kV circuits. One of the 33 kV circuits is directly from the Main 1 busbar at Tamworth BSP. The other 33 kV circuit is from Polesworth Primary, which is fed from Tamworth BSP via two 33 kV circuits (one from the Main 1 busbar and one from the Main 2 busbar). The two 33/11 kV transformers at Atherstone are 12/19/24 MVA units.

Under a FCO condition for the loss of one of the transformers at Atherstone Primary, the remaining transformer in service supplies the entire site demand. The firm capacity of the site is therefore limited by the rating of one of the transformers.

Figure 19 Atherstone Primary geographic network coverage

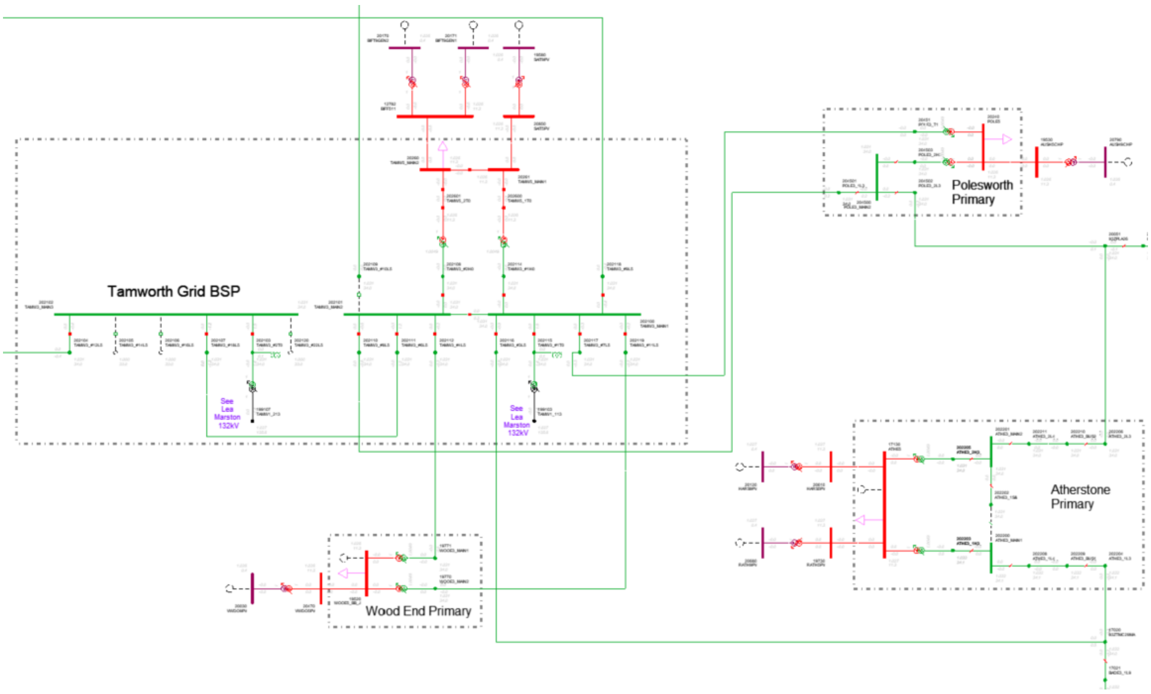

Figure 20 Atherstone Primary 33 kV network schematic

Atherstone 33/11 kV Transformer Capacity

Constraint summary

Generation Demand

The table below outlines the nature of the network constraint at Atherstone Primary identified in the network analysis. The constraint occurs in 2025 during intermediate warm peak demand in all scenarios (except for Steady Progression for T1), as well as during winter peak for Leading the Way. The constraint also occurs at summer peak in Leading the Way in 2028 onwards, as well as in 2032 for Best View and Consumer Transformation.

Constrained assets	Atherstone 33/11 kV transformers	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand (from 2025 LW, 2028 BV/CT and SP/ST by 2032) Intermediate Warm Peak Demand (arranged only in 2025 except for LW) Summer Peak Demand (from 2028 LW, 2032 BV/CT)	
Limiting factor of constrained assets	Thermal ratings	
Outage combination which causes the constraint	First Circuit Outage	Outage on one of the transformers, busbars or 33 kV circuits to Atherstone Primary

Scenario identification

The tables below highlight when the constraints occur for T1 and T2 during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

T2 transformer constraints:

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

T1 transformer constraints:

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression			✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

The following solution options could resolve the constraint described above. Any final solution will be subject to a cost benefit analysis.

Solution option	Summary
Reinforcement	Uprate both transformers at Atherstone Primary to 20/40 MVA units. Various sections of the 33 kV infeeds will also require uprating to release the required capacity. This will alleviate the constraint and provide ample headroom for future load growth in the area.
Operational mitigation	This constraint could be managed by only taking outages in the summer, but this is not an enduring solution as the constraint becomes an issue for faults and at summer peak between 2025 and 2032 depending on the scenario as described above.
Load Management Schemes	Any additional connections into this group may be included in an Active Network Management (ANM) scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down flexibility contracts could benefit this area and defer conventional reinforcement in the short-medium term, but this will become less effective and economical as the demand grows in the area.

Atherstone and Polesworth 33 kV Circuit Capacity

Constraint summary

Generation Demand

The table below outlines the nature of the network constraint on the 33 kV circuit from Tamworth Main 2 busbar and Polesworth Primary identified in the network analysis. The constraint is present in the baseline year for winter peak and intermediate warm peak, overloads also occur in summer in 2025 for all scenarios except Steady Progression (where it occurs in summer from 2028 onwards).

Constrained assets	33 kV circuit from Tamworth Main 1 to Polesworth Primary	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Demand (from 2025, except 2028 for SP)	
Limiting factor of constrained assets	Thermal rating	
Outage combination which causes the constraint	First Circuit Outage	Arranged or fault outage of the Main 1 busbar at Tamworth (results in the loss of two of the three 33 kV circuits to Polesworth and Tamworth Primaries)

Scenario identification

The table below highlights when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression	✓	✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

The following solution options could resolve the constraint described above. Any final solution will be subject to a cost benefit analysis.

Solution option	Summary
Reinforcement	Move one of the two 33 kV circuits currently connected onto Tamworth Main 1 busbar onto Tamworth Main 3 busbar. An outage on any of the busbars will then only result in the loss of one of the three circuits to Polesworth and Atherstone, leaving the remaining two circuits with ample capacity for the load on the two primaries for the foreseeable future. This solution would be significantly cheaper than uprating the circuit(s).
Operational mitigation	Temporary 11 kV transfers could help mitigate some of the immediate constraints but a more conventional intervention may be necessary as the demand grows.
Load Management Schemes	Any additional connections into this group may be included in an Active Network Management (ANM) scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down flexibility contracts could benefit this area and defer conventional reinforcement in the short-medium term, but is likely to not be economical as the reinforcement option outlined above should be quite cheap and flexibility would be required for significant lengths of time over multiple seasons.

Nottingham BSP

Network Overview

Nottingham BSP is a 132/33 kV substation fed from Ratcliffe GSP. The site has four Grid Transformers rated to 45/90/117 MVA along with five 33 kV busbars. The four transformers are run split, with GT2 and GT3 run together, and GT1 and GT4 run together.

Nottingham BSP supplies 12 Primary substations under normal running arrangements: Beeston, Boots, Castle Road, Clifton, Cotgrave, Lenton, North Wilford, Sneinton, St Anns (T4), Talbot Street, West Bridgford and Wollaton Road.

For arranged outages on one of the Grid Transformers or 132 kV incoming circuits at Nottingham BSP the bus-section breaker between the Main 2 and Main 1A busbars is closed. This parallels the three remaining transformers in preparation for the next credible fault (of a Grid Transformer at Nottingham BSP). For certain arranged outages the 11 kV busbars at various Primaries are split to prevent loose couples in the event of a subsequent fault.

Figure 21 Nottingham BSP geographic network coverage

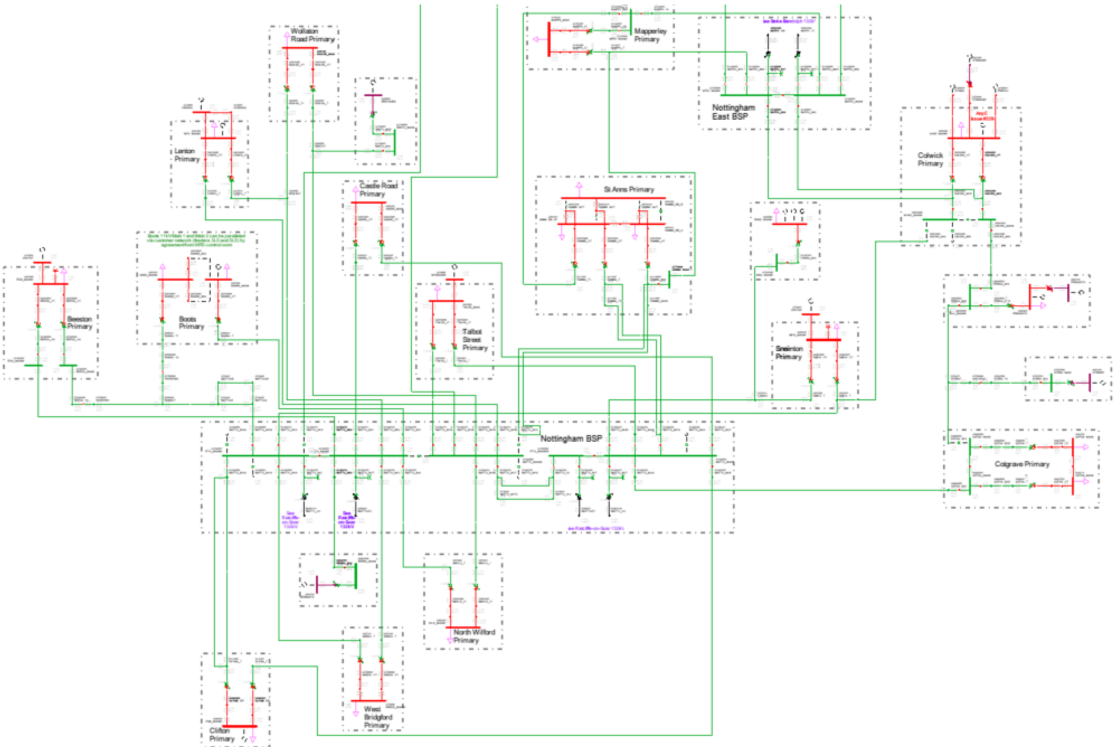

Figure 22 Nottingham BSP 33 kV network schematic

Clifton 33/11 kV Transformer Capacity

Constraint summary

Generation | **Demand**

The table below outlines the nature of the network constraint on the transformers at Clifton Primary identified in the network analysis. For the loss of one of the transformers the other picks up the full load of Clifton Primary. This overloads the remaining transformer at winter peak and intermediate warm peak from 2028 in WPD Best View and Leading the Way, and from 2032 in Consumer Transformation as outlined below.

Constrained assets	Clifton Primary 33/11 kV transformers T1 and T2	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand (fault and arranged outages) Intermediate Warm Peak Demand (arranged outages only in 2028)	
Limiting factor of constrained assets	20/40 MVA transformer rating	
Outage combination which causes the constraint	First Circuit Outage	Outage on one of the transformers or circuits at Clifton Primary; also on the Main 3 or Main 4 busbars at Nottingham BSP

Scenario identification

The table below highlights when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

Scenario	**Study year**			
	Baseline	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

The following solution options could resolve the constraint described above. Any final solution will be subject to a cost benefit analysis.

Solution option	**Summary**
Reinforcement	The transformers at Clifton Primary are already the highest rated 33/11 kV units WPD utilises on the network, so uprating these is not an option to alleviate this constraint. Due to the high demand growth in the area and the other constraints within the Nottingham BSP group building a new Primary substation and transferring demand over to it is likely the optimal solution (and will create significant headroom for further load growth in the area).
Operational mitigation	As this constraint occurs under a fault condition the options for alleviating the constraint operationally are limited.
Load Management Schemes	Any additional connections into this group may be included in an Active Network Management (ANM) scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down flexibility contracts could benefit this area and defer conventional reinforcement in the short-medium term, but this will become less effective and economical as the demand grows in the area (especially given the speed of the projected demand growth).

West Bridgford 33 kV Circuit Capacity

Constraint summary

Generation Demand

The table below outlines the nature of the network constraint on the two 33 kV circuits feeding West Bridgford Primary identified in the network analysis. For the loss of one of the circuits, the remaining circuit in service supplies the full load of West Bridgford Primary. This overloads the remaining circuit for winter, intermediate warm and summer peak demand conditions for various scenarios between 2025 and 2032 as summarised below. The constraint is an issue under both arranged and fault conditions (except in 2025 under Best View where the constraint only occurs for arranged outages).

Constrained assets	West Bridgford Primary 33 kV feeder circuits	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand (from 2025 in BV/CT/LTW, 2028 in ST and 2032 in SP) Intermediate Warm Peak Demand (from 2028 in BV/CT/LTW and 2032 in ST/SP) Summer Peak Demand (from 2032 in BV/CT/LTW)	
Limiting factor of constrained assets	Thermal rating	
Outage combination which causes the constraint	First Circuit Outage	Outage on one of the transformers or circuits at West Bridgford Primary or on the Main 2 or Main 3 busbars at Nottingham BSP

Scenario identification

The table below highlights when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				✓
System Transformation			✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

The following solution options could resolve the constraint described above. Any final solution will be subject to a cost benefit analysis.

Solution option	Summary
Reinforcement	Uprating the two 33 kV circuits to West Bridgford Primary would alleviate this constraint. This could be carried out alongside the replacement of the 33/11 kV transformers at West Bridgford.
Operational mitigation	As this constraint occurs under a fault condition the options for alleviating the constraint operationally are limited. Restricting the season that outages are taken could alleviate the constraint in 2025 under Best View but this is not an enduring solution.
Load Management Schemes	Any additional connections into this group may be included in an Active Network Management (ANM) scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down flexibility contracts could benefit this area and defer conventional reinforcement in the short-medium term, but this will become less effective and economical as the demand grows in the area (especially given the speed of the projected demand growth).

West Bridgford 33/11 kV Transformer Capacity

Constraint summary

Generation Demand

The table below outlines the nature of the network constraint on the transformers at West Bridgford Primary identified in the network analysis. For the loss of one of the transformers the remaining transformer in service supplies the full load at West Bridgford Primary. This overloads the remaining transformer for winter peak demand conditions. Results for this constraint are given for winter peak only, as the transformers at West Bridgford are not standard units used on WPD's networks and as such the seasonal ratings are not fully captured. This does not affect the trigger year for the constraint as winter peak is deemed the most onerous season in this case. The constraint occurs for both arranged and fault outages.

Constrained assets	West Bridgford Primary 33/11 kV transformers T1 and T2	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	35 MVA transformer rating	
Outage combination which causes the constraint	First Circuit Outage	Outage on one of the transformers or circuits at West Bridgford Primary or on the Main 2 or Main 3 busbars at Nottingham BSP

Scenario identification

The table below highlights when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

Scenario	Study year			
	Baseline	**2025**	**2028**	**2032**
Steady Progression				✓
System Transformation				✓
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

The following solution options could resolve the constraint described above. Any final solution will be subject to a cost benefit analysis.

Solution option	Summary
Reinforcement	The transformers at West Bridgford Primary could be uprated to 20/40 MVA units. This would free up some firm capacity and address condition based issues with the transformers as the existing pair were commissioned in 1965. However; uprating the transformers would not be sufficient in later years due to the demand forecast in 2032 under the higher growth scenarios. Due to the high demand growth in the area and the other constraints within the Nottingham BSP group, establishment of a new Primary substation to transfer demand from West Bridgford and Clifton is likely the optimal solution (and will create significant headroom for further load growth in the area).
Operational mitigation	As this constraint occurs under a fault condition the options for alleviating the constraint operationally are limited.
Load Management Schemes	Any additional connections into this group may be included in an Active Network Management (ANM) scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down flexibility contracts could benefit this area and defer conventional reinforcement in the short-medium term, but this will become less effective and economical as the demand grows in the area (especially given the speed of the projected demand growth).

Sneinton 33/11 kV Transformer Capacity

Constraint summary

Generation **Demand**

The table below outlines the nature of the network constraint on the transformers at Sneinton Primary identified in the network analysis. For the loss of one of the transformers the other picks up the full load at Sneinton Primary. This overloads the remaining transformer at winter peak, intermediate warm peak and summer peak for various scenarios in 2028 and 2032 as summarised below. The constraint is an issue under both arranged and fault conditions (except in Best View and Consumer Transformation in 2028 and at summer peak in Best View and Leading the Way in 2032 where the constraint only occurs for arranged outages).

Constrained assets	Sneinton Primary 33/11 kV transformers T1 and T2	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand (from 2028 in BV/LTW and CT in 2032) Intermediate Warm Peak Demand (from 2028 in BV/CT/LTW) Summer Peak Demand (from 2032 in BV/LTW)	
Limiting factor of constrained assets	12/24 MVA transformer rating	
Outage combination which causes the constraint	First Circuit Outage	Outage on one of the transformers or circuits at Sneinton Primary or on the Main 3 or Main 4 busbars at Nottingham BSP

Scenario identification

The table below highlights when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

Scenario	**Study year**			
	Baseline	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

The following solution options could resolve the constraint described above. Any final solution will be subject to a cost benefit analysis.

Solution option	**Summary**
Reinforcement	The transformers at Sneinton Primary could be uprated to 20/40 MVA units. Various sections of the 33 kV feeder circuits would also need to be uprated to release the extra capacity. This would provide enough capacity for the projected demand growth in the area up to 2032 under every growth scenario. If a new Primary substation were built in the area demand could be shifted from Sneinton Primary to the new Primary but this would not need to be done before 2032 under any scenario if the transformers and circuits are uprated as suggested above.
Operational mitigation	As this constraint occurs under a fault condition the options for alleviating the constraint operationally are limited.
Load Management Schemes	Any additional connections into this group may be included in an Active Network Management (ANM) scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down flexibility contracts could benefit this area and defer conventional reinforcement in the short-medium term, but this will become less effective and economical as the demand grows in the area (especially given the speed of the projected demand growth).

Wollaton Road 33 kV Circuit and 33/11 kV Transformer Capacity

Constraint summary

Generation | **Demand**

The table below outlines the nature of the network constraint on the transformers at Wollaton Road Primary identified in the network analysis. For the loss of one of the transformers the other picks up the full load at Wollaton Road Primary. This overloads the remaining transformer at winter peak and intermediate warm peak in 2028 for Best View and Leading the Way and in 2032 for Consumer Transformation. The constraint occurs for both arranged and fault outages. Some sections of the 33 kV circuits feeding Wollaton Road also overload for various FCOs (triggered in the same years, scenarios and seasons as the transformer constraint for both arranged and fault outages).

Constrained assets	Wollaton Road Primary 33/11 kV transformers T1 and T2 (also sections of 33 kV circuit)	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Thermal rating	
Outage combination which causes the constraint	First Circuit Outage	Outage on one of the transformers or circuits at Wollaton Road Primary or on the Main 1A or Main 2 busbars at Nottingham BSP

Scenario identification

The table below highlights when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				
System Transformation				
Consumer Transformation				✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

The following solution options could resolve the constraint described above. Any final solution will be subject to a cost benefit analysis.

Solution option	Summary
Reinforcement	The transformers at Wollaton Road Primary are already the highest rated 33/11 kV units WPD utilises on the network, so uprating these is not an option to alleviate this constraint. Uprating the lower rated section of 33 kV circuit to T1 and the section of 33 kV circuit up to the tee point which feeds both Lenton T2 and Wollaton Road T2 would increase the capacity of the site and allow the transformers to be fully utilised, but not enough to handle the projected demand growth in some scenarios in 2032. Due to the high demand growth in the area and the other constraints within the Nottingham BSP group establishment of a new Primary substation to transfer load from existing Primaries is likely the optimal solution (and will create significant headroom for further load growth in the area).
Operational mitigation	As this constraint occurs under a fault condition the options for alleviating the constraint operationally are limited.
Load Management Schemes	Any additional connections into this group may be included in an Active Network Management (ANM) scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down flexibility contracts could benefit this area and defer conventional reinforcement in the short-medium term, but this will become less effective and economical as the demand grows in the area (especially given the speed of the projected demand growth).

Ratcliffe to Loughborough 132 kV

Network Overview

Ratcliffe is a GSP with four SGTs which supplies four BSPs under normal running arrangements: Loughborough, Nottingham, Toton and Willoughby. Loughborough BSP is fed via two 132 kV circuits from Ratcliffe GSP, with a tee to Coalville BSP which is left open under normal running arrangements.

For certain outages at Enderby GSP, Coalville and Hinckley 132/11 kV can be transferred to Ratcliffe GSP. This puts the demand of Loughborough BSP, Coalville BSP and Hinckley 132/11 kV onto the two circuits from Ratcliffe GSP. The capacity of these circuits is limited by the sections of underground cable from Ratcliffe GSP to the start of the dual overhead line circuit. These cables are derated due to a number of ducted sections to 169 MVA (winter and intermediate cool) and 146 MVA (summer and intermediate warm).

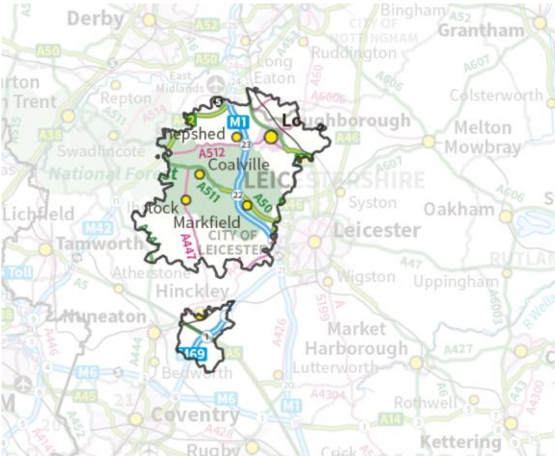

Figure 23 Loughborough, Coalville and Hinckley 11 kV geographic network coverage

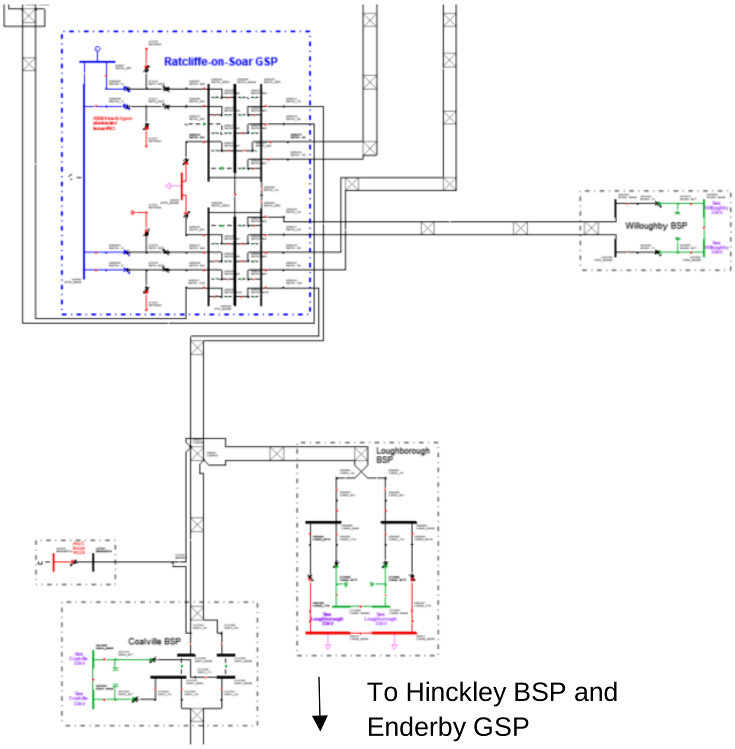

Figure 24 Ratcliffe GSP to Loughborough BSP 132 kV network schematic

Constraint summary

The table below outlines the nature of the network constraint on the 132 kV circuits from Ratcliffe GSP to the Loughborough tee identified in the network analysis. This constraint occurs if the transfer of Coalville BSP and Hinckley 11 kV is required.

Constrained assets	132 kV cables from Ratcliffe GSP to the Loughborough tee	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Demand	
Limiting factor of constrained assets	Thermal rating of sections of underground cable	
Outage combination which causes the constraint	Second Circuit Outage	Outage of one of the SGTs at Enderby GSP leading to the transfer of Coalville BSP and Hinckley 11 kV into Ratcliffe GSP, followed by a fault on one of the circuits from Ratcliffe GSP to the Loughborough tee

Scenario identification

The table below highlights when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression	✓	✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

The following solution options could resolve the constraint described above. Any final solution will be subject to a cost benefit analysis.

Solution option	Summary
Reinforcement	Uprate the sections of 132 kV cable from Ratcliffe GSP to the Loughborough tee. This will enable the transfer to be utilised without risking overloading one of the circuits for the fault described above.
Operational mitigation	Not utilising the transfer would alleviate this constraint, but subsequent overloads would be triggered at Enderby GSP as a result as the transfer is required to support Enderby GSP.
Load Management Schemes	Any additional connections into this group may be included in an Active Network Management (ANM) scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down flexibility contracts could benefit this area and defer conventional reinforcement in the short-medium term, but this will become less effective and economical as the demand grows in the area.

Hallcroft Road Primary

Network Overview

Hallcroft Road Primary is a 33/11 kV substation connected via two 33 kV circuits from Checkerhouse BSP within the Staythorpe GSP group. It consists of two Primary transformers, T1 and T2, each rated 6/12 MVA.

The site runs closed at 11 kV and each transformer supplies the entire site demand following a fault or arranged outage on the other.

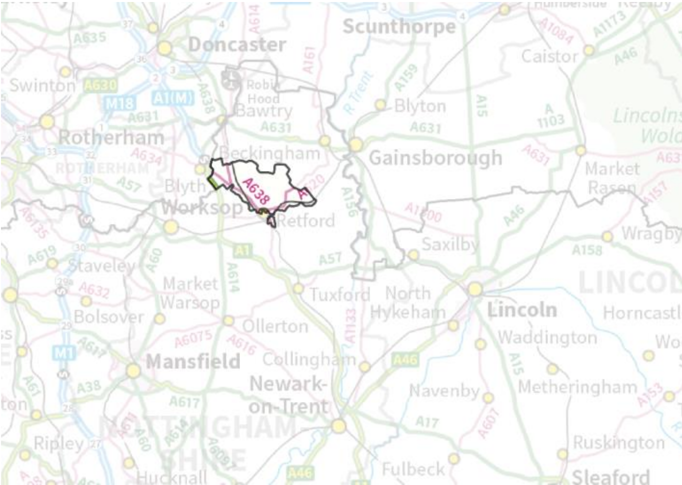

Figure 25 Hallcroft Road Primary geographic network coverage

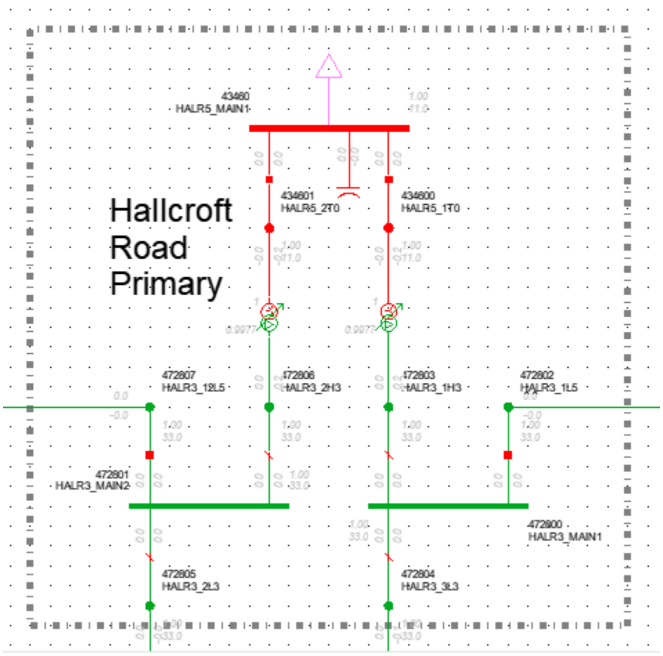

Figure 26 Hallcroft Road Primary 33 kV network schematic

Constraint summary

Generation | **Demand**

For a first circuit arranged or fault outage on either 33/11 kV transformer, the remaining in-service transformer overloads as the entire group demand is supplied via a single transformer.

The table below outlines the nature of the network constraints identified in the network analysis.

Constrained assets	Hallcroft Road 33/11 kV transformers	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	6/12 MVA rating of the 33/11 kV transformers	
Outage combination which causes the constraint	First Circuit Outage	Arranged or fault outage on either 33/11 kV transformer or 33 kV circuit from Checkerhouse to Hallcroft Road

Scenario identification

The table below highlights when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

Scenario	**Study year**			
	Baseline	**2025**	**2028**	**2032**
Steady Progression	✓	✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

The following solution options could resolve the constraints described above. Any final solution will be subject to a cost benefit analysis.

Solution option	**Summary**
Reinforcement	Replace both of the existing 33/11 kV transformers with larger units.
Operational mitigation	Temporary 11 kV transfers could help mitigate some of the immediate constraints but a more conventional intervention may be necessary as the demand grows.
Load Management Schemes	Very limited due to the potential Engineering Recommendation P2/7 non-compliance for a Class C group demand.
Flexibility services	Generation turn up and/or demand turn down via the ‘Secure’ product. Dispatch of services may be required for an extended period of time given the constraint is present under a First Circuit Outage and across multiple seasons.

Hawton BSP

Network Overview

Hawton BSP is a 132/33 kV site fed via double tee'd 132 kV circuits between Staythorpe C GSP and Asfordby BSP. The circuits largely consist of 175 mm^2 ACSR conductors on a double circuit tower line. Hawton BSP consists of two 90 MVA 132/33 kV transformers that run closed at 33 kV.

For a first circuit (arranged or fault) outage on either of the incoming 132 kV circuits to Hawton, the remaining in-service circuit picks up the entire Hawton group demand.

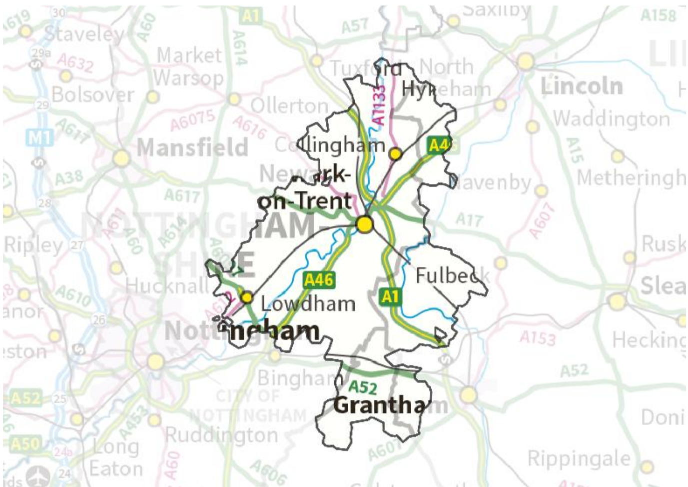

Figure 27 Hawton BSP geographic network coverage

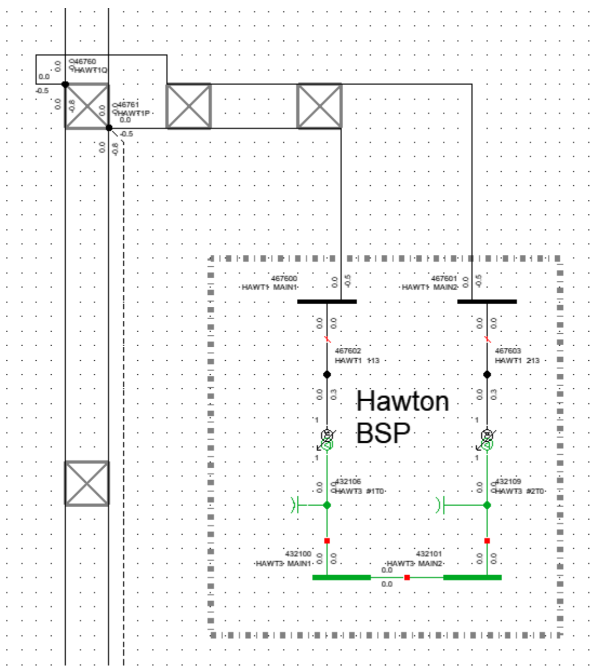

Figure 28 Hawton BSP 132 kV network schematic

Constraint summary

Generation | Demand

Either 132 kV incoming circuit into Hawton BSP is likely to overload following a fault or an arranged outage on the other.

The table below outlines the nature of the network constraints identified in the network analysis.

Constrained assets	132 kV circuits from tee points to Hawton BSP	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand (from 2028)	
Limiting factor of constrained assets	Circuit rating (largely consisting of 175 mm^2 ACSR tower line conductors)	
Outage combination which causes the constraint	First Circuit Outage	Arranged or fault outage on either of the 132 kV circuits into Hawton BSP
	Second Circuit Outage	A first circuit outage leading to demand being transferred into Hawton BSP, followed by a second circuit fault

Scenario identification

The table below highlights when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				✓
System Transformation				✓
Consumer Transformation			✓	✓
Leading the Way		✓	✓	✓
WPD Best View			✓	✓

Solution options

The following solution options could resolve the constraints described above. Any final solution will be subject to a cost benefit analysis.

Solution option	Summary
Reinforcement	Uprate the existing 132 kV tower line circuits to Hawton BSP.
Operational mitigation	Very limited due to the First Circuit Outage constraint and the potential Engineering Recommendation P2/7 non-compliance for a Class D group demand.
Load Management Schemes	Very limited due to the potential Engineering Recommendation P2/7 non-compliance for a Class D group demand.
Flexibility services	Generation turn up and/or demand turn down via the ‘Secure’ product. Dispatch of services may be required for an extended period of time given the constraint is present under a First Circuit Outage and across multiple seasons.

Staythorpe GSP

Network Overview

Staythorpe C GSP is a 132 kV double busbars site fed via two 400/132 kV Super Grid Transformers (SGT1 and SGT2, each rated 240 MVA) that run split at 132 kV under normal running configuration.

Staythorpe GSP supplies Hawton and Asfordby BSPs, also Staythorpe B switching site which then supplies Grantham South, Grantham North (132/11 kV side), and Checkerhouse BSPs.

There are also 132 kV interconnections available to:

- Chesterfield GSP, primarily for the transfer of Mansfield and Clipstone BSPs over to Staythorpe C via a double circuit tower line; and another double circuit tower line to allow for the transfer of Pinxton and Annesley BSPs, also to Staythorpe C;
- Willington GSP which is primarily for the transfer of Heanor and Stanton BSPs over to Staythorpe C;
- West Burton GSP which allows for the transfer of Checkerhouse BSP away from Staythorpe.

For a first circuit arranged or fault outage affecting the infeed from either SGT at Staythorpe C, the remaining SGT in service transformer supplies the group demand.

Network Operability Modelling

The network operates as follows:

- Under normal running arrangement, the SGTs run split at Staythorpe 132 kV but coupled at various 33 kV and 11 kV busbars across the downstream network.
- For various arranged outages at Chesterfield,
  - Mansfield and Clipstone BSPs are transferred into Staythorpe GSP, or
  - Pinxton and Annesley BSPs are transferred into Staythorpe GSP

  Subsequently, Checkerhouse BSP is transferred away from Staythorpe GSP and on to West Burton GSP to release capacity.
- For various arranged outages at Willington GSP, Heanor and Stanton BSPs are transferred into Staythorpe C. Subsequently, Checkerhouse BSP is transferred away from Staythorpe GSP and on to West Burton GSP to release capacity.

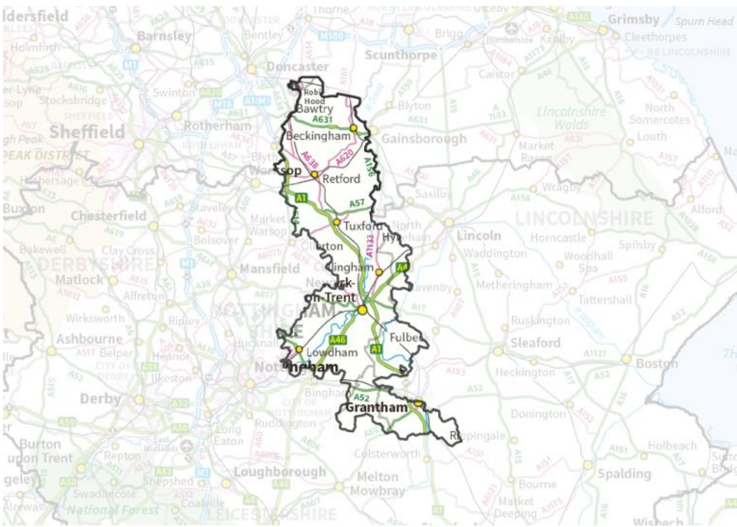

Figure 29 Staythorpe GSP geographic network coverage

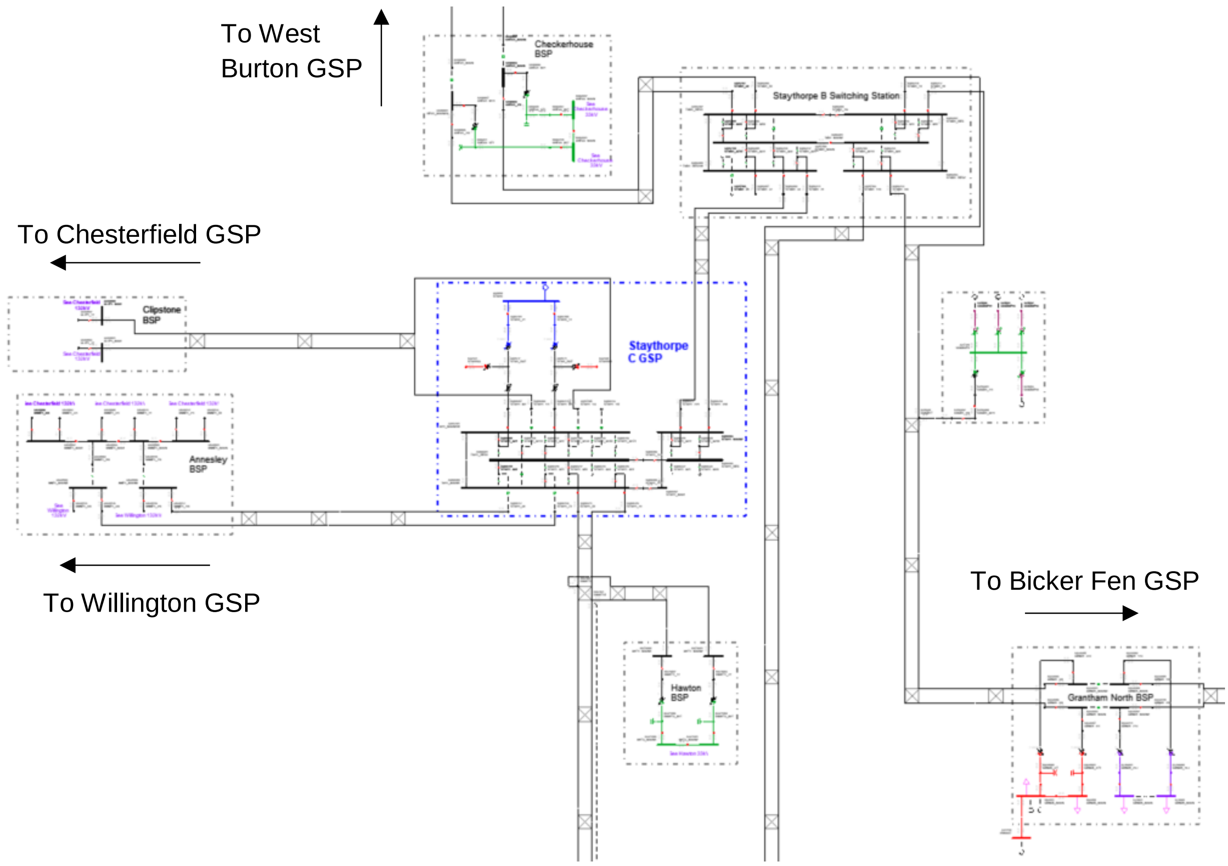

Figure 30 Staythorpe GSP 132 kV network schematic

Constraint summary

Generation Demand

For arranged outages at Chesterfield GSP or Willington GSP leading to BSPs being transferred into Staythorpe C, a subsequent fault on either SGT1 or SGT2 would overload the remaining SGT in service.

The table below outlines the nature of the network constraints identified in the network analysis.

Constrained assets	Staythorpe C SGT1 or SGT2	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	240 MVA rating of either SGT	
Outage combination which causes the constraint	Second Circuit Outage	Arranged outage at Chesterfield or Willington GSPs leading to load transfers to Staythorpe C, followed by a second circuit fault outage on either SGT1 or SGT2 at Staythorpe C

Scenario identification

The table below highlights when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

Scenario	Study year			
	Baseline	2025	2028	2032
Steady Progression	✓	✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

The following solution options could resolve the constraints described above. Any final solution will be subject to a cost benefit analysis.

Solution option	Summary
Reinforcement	Install a third SGT at Staythorpe C with associated busbar extension works. This should be accompanied by a detailed fault level assessment to identify any necessary re-plant works.
Operational mitigation	Limited due to the levels of demand across the GSPs in the area. See options below: • Utilising the short term ratings of the SGTs could provide additional capacity, but this does not alleviate the constraint in the long term. • Restrict the transfers onto Staythorpe C GSP to the summer season, although this may not always be feasible due to the duration of certain 132 kV outages. • Limiting the transfers on to Staythorpe C, but this would identify overload constraints at both Chesterfield GSP and Willington GSP.
Load Management Schemes	Very limited due to the potential Engineering Recommendation P2/7 non-compliance for Class D group demands.
Flexibility services	Generation turn up and/or demand turn down via the ‘Dynamic’ product.

Tuxford Primary

Network Overview

Tuxford Primary is a single 33/11 kV transformer site fed via a 33 kV circuit from Checkerhouse BSP via Beavercotes Primary. There is 33 kV interconnection to Hawton BSP which is normally run open at Carlton-on-Trent Primary.

The site relies on 11 kV interconnections from Ollerton, Woodbeck, and Beavercotes Primaries for the loss of supply to its transformer, which is a 6/12 MVA unit.

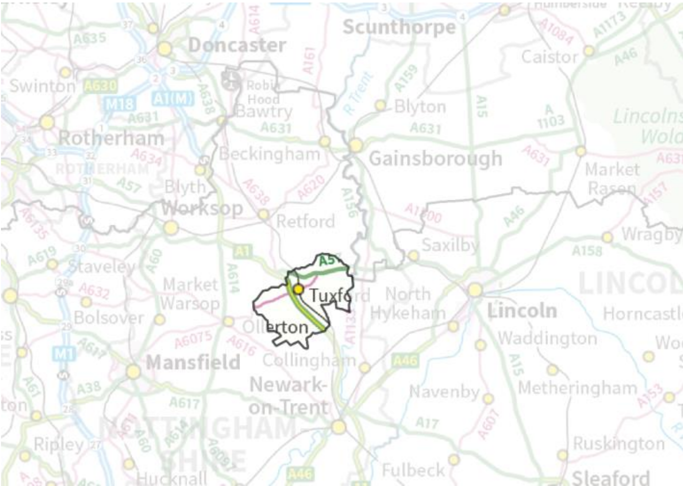

Figure 31 Tuxford Primary geographic network coverage

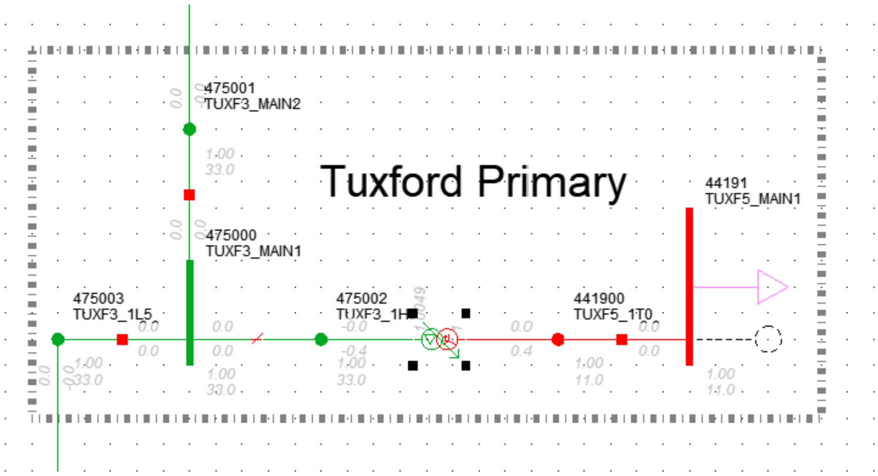

Figure 32 Tuxford Primary 33 kV network schematic

Constraint summary

Generation Demand

For the arranged or fault outage of the infeed to the Primary transformer at Tuxford, the 11 kV interconnections are not likely to sustain Tuxford group demand leading to overloads and voltages dropping to below 0.94 per unit.

The table below outlines the nature of the network constraints identified in the network analysis.

Constrained assets	11 kV interconnections between Tuxford and neighbouring Primaries	
Type(s) of constraint	Thermal overload and voltage constraint of 11 kV network	
Constrained condition(s)	Winter Peak Demand: All scenarios Intermediate Warm Peak Demand: All scenarios except Steady Progression. Summer Peak Demand: WPD Best View, Consumer Transformation and Leading the Way scenarios only.	
Limiting factor of constrained assets	11 kV interconnections	
Outage combination which causes the constraint	First Circuit Outage	Arranged or fault outage of the 33/11 kV transformer

Scenario identification

The table below highlights when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				✓
System Transformation			✓	✓
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

The following solution options could resolve the constraints described above. Any final solution will be subject to a cost benefit analysis.

Solution option	**Summary**
Reinforcement	Install an additional 33 kV circuit into Tuxford Primary from Beavercotes Primary, and a second 33/11 kV transformer with associated 33 kV and 11 kV busbar extension works.
Operational mitigation	Very limited due to the First Circuit Outage constraint and the potential Engineering Recommendation P2/7 non-compliance for a Class C group demand.
Load Management Schemes	Very limited due to the potential Engineering Recommendation P2/7 non-compliance for a Class C group demand.
Flexibility services	Generation turn up and/or demand turn down via the ‘Dynamic’ product. Dispatch of services may be required for an extended period of time given the constraint is present under a First Circuit Outage and across multiple seasons.

Woodbeck Primary

Network Overview

Woodbeck Primary is a single 33/11 kV transformer site fed via a single 33 kV circuit from Checkerhouse BSP via Ordsall Road Primary. The site relies on 11 kV interconnections from Ordsall Road, North Wheatley, and Tuxford Primary substations for the loss of supply to its transformer, which is a 12/24 MVA unit.

Figure 33 Woodbeck Primary geographic network coverage

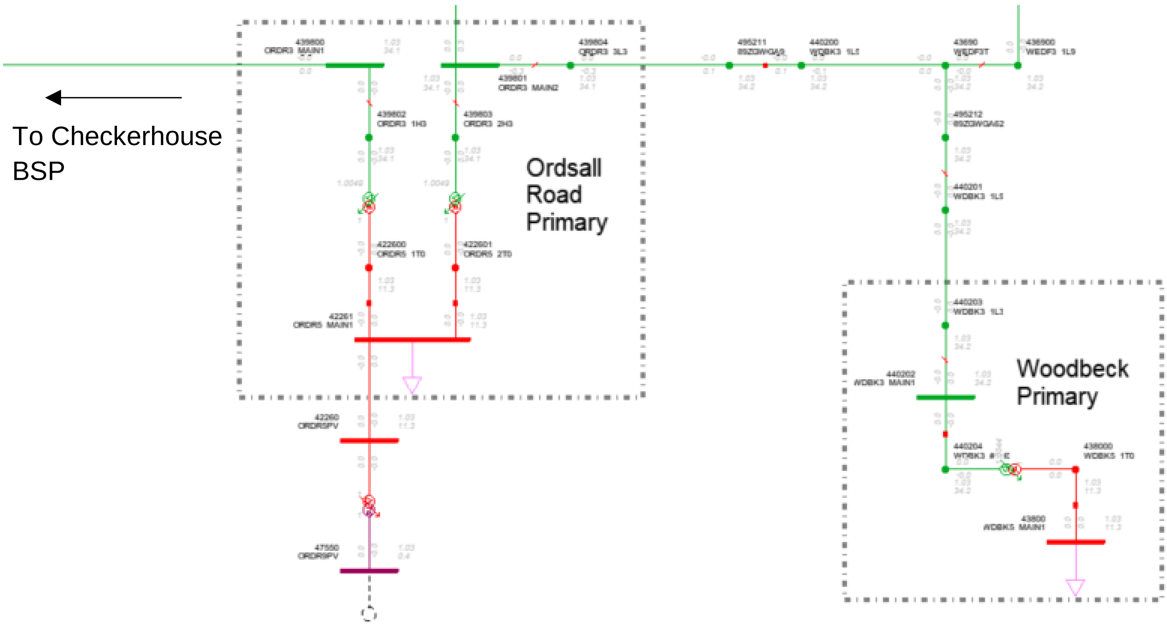

Figure 34 Woodbeck Primary 33 kV network schematic

Constraint summary

For the arranged or fault outage of the infeed to the Primary transformer at Woodbeck, the 11 kV interconnections are not likely to sustain the site's group demand leading to overloads and voltages dropping to below 0.94 per unit.

The table below outlines the nature of the network constraints identified in the network analysis.

Constrained assets	11 kV interconnections between Woodbeck and neighbouring Primaries	
Type(s) of constraint	Thermal overload and voltage constraint of 11 kV network	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	11 kV interconnecting circuits to neighbouring Primary substations	
Outage combination which causes the constraint	First Circuit Outage	Outage of the 33/11 kV transformer

Scenario identification

The table below highlights when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation	✓	✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

The following solution options could resolve the constraints described above. Any final solution will be subject to a cost benefit analysis.

Solution option	Summary
Reinforcement	Option 1: Reinforce the 11 kV interconnections to Woodbeck Primary to resolve the thermal and voltage constrains.
	Option 2: Install a second 33 kV circuit to Woodbeck and a second 33/11 kV transformer with associated 11 kV circuit breaker works.
Operational mitigation	Very limited due to the First Circuit Outage constraint and the potential Engineering Recommendation P2/7 non-compliance for a Class B group demand.
Load Management Schemes	Very limited due to the potential Engineering Recommendation P2/7 non-compliance for a Class B group demand.
Flexibility services	Generation turn up and/or demand turn down via the 'Dynamic' product. Dispatch of services may be required for an extended period of time given the constraint is present under a First Circuit Outage and across multiple seasons.

Holbeach Primary and Long Sutton Primary

Network Overview

Holbeach and Long Sutton are two 33/11 kV Primary substations fed from South Holland BSP and Spalding BSP. Holbeach Primary is supplied via two transformers rated to 12/19/24 MVA, Long Sutton Primary is also supplied via two 12/19/24 MVA transformers. Holbeach Primary is fed via two 33 kV circuits, one from South Holland BSP and one from Spalding BSP. Long Sutton Primary is fed via two 33 kV circuits, both from South Holland BSP. One of these circuits is teed off from the circuit which feeds Holbeach Primary T2. There is also a 33 kV circuit from Holbeach to Long Sutton which is left open under normal running arrangements.

Spalding and South Holland BSPs are supplied from Walpole GSP via three 132/33 kV Grid Transformers (one at South Holland BSP rated to 30/60/78 MVA and two at Spalding BSP, each rated to 45/90/117 MVA). There are two 33 kV circuits between Spalding and South Holland BSPs. The two BSPs are run in parallel, with Spalding BSP picking up the full group load for the loss of the single transformer at South Holland BSP.

Under an outage (arranged or fault) condition for the loss of one of the transformers at either Primary, the remaining transformer in service supplies the group demand. The firm capacity of the two sites is limited by voltage regulation.

Figure 35 Holbeach Primary and Long Sutton Primary geographic network coverage

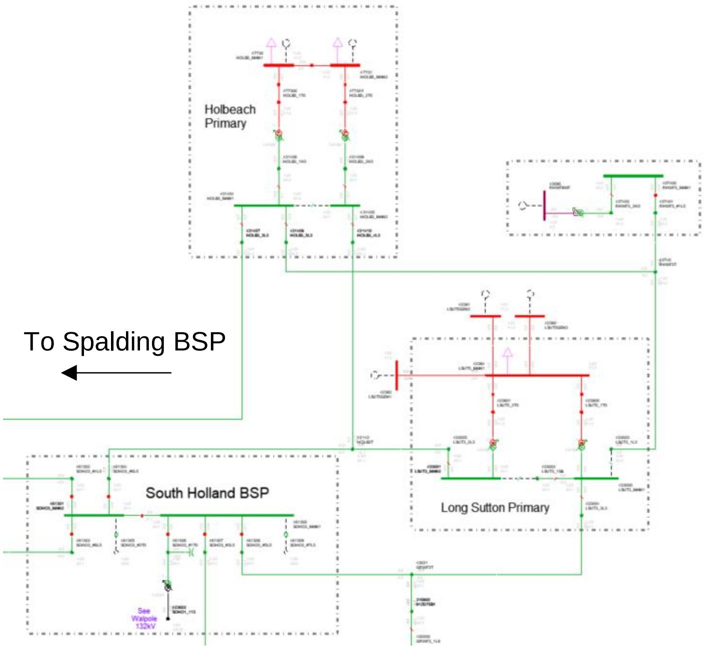

Figure 36 Holbeach Primary and Long Sutton Primary 33 kV network schematic

Constraint summary

The table below outlines the nature of the network constraint at Holbeach Primary and Long Sutton Primary identified in the network analysis. For the loss of the Main 1 busbar at South Holland BSP the voltage drops below 0.94 per unit on the downstream 33 kV network. This puts a number of customers at risk of their supply dropping to below the statutory voltage limit. This occurs in the baseline at winter peak demand and is further triggered in other seasons in some scenarios from 2025 onwards. Works are currently underway to uprate the 33 kV circuit from Spalding BSP to Holbeach Primary, reducing its impedance and improving voltage regulation.

From 2028 under the Consumer Transformation and Leading the Way scenarios and from 2032 in all scenarios thermal constraints also occur for various FCO conditions at Long Sutton Primary and Holbeach Primary for winter peak and intermediate warm peak demand (both arranged and fault conditions).

Constrained assets	33/11 kV transformers and 33 kV feeder circuits to both Primaries	
Type(s) of constraint	Thermal overload and voltages outside of statutory limits	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Voltage regulation and thermal rating	
Outage combination which causes the constraint	First Circuit Outage	Outage (arranged or fault) on South Holland BSP Main 1 busbar, or an outage (arranged or fault) on one of the 33/11 kV transformers or feeder circuits to Long Sutton Primary or Holbeach Primary

Scenario identification

The table below highlights when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation	✓	✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

The following solution options could resolve the constraint described above. Any final solution will be subject to a cost benefit analysis.

Solution option	**Summary**
Reinforcement	Establishing a new Primary substation between Holbeach and Long Sutton (with two new 12/24 MVA transformers fed by new 33 kV circuits from South Holland BSP) and transferring load from the two existing Primaries would alleviate both the thermal and voltage issues in the area. Another 132/33 kV Grid Transformer could also be installed at South Holland BSP to further support demand growth in the area (demand would then no longer need to be picked up entirely from Spalding BSP under FCO conditions).
Operational mitigation	Temporary 11 kV transfers could help mitigate some of the immediate constraints but a more conventional intervention may be necessary as the demand grows.
Load Management Schemes	Any additional connections into this group may be included in an Active Network Management (ANM) scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down flexibility contracts could benefit this area and defer conventional reinforcement in the short-medium term, but this will become less effective and economical as the demand grows in the area.

Ilkeston Primary

Network Overview

Ilkeston Primary is a 33/11 kV site connected via two direct 33 kV circuits from Stanton BSP within Willington GSP group. It consists of two Primary transformers, T1 and T2, each rated 21.75 MVA; the incoming circuits from Stanton are predominantly 150 mm[2] ACSR overhead lines with ratings of 23.9 MVA (summer) and 27 MVA (winter).

The site runs closed at 11 kV, for an outage (arranged or fault) of a transformer or incoming 33 kV circuit the remaining transformer and circuit in service supplies the entire Ilkeston group demand.

Figure 37 Ilkeston Primary geographic network coverage

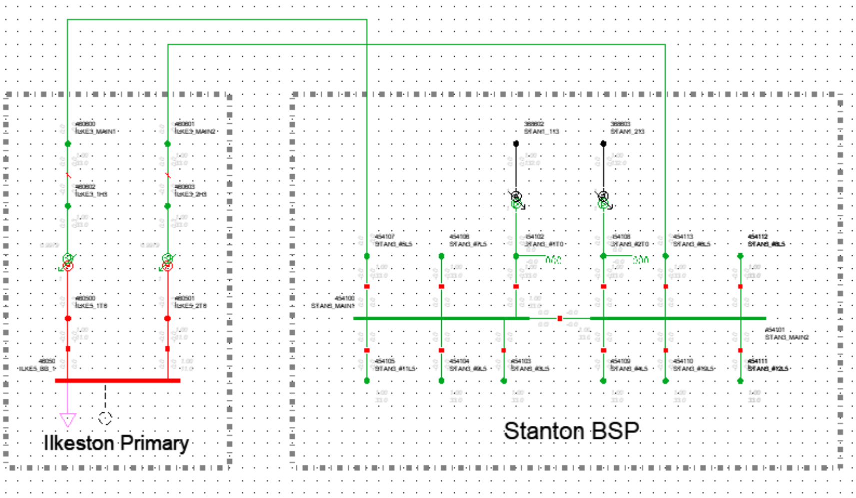

Figure 38 Ilkeston Primary 33 kV network schematic

Constraint summary

Generation | Demand

For a first circuit arranged or fault outage on either T1 or T2 infeeds, the remaining in-service transformer is likely to overload. The same outage also results in overloads of the remaining 33 kV incoming circuit; however this only occurs from 2028 onwards.

The table below outlines the nature of the network constraints identified in the network analysis.

Constrained assets	Ilkeston 33/11 kV transformers and 33 kV incoming circuits	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand (from 2028)	
Limiting factor of constrained assets	21.75 MVA rating of the 33/11 kV transformers, and Rating of 33 kV circuits consisting mainly of 150 mm^2 ACSR overhead line conductor.	
Outage combination which causes the constraint	First Circuit Outage	Arranged or fault outage on either 33/11 kV transformer or 33 kV circuit

Scenario identification

The table below highlights when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

33/11 kV Transformer Constraint:

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				✓
System Transformation			✓	✓
Consumer Transformation	✓	✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

33 kV Circuit Constraint:

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				✓
System Transformation			✓	✓
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

The following solution options could resolve the constraints described above. Any final solution will be subject to a cost benefit analysis.

Solution option	Summary
Reinforcement	Replace both of the existing 33/11 kV transformers with larger units; and uprate the 33 kV circuits between Stanton BSP and Ilkeston Primary.
Operational mitigation	Temporary 11 kV transfers could help mitigate some of the immediate constraints but a more conventional intervention may be necessary as the demand grows.
Load Management Schemes	Very limited due to the potential Engineering Recommendation P2/7 non-compliance for a Class C group demand.
Flexibility services	Generation turn up and/or demand turn down via the ‘Secure’ product. Dispatch of services may be required for an extended period of time given the constraint is present under a First Circuit Outage and across multiple seasons.

Willington to Spondon 132 kV

Network Overview

Willington GSP is a 132 kV double busbar site fed via four Super Grid Transformers that run 2+2 split under normal running configuration.

Spondon 132 kV is a double busbar site, normally run solid, and fed via three 132 kV circuits from Willington GSP. It primarily supplies a large embedded generator, Derby South (GT1 and GT2), Spondon B, Stanton and Heanor BSPs.

The circuits are connected as follows:

- Willington Main 1 – Burton tee – Spondon Main 1;
- Willington Main 1 – Derby South Main 1 – Spondon Reserve 1;
- Willington Reserve 1 – Derby South Main 2 – Spondon Main 1.

There is a fourth 132 kV circuit between Willington and Derby South, however it is not coupled with the other three circuits, and it does provide further interconnection to Spondon.

Stanton and Heanor BSPs have two 132 kV interconnectors to Staythorpe C (via Loscoe switching site) and can be transferred across for various arranged first circuit outages.

Network Operability Modelling

The network operates as follows:

- Under normal running arrangement, Willington GSP is run 2+2 split but paralleled at Spondon 132 kV busbars via the three circuits mentioned above.
- Under arranged busbar outages at Willington 132 kV or arranged circuit outages affecting any of the three circuits between Willington and Spondon, Heanor and Stanton are transferred onto Staythorpe C GSP. The remaining group demand is then expected to be picked up by the 132 kV busbars and remaining circuits in service. A subsequent second circuit fault outage could result with the entire group demand on the remaining third circuit between Willington and Spondon.
- Certain busbar fault outages at Willington or Spondon result in the loss of two of the three 132 kV circuits feeding the network. This would result with the entire group demand (including those of Heanor and Stanton) on the remaining third circuit.

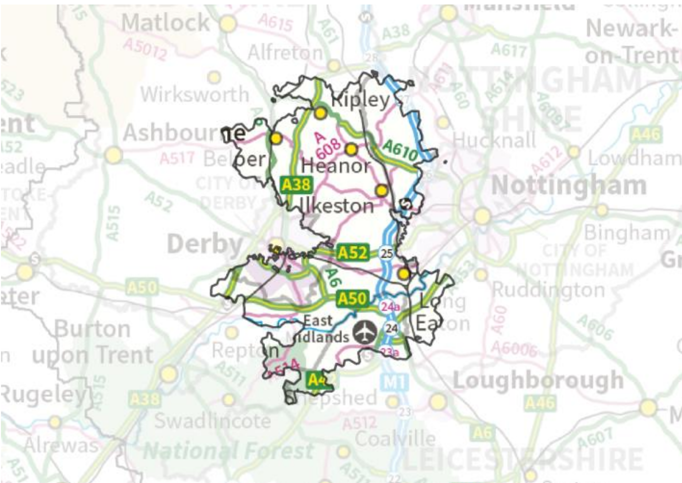

Figure 39 Willington - Spondon geographic network coverage

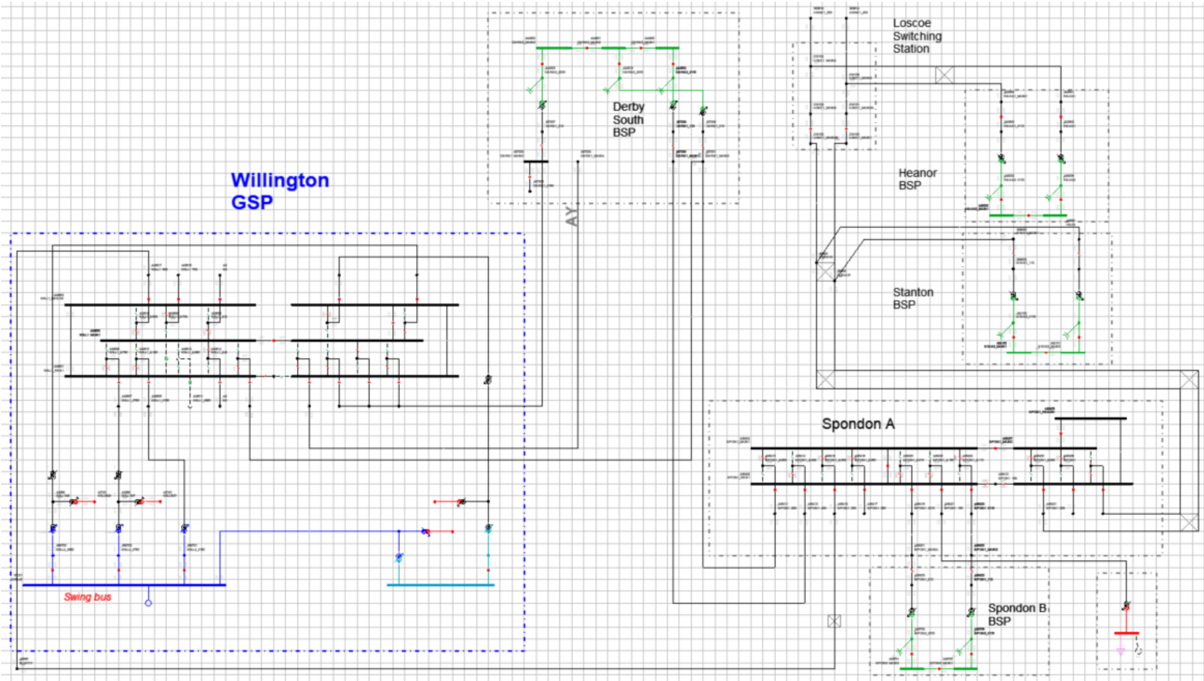

Figure 40 Willington - Spondon 132 kV network schematic

Constraint summary

Generation Demand

The 132 kV circuits between Willington and Spondon are likely to overload under:

- A busbar fault outage at Willington or Spondon, taking out two of the three incoming circuits.
- A first circuit arranged outage on one of three circuits, followed by a fault on another.

The worst overloads are observed on the following sections:

- Willington to Burton Tee to Spondon
- Derby South Main 1 to Spondon Reserve 1
- Derby South Main 2 to Spondon Main 1

The table below outlines the nature of the network constraints identified in the network analysis.

Constrained assets	Three 132 kV circuits between Willington GSP and Spondon A	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand Summer Peak Demand	
Limiting factor of constrained assets	Circuit rating (particularly the sections consisting of 175 mm^2 ACSR tower line conductors)	
Outage combination which causes the constraint	First Circuit Outage	Busbar fault outage at Willington Main 1 or Spondon Main 1
	Second Circuit Outage	Arranged busbar or circuit outages affecting one of the 132 kV circuits between Willington and Spondon, followed by a second circuit fault outage on another

Scenario identification

The table below highlights when the constraints occur during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

Scenario	Study year			
	Baseline	**2025**	**2028**	**2032**
Steady Progression	✓	✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

The following solution options could resolve the constraints described above. Any final solution will be subject to a cost benefit analysis.

Solution option	Summary
Reinforcement	Construct an additional 132 kV circuit between Derby South and Spondon, utilising the existing fourth circuit between Willington and Derby South. This will create four infeeds between Willington and Spondon, three of which connect via Derby South. This would further require modification to the existing busbar configurations at Willington, Spondon, and Derby South to allow for an even load split between the four circuits, also to prevent the loss of two circuits under a busbar fault outage. This solution will require partial replanting at Willington and at Spondon 132 kV. This should be accompanied by a detailed fault level assessment to identify any necessary re-plant works.
Operational mitigation	Very limited especially considering the first busbar fault outage constraint which would require significant load transfers under normal running arrangement and subsequently shifting the constraint to other parts of the network. For the second circuit outage constraint, load transfers out of the group are available during the arranged outage but this would also exacerbate issues on other parts of the network.
Load Management Schemes	A combination of post fault ratings and overload protection might help mitigate some of the constraints; however a more conventional intervention may be necessary as the demand grows across the 0-10 year period.
Flexibility services	Generation turn up and/or demand turn down via the 'Secure' product could help alleviate some of the constraints, however dispatch of services may be required for an extended period of time given the level of overload observed, and the constraint being present under a First Circuit Outage and across multiple seasons.

Winster BSP

Network Overview

Winster BSP is a 132/33 kV substation located near the village of Winster, fed from Willington GSP by the ‘AR’ 132 kV dual circuit overhead (OH) tower line. The circuits are each 35 km long and strung with 175 mm^2 ACSR conductor.

The BSP has two Grid Transformers rated to 30/60/78 MVA. The transformers run in parallel under normal running arrangements and in the event of an outage (arranged or fault) of one transformer, the remaining transformer in service supplies the entire BSP demand.

The Primary substations fed from Winster BSP are Ashbourne, Bakewell, Cromford, Hopton, Longcliffe, Matlock and Millclose. Bakewell, Cromford and Hopton are all single transformer Primary substations. The demand growth in the area is forecast to exceed the firm capacity of Winster BSP in the near future.

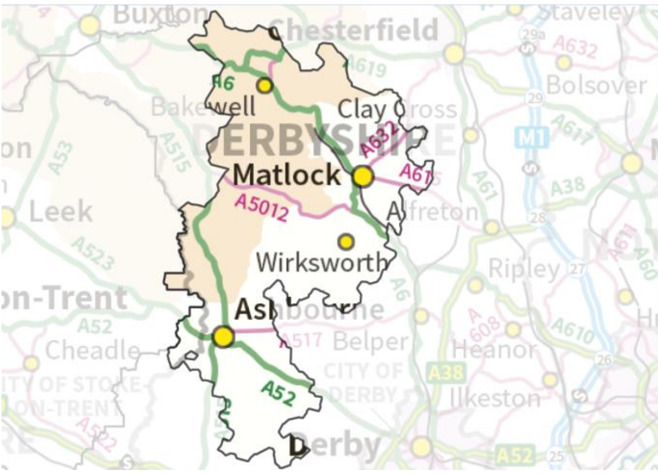

Figure 41 Winster BSP geographic network coverage

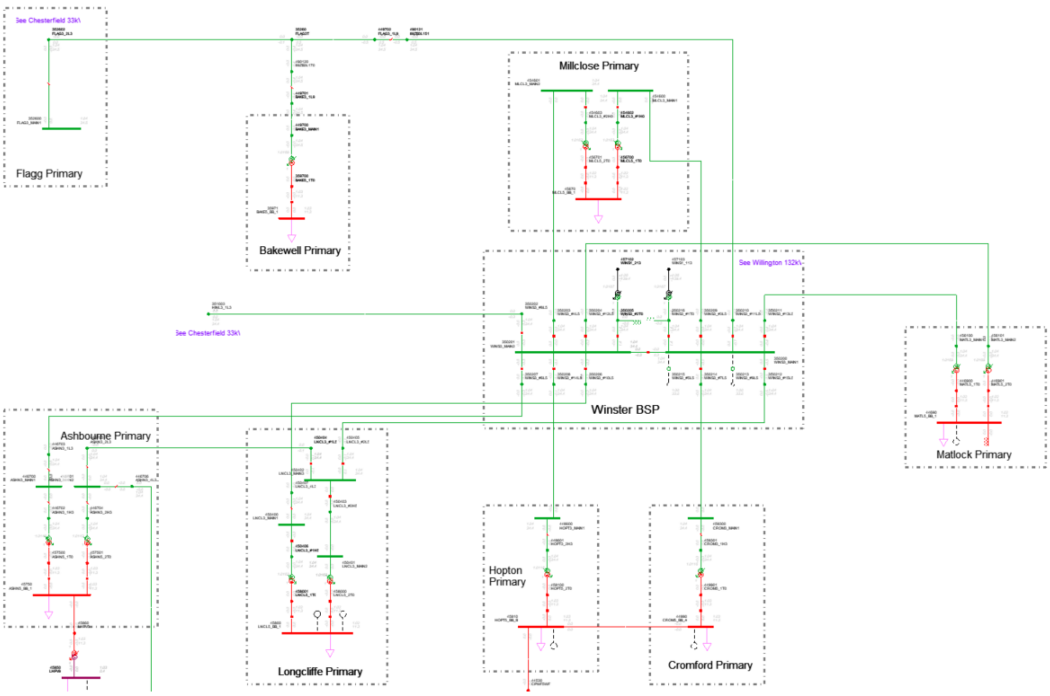

Figure 42 Winster BSP 33 kV network schematic

Winster 132/33 kV Grid Transformer Capacity

Constraint summary

Generation Demand

The table below outlines the nature of the network constraint on the Grid Transformers at Winster BSP identified in the network analysis. In 2025 the constraint is only for arranged outages, except in Best View and Leading the Way where the constraint occurs for a fault in intermediate warm (GT1 only). By 2028 the constraint also occurs for fault conditions in System Transformation and by 2032 in Steady Progression as well.

Constrained assets	132/33 kV transformers at Winster BSP	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand (from 2025 BV/LTW, 2028 CT/ST and 2032 SP) Intermediate Warm Peak Demand (arranged only in 2025 for ST/CT)	
Limiting factor of constrained assets	30/60/78 MVA rating of the 132/33 kV transformers	
Outage combination which causes the constraint	First Circuit Outage	Outage on either 132/33 kV transformer, feeder circuit or 33 kV busbar

Scenario identification

The tables below highlight when the constraint occurs for GT1 and GT2 during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

Transformer GT1 constraint:

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression	✓		✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Transformer GT2 constraint:

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression			✓	✓
System Transformation		✓	✓	✓
Consumer Transformation		✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

The following solution options could resolve the constraint described above. Any final solution will be subject to a cost benefit analysis.

Solution option	Summary
Reinforcement	Replace the existing 30/60/78 MVA Grid Transformers with 45/90/117 MVA units. This would alleviate the constraint and provide ample headroom for future load growth in the area. The 132 kV circuits to Winster BSP would not need uprating.
Operational mitigation	This constraint could be managed by only taking outages in the summer, but this is not an enduring solution as the constraint is an issue for fault conditions by 2025 under some scenarios as described above.
Load Management Schemes	Any additional connections into this group may be included in an Active Network Management (ANM) scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Continuing to utilise flexibility contracts be used to defer conventional reinforcement in the short-medium term, but this will become less effective and economical as the demand grows in the area.

Cromford 33/11 kV Transformer Capacity

Constraint summary

Generation Demand

The table below outlines the nature of the network constraint on the transformer at Cromford Primary identified in the network analysis. The constraint occurs for arranged outages as the demand from Hopton Primary is supplied via 11 kV interconnection from Cromford Primary.

Constrained assets	33/11 kV transformer at Cromford Primary	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand Intermediate Warm Peak Demand	
Limiting factor of constrained assets	Rating of the 33/11 kV transformer	
Outage combination which causes the constraint	First Circuit Outage	Outage on the 33/11 kV transformer/the feeder circuit at Hopton Primary or on the Main 2 busbar at Winster BSP, resulting in the transfer of demand at Hopton Primary onto Cromford Primary

Scenario identification

The table below highlights when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression		✓	✓	✓
System Transformation		✓	✓	✓
Consumer Transformation	✓	✓	✓	✓
Leading the Way		✓	✓	✓
WPD Best View		✓	✓	✓

Solution options

The following solution options could resolve the constraint described above. Any final solution will be subject to a cost benefit analysis.

Solution option	Summary
Reinforcement	Install a second 33/11 kV transformer at Hopton Primary, along with a new 33 kV feeder circuit from Winster BSP. This would mean that for an outage on one of the transformers at Hopton Primary, the load could be supplied by the remaining transformer without relying on back feed capacity at 11 kV from Cromford Primary.
Operational mitigation	Load could be moved on the 11 kV network to other Primaries in the area under outage conditions. To fully assess the viability of this option a more in depth study looking at the 11 kV network is required. Another option could be to only take arranged outages in the summer but this would reduce the operability of the network and would not be an enduring solution.
Load Management Schemes	Any additional connections into this group may be included in an Active Network Management (ANM) scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down flexibility contracts could benefit this area and defer conventional reinforcement in the short-medium term, but this will become less effective and economical as the demand grows in the area.

Bakewell 33/11 kV Transformer Capacity

Constraint summary

Generation | **Demand**

The table below outlines the nature of the network constraint at Bakewell Primary identified in the network analysis. The constraint occurs when demand exceeds the firm capacity of Bakewell Primary, which is limited by the 11 kV back feeds to around 6 MVA.

Constrained assets	11 kV interconnections between Bakewell Primary and Millclose Primary	
Type(s) of constraint	Thermal overload	
Constrained condition(s)	Winter Peak Demand	
Limiting factor of constrained assets	11 kV interconnecting circuits to neighbouring Primary substations	
Outage combination which causes the constraint	First Circuit Outage	Outage on the 33/11 kV transformer at Bakewell Primary

Scenario identification

The table below highlights when the constraint occurs during the 0-10 year period across the different scenarios studied from the 2021 Distribution Future Energy Scenarios.

	Study year			
Scenario	**Baseline**	**2025**	**2028**	**2032**
Steady Progression				✓
System Transformation				✓
Consumer Transformation			✓	✓
Leading the Way			✓	✓
WPD Best View			✓	✓

Solution options

The following solution options could resolve the constraint described above. Any final solution will be subject to a cost benefit analysis.

Solution option	**Summary**
Reinforcement	Install a second 33/11 kV transformer at Bakewell Primary, along with a new 33 kV circuit to Winster BSP. This would mean that for an outage on one of the transformers at Bakewell Primary the load could be supplied by the remaining transformer, without relying on back feeds at 11 kV to Millclose Primary, alleviating the constraint.
Operational mitigation	Load could be moved on the 11 kV network to other Primaries in the area under outage conditions. To fully assess the viability of this option a more in depth study looking at the 11 kV network is required.
Load Management Schemes	Any additional connections into this group may be included in an Active Network Management (ANM) scheme, which could also be utilised to manage constraints on over-committed networks.
Flexibility services	Generation turn up and/or demand turn down flexibility contracts could benefit this area and defer conventional reinforcement in the short-medium term, but this will become less effective and economical as the demand grows in the area.

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