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ED2 Worst Served Customers Stakeholder Report

October 2024

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Appendix – Detailed information of the RIIO-ED2 WSC projects

1 Definitions

GVR	Gas Vacuum Recloser (a pole mounted device capable of clearing and reclosing onto overhead faults to restore customers during transient fault activity).
HV	High Voltage (for the purposes of this document, 11,000 volts or 6,600 volts).
LV	Low Voltage - a voltage less than one thousand volts.
NOP	Normally Open Point (referring to a switch or circuit breaker that is normally open. This device can typically be used to restore supplies via an alternate circuit).
OHL	Overhead Line.
RC	Remote Control (related to a network switch or breaker that can be controlled remotely including by network automation systems).
RIIO-ED2	Current Ofgem regulatory period.
WSC	Worst Served Customer (as defined by Ofgem) a customer who has experienced twelve or more unplanned higher voltage (HV and above) interruptions over a three-year period with no less than two interruptions in any one year.

2 Introduction

For the RIIO-ED2 (2023-2028) period, Ofgem has defined a worst-served customer (WSC) as being one who has experienced twelve or more unplanned HV interruptions over a three-year period with no less than two interruptions in any one year[1]. To address the issue of WSCs, Ofgem has provided a Use-It-Or-Lose-It allowance of £27.1m (24/25 prices)[2]. We will use this money to invest in the network to address the network performance issues affecting WSCs. Aligned with this, we have made it one of our RIIO-ED2 Business Plan commitments to have no WSCs on the network before the end of March 2028.

To give Ofgem and our stakeholders confidence we are applying a structured and cost-efficient approach to designing solutions for WSCs, the ED2 licence requires us under SpC 3.4 to comply with the WSC Governance Document, including publishing on our website our ED2 WSC methodology, setting out our approach to identifying WSC projects, the options considered and the how they have been costed.

In section 3 we outline the approach we have taken to identifying which customers we will be targeting through our ED2 investment programme, setting out the number of WSCs that we have, and the number of networks (or feeders) that will be in scope of our planned interventions.

Section 5 provides an overview of the scope of the work we propose to undertake across the various projects and the approach we have taken to prioritising the investments, whilst section 6 describes further work we will do to monitor our network and bring forward additional investments to address newly emerging issues not in the scope of the main programme of work.

The specific details of the work for each of the investment projects is set out in sections 9 & 10 and summarised in section 11. An update on the progress to-date is captured in section 12.

3 Network performance analysis

We have analysed the underlying HV network performance, applying Ofgem's ED2 WSC definition to each three-year period from 2015 through to 2023. To ensure we focus our efforts on interruptions that are reflective of poorly performing network, we have discounted the following interruptions:

- Interruptions that were less than three minutes in duration as these do not qualify under Ofgem's definition.
- Interruptions during temporary abnormal HV network running arrangements while the WSCs were supplied via another HV circuit.
- Multiple interruptions within a 24hr period which are often a result of the same fault incident (we have only considered the first interruption)
- Interruptions from the disconnection of temporary mobile generators after associated fault repairs.

This revealed that 3,040 customers would have qualified as Worst-Served during the period from 2015 to 2023 and were spread across 32 HV feeders that supplied 40,961 customers overall.

[1] Version 1 of the WSC Governance Document referred to in Special Condition 3.4 of the Electricity Distribution Licence.

[2] ENWL RIIO-ED2 Final Determination pg. 29

4 Co-ordination with other ED2 proposals

We are mindful that while the benefits of the investments will be material, significantly improving the reliability of the electricity supplies for thousands of customers, our construction work can be very disruptive. To ensure efficient delivery of the work and to minimise the impact on customers and residents, we are co-ordinating our WSC network investments with other major construction projects we have planned on the network during RIIO-ED2. This includes any reinforcement, refurbishment, and other capital investment projects.

We also applied to Ofgem for additional funding relating to storm resilience improvements under the Storm Arwen re-opener in January 2024. As many of the WSC circuits are also impacted by storm events, it is possible that additional resilience-related work may be identified on these circuits which will be co-ordinated with the reliability-related scope of works set out in this report, subject to Ofgem agreement of funding.

5 Scope of work

In ED2 Ofgem has amended the efficacy constraints of ED1 which significantly restricted the extent of the network investments we were able to make. As a result of this change, we are better able to develop a more comprehensive range of solutions to the underlying performance issues affecting WSCs.

Here we set out the general scope of the proactive network investments we will be undertaking on WSCs during ED2 while section 9 of this report provides more detail for each of the individual WSC projects.

We have developed network investment projects for each of the 32 HV feeders and where appropriate its associated backup feeder (known as a backfeed). Each of the projects are fully scoped and are in the detailed planning and design phase ahead of construction which is planned to commence in 2025.

Subject to detailed design, the investment projects will typically comprise a mix of HV feeder reconfiguration (i.e. moving Normally Open Points), undergrounding, or refurbishment of poorly performing or fault prone overhead line feeder sections. In a limited number of instances to reduce customer risk, the creation of new underground HV cable feeders out of associated primary substations has also been considered. In many instances, enhanced network automation and additional protection zones have also been included. Secondary network switchgear replacements will be required to facilitate the fitting of automation on several feeders.

While the total allowance for WSC in ED2 is material, the high number of HV feeders and the high potential cost of associated network investments required that we undertook a holistic assessment of the programme to ensure that the proposed interventions were suitably prioritised, i.e. it was proposed that a greater proportion of the overall allowance was targeted on those feeders which benefit most WSCs through improvement in overall network performance.

Based on high-level, preliminary studies, each of the 32 HV feeders was assigned to one of the following four investment prioritisation categories:

1. **High –** Expected cost of individual project: £0.8m to £2.1m

   These solutions typically involved longer HV cable laying and network reconfiguration, including new feeders out of the primary substation via a primary board extension.

2. **Medium** – Expected cost of individual project: £0.25m to £0.9m

Similar to High but with smaller amounts of cable laying. These solutions were concentrated on OHL undergrounding / refurbishment of poorly performing sections.

3. **Low** – Expected cost of individual project: up to £0.25m

   Similar to the range of interventions we used in ED1, solutions in the low category will include those with minimal cable lay or network reconfiguration.

4. **No additional work required** – No additional cost.

   Feeders in this category are expected to have benefited from network investments we conducted in ED1, thereby avoiding the need for further investment in ED2, or where the network performance has improved considerably in recent years.

In categories 1, 2 and 3, secondary network switchgear replacement will be required to facilitate the fitting of automation, and we will consider additional network automation alongside modification or enhancement of existing HV feeder protection.

6 Reactive programme

In our ED2 business plan, we have made a commitment to having no qualifying WSC on our network by 2028. We are delivering this through both the proactive network investments described in section 5, which aim to make substantive and sustained improvements in performance to previously qualified WSC networks, alongside a reactive, tactical intervention programme which seeks to address any newly emerging WSC performance issues.

It is the combination of the proactive and reactive network investments that gives us confidence to make having no WSCs on our network before the end of 2028 one of our RIIO-ED2 business plan commitments.

Our analysis shows that large numbers of customers are at a performance level just below the Ofgem ED2 WSC qualifying threshold. Owing to the inherent variability in performance year on year, it is not possible to predict if these customers will, during ED2, qualify as worst served. During RIIO-ED1, we adopted for a reactive approach to work on WSCs, establishing a notional provision in our investment plan of £500k to allow work on these feeders.

To allow us to address these customers, we are continuing with the approach introduced in ED1 which will sit alongside the main programme in ED2. This provisions £250k in each year for tactical interventions in response to new or emergent WSC issues. We call this our reactive WSC programme.

7 Poor performing backup (backfeed) feeders

In many instances, the poor reliability of adjacent backup (or backfeed) HV feeders can dramatically contribute to the numbers of qualifying WSCs on a HV feeder. Therefore, to ensure that all network factors contributing to poor performance outcomes was considered, further analysis was carried out to determine the influence of poor performing backfeeds on the performance of the worst served customers, specifically the impact of preventing network automation from restoring the WSC protection zones within three minutes. Seven such backfeed circuits were identified as likely to benefit from investment as part of the associated ED2 WSC projects. These feeders are included in the investment table summary (section 11).

8 Total number of WSC in FY24

The number of customers that met the Ofgem RIIO-ED2 requirement and therefore qualified as a WSC as of the regulatory year ending on 31 March 2024 was 906. These customers are spread across 13 HV feeders as listed below.

HV Feeder	WSCs	Associated Project
Askerton - Fell End	25	60002581 - Reactive WSC project in progress
Bollington - Clarence Mill	153	60000311 - Reactive WSC project in progress
Capontree - Capon Hill	25	60004438 - Reactive WSC project in progress
Dalton - Highfield Gen / Greystones	4	60002768 - ED2 WSC project in progress
Grange - Lindale Sw Stn	96	60002759 - ED2 WSC project in progress
Haverthwaite - Haverthwaite ABS	156	60002748 - ED2 WSC project in progress
Ingleton - Ingleton Industrial	12	60002767 - ED2 WSC project in progress
Kirkby Stephen - Enterber ABS	71	60002758 - ED2 WSC project in progress
Mintsfeet - Kingdom Hall	50	60002762 - ED2 WSC project in progress
Petteril Bank - Hopehill Dr	107	60002764 - ED2 WSC project in progress
Silloth - Harvest Pk	80	60002580 - Reactive WSC project in progress
Silloth – North Hill	9	60004439 - Reactive WSC project in progress
Tarleton - Boundary Ln	118	60002573 - ED2 WSC project in progress

9 Background information for the RIIO-ED2 WSC projects

This section summarises each of the ED2 Worst Served Customers projects. More detailed information on each project can be found in the appendix, including the performance issues affecting each HV feeder, a geographical map of the network, the proposed scope of the work planned, and any alternative options that we considered.

Name of WSC project	AMBLESIDE - BORRANS COURT
WSC project reference	60002749
Areas affected	Regions between Skelwith Bridge and Hawkshead
Number of WSCs	201
Year feeder last qualified	2022
Number of WSCs project is expected to benefit	201
Expected completion date	March 2028
Expected cost (dependent on detailed design)	£2,000k
Description	A new dedicated underground HV feeder from Ambleside to Skelwith Bridge is to be installed in addition to targeted undergrounding and refurbishment of vulnerable overhead line sections supplying the WSCs (this will require a new circuit breaker to be installed at Ambleside and a switchgear change at Skelwith Bridge). Installation of new remote-control devices to optimise existing automation and two poor performing backfeeds will be refurbished to improve overall network resilience.

Name of WSC project	KIRKBY MOOR - WALL END VIA LOCAL RMU
WSC project reference	60002751
Number of WSCs	134
Areas affected	Duddon Valley (between Ulpha and Broughton in Furness)
Year feeder last qualified	2020

Number of WSCs project is expected to benefit	134
Expected completion date	March 2028
Expected cost (dependent on detailed design)	£2,100k
Description	It is proposed to rebuild / refurbish sections of the existing overhead line supplying the WSCs which is prone to high fault volumes while problematic overhead sections upstream of the WSCs is to be undergrounded. Additional remote-control devices have been proposed to improve automation performance, whilst a backfeed out of Coniston will require targeted refurbishment works.

Name of WSC project	WINDERMERE - HEATHWAITE
WSC project reference	60002750
Areas affected	Bowland Bridge and Cartmel Fell regions
Number of WSCs	151
Year feeder last qualified	2022
Number of WSCs project is expected to benefit	151
Expected completion date	March 2028
Expected cost (dependent on detailed design)	£2,100k
Description	It is proposed that a new primary circuit breaker is installed at Haverthwaite primary to allow for a cable circuit to be installed between Haverthwaite and Newby Bridge. The network will need to be reconfigured at Newby Bridge to allow for the existing circuit to be split, significant overhead line refurbishment is required, additional protection zones are to be created, and new remote-control switches are to be installed to improve the existing network automation systems.

Name of WSC project	ASPATRIA - HALL BANK ABS
WSC project reference	60002756
Areas affected	Blindcrake
Number of WSCs	156
Year feeder last qualified	2020
Number of WSCs project is expected to benefit	156
Expected completion date	March 2028
Expected cost (dependent on detailed design)	£1,100k
Description	It is proposed to refurbish sections of the existing overhead line supplying the WSCs while undergrounding fault prone overhead sections out of Aspatria primary. Additional remote-control devices have been proposed to improve automation performance in additional to new reclosers to minimise the impact of future faults and improve transient restoration.

Name of WSC project	HAVERTHWAITE - HAVERTHWAITE ABS
WSC project reference	60002748
Areas affected	Satterthwaite and Near Sawrey regions
Number of WSCs	307
Year feeder last qualified	2024
Number of WSCs project is expected to benefit	307
Expected completion date	March 2028
Expected cost (dependent on detailed design)	£2,200k
Description	It is proposed that a new cable circuit is installed between Haverthwaite and Newby Bridge switching station to allow for the

	WSC network to be reconfigured and split into two separate sections (this will require an additional circuit breaker to be installed at Haverthwaite primary). New remote-control devices will be required to optimise network automation while overhead lines supplying the WSCs are to be refurbished in addition to a poorly performing backfeed (also supplied out of Haverthwaite primary).

Name of WSC project	WHASSET - DUGG HILL
WSC project reference	60002753
Areas affected	Region northwest of Levens
Number of WSCs	72
Year feeder last qualified	2022
Number of WSCs project is expected to benefit	72
Expected completion date	March 2028
Expected cost (dependent on detailed design)	£1,500k
Description	A new dedicated underground feeder from Whasset primary substation to Leasgill switching station has been proposed in addition to overhead line refurbishment, installation of new protection devices and additional remote-control switches. To enable this work, a new circuit breaker will be required at Whasset, a switchgear change will be required at Leasgill switching station and overhead line rebuilding will be required at sites which are prone to high volumes of bird strikes.

Name of WSC project	RIBBLESDALE - WADDOW PK
WSC project reference	60002572
Areas affected	Region northwest of Dunsop Bridge
Number of WSCs	28

Year feeder last qualified	2023
Number of WSCs project is expected to benefit	28
Expected completion date	March 2028
Expected cost (dependent on detailed design)	£1,100k
Description	It is proposed that a new circuit is installed between Ribblesdale primary and Waddington to allow for the WSC feeder to be split into two separate circuits (a new circuit breaker at Ribblesdale primary will be required to supply the new circuit). Additionally, the local overhead line to the WSCs and the corresponding backfeed to the WSCs are to be refurbished.

Name of WSC project	GRANGE – LINGARTH / HAMPSFIELD ABS
WSC project reference	60002759
Areas affected	Meathop and Lindale (South of Lingarth)
Number of WSCs	113
Year feeder last qualified	2024
Number of WSCs project is expected to benefit	113
Expected completion date	March 2028
Expected cost (dependent on detailed design)	£1,200k
Description	It is proposed to underground part of the existing feeder while also looping the WSC radial network into the mainline which will both reduce fault rates and improve restoration performance. Relocation of existing pole mounted switching points, replacement of protection relays, strategic switchgear replacement and refurbishment of the overhead network local to the WSCs will be required.

Name of WSC project	KIRKBY STEPHEN - ENTERBER ABS / WINTON / HARTLEY
WSC project reference	60002758
Areas affected	Regions between Warcop and Great Musgrave
Number of WSCs	149
Year feeder last qualified	2024
Number of WSCs project is expected to benefit	149
Expected completion date	March 2028
Expected cost (dependent on detailed design)	£800k
Description	It is proposed to refurbish the overhead line network beyond Hallgarth and Chapel Garth in addition to a small amount of LV refurbishment. It is also proposed to overlay some fault prone cable in the region of Warcop and to replace an old non-monitored Sectionaliser with a new remote-control Sectionaliser.

Name of WSC project	PETTERIL BANK - HOPESHILL DRIVE
WSC project reference	60002764
Areas affected	Regions between Cumwhitton and Cumrew
Number of WSCs	109
Year feeder last qualified	2024
Number of WSCs project is expected to benefit	109
Expected completion date	March 2028
Expected cost (dependent on detailed design)	£1,100k
Description	It is proposed that a new circuit is installed out of Petteril Bank primary to allow for the WSC feeder to be split into two separate circuits (which will require a new circuit breaker at Petteril Bank

	and additional network reconfiguration works). The local WSC overhead line network is to be refurbished, while reclosers and remote-control switches are to be deployed to limit the impact of future faults.

Name of WSC project	HDA NO1 - WINSCALES AVE / LANDFILL GENERATION
WSC project reference	60002760
Areas affected	Region between Low Moresby and Moresby Parks
Number of WSCs	70
Year feeder last qualified	2021
Number of WSCs project is expected to benefit	70
Expected completion date	March 2028
Expected cost (dependent on detailed design)	£1,000k
Description	It is proposed that a new circuit is installed out of HDA No1 primary to allow for the WSC feeder to be split into two separate circuits (which will require network reconfiguration works, a switchgear change at Howgate switching station, and a new circuit breaker at HDA No1 primary). The local WSC overhead line network is to be refurbished, and remote-control switches are to be deployed to limit the impact of future faults.

Name of WSC project	HDA NO1 - LAMPLUGH RD / DEANCROSS GVR
WSC project reference	60002757
Areas affected	Region between Rowrah and Frizington
Number of WSCs	155
Year feeder last qualified	2022
Number of WSCs project is expected to benefit	155

Expected completion date	March 2028
Expected cost (dependent on detailed design)	£700k
Description	The proposals include undergrounding of targeted overhead sections, adjustments to protection systems, refurbishment of the local WSC overhead line sections and additional remote-control switches to improve automation performance.

Name of WSC project	PREESALL - PILLING STN & LITTLE TONGUES LN
WSC project reference	60002752
Areas affected	Region northwest of Nateby and the region south of Pilling
Number of WSCs	116
Year feeder last qualified	2022
Number of WSCs project is expected to benefit	116
Expected completion date	March 2028
Expected cost (dependent on detailed design)	£1,300k
Description	It is proposed that a new cable circuit is installed from Preesall primary to Pilling Station to allow for the network to be reconfigured. This will require a new primary circuit breaker to be installed, a switchgear change at Pilling Station, adjustments to network protection settings, and overhead line undergrounding / refurbishment at WSC locations.

Name of WSC project	ASKAM - DRUM CLOSURES SW STN
WSC project reference	60002766
Areas affected	Region between Whitbeck and Silecroft
Number of WSCs	44

Year feeder last qualified	2022
Number of WSCs project is expected to benefit	44
Expected completion date	March 2028
Expected cost (dependent on detailed design)	£600k
Description	Proposals are aimed at refurbishment of the upstream overhead network in relation to the WSCs. Additionally, WSC spur lines are to be rebuilt with covered conductor which have seen high levels of fault activity in recent years.

Name of WSC project	GOWHOLE - NEW ST / SIGNAL BOX MARSH LANE
WSC project reference	60002795
Areas affected	Region south of Higher Chisworth
Number of WSCs	111
Year feeder last qualified	2021
Number of WSCs project is expected to benefit	111
Expected completion date	March 2028
Expected cost (dependent on detailed design)	£400k
Description	It is proposed that a new circuit is installed out of Gowhole primary to allow for the WSC feeder to be split into two separate circuits. The local WSC overhead line network is to be refurbished, and additional reclosers / remote-control switches are to be deployed to limit the impact of future faults.

Name of WSC project	HANGING BRIDGE - BANKS FM SOLLOM / RUFFORD MARINA
WSC project reference	60002574

Areas affected	Sollom
Number of WSCs	29
Year feeder last qualified	2022
Number of WSCs project is expected to benefit	29
Expected completion date	March 2028
Expected cost (dependent on detailed design)	£700k
Description	It is proposed that a new circuit is installed out of Hanging Bridge primary to allow for the WSC feeder to be split into two separate circuits while a new interconnector is to be installed between an adjacent circuit out of Hanging Bridge. This will require a new circuit breaker to be installed at Hanging Bridge primary, in addition to some overhead line refurbishment and the installation of additional reclosers / remote-control switches to limit the impact of future faults.

Name of WSC project	DALTON - GREYSTONES LN / WOOD HEAD ABS
WSC project reference	60002768
Areas affected	Gleaston, Scales and Leece
Number of WSCs	16
Year feeder last qualified	2024
Number of WSCs project is expected to benefit	16
Expected completion date	March 2028
Expected cost (dependent on detailed design)	£900k
Description	It is proposed that a new primary circuit breaker is installed at Dalton to allow for a cable circuit to be installed from Dalton to Greystones Lane substation. This will require some network reconfiguration works while the local WSC overhead line network

	is refurbished, and additional remote-control switches are to be deployed to optimise network automation.

Name of WSC project	INGLETON - INGLETON INDUSTRIAL
WSC project reference	60002767
Areas affected	Region near Ribblehead Quarry (north of Helwith Bridge)
Number of WSCs	43
Year feeder last qualified	2024
Number of WSCs project is expected to benefit	43
Expected completion date	March 2028
Expected cost (dependent on detailed design)	£500k
Description	Several sections of fault prone overhead line are to be rebuilt with covered conductor and surveyed for cutting of encroaching tree lines. It is also proposed to carryout refurbishment of a poorly performing backfeed circuit out of Helwith Bridge primary which impacts the restoration performance of the WSC section.

Name of WSC project	MINTSFEET - KINGDOM HALL
WSC project reference	60002762
Areas affected	Grayrigg and north of Selside
Number of WSCs	53
Year feeder last qualified	2024
Number of WSCs project is expected to benefit	53
Expected completion date	March 2028

Expected cost (dependent on detailed design)	£900k
Description	It is proposed to carry out refurbishment works on the WSC overhead sections while two cable interconnectors are installed to allow for automatic restoration of the WSCs during the loss of upstream network. Additional overhead remote-control has been proposed to improve automation efficiency on the WSC sections, including at the new interconnection points.

Name of WSC project	WILLOWHOLME - SPORTS PAV SHEEPMOUNT
WSC project reference	60002763
Areas affected	Region south of Low Crosby
Number of WSCs	9
Year feeder last qualified	2020
Number of WSCs project is expected to benefit	9
Expected completion date	March 2028
Expected cost (dependent on detailed design)	£600k
Description	It is proposed to overlay fault prone cable sections that currently supply the WSCs while the local overhead network is to be refurbished. Additional ground mounted remote-control has been proposed to improve automation efficiency on the WSC section, including the main backfeed to Fusehill primary.

Name of WSC project	SOUTHWEST MACCLESFIELD - IVYMEADE
WSC project reference	60002794
Areas affected	Region southwest of Birtles
Number of WSCs	58

Year feeder last qualified	2019
Number of WSCs project is expected to benefit	58
Expected completion date	March 2028
Expected cost (dependent on detailed design)	£900k
Description	It is proposed that a new circuit breaker is installed at SW Macclesfield primary to enable a new cable circuit out to Henbury. Reconfiguration works will be required at Henbury to allow for the circuit to be split in two, while sections of overhead line supplying the WSCs will be refurbished, and selected sections of overhead line through wooded areas are to be rebuilt with covered conductor.

Name of WSC project	TARLETON - BOUNDARY LN / NEW HS NURSERIES
WSC project reference	60002573
Areas affected	Banks
Number of WSCs	554
Year feeder last qualified	2024
Number of WSCs project is expected to benefit	223 (331 customers have already been transferred onto another circuit during ED1)
Expected completion date	March 2028
Expected cost (dependent on detailed design)	£200k
Description	Reinforcement and reconfiguration of this circuit was carried out in ED1 which has improved recent performance for several of the WSCs, while refurbishment of the main WSC spur has recently been carried out. However, further upstream refurbishment has now been proposed due to recent fault activity in this area.

Name of WSC project	ORMSKIRK - GREEN LN

WSC project reference	60002575
Areas affected	Region northeast of Haskayne
Number of WSCs	2
Year feeder last qualified	2018
Number of WSCs project is expected to benefit	2
Expected completion date	March 2028
Expected cost (dependent on detailed design)	£100k
Description	A new auto-recloser has been installed on this circuit as part of recent quality of supply scheme which should improve the overall performance of the feeder. It is now proposed to refurbish the local overhead line that supplies the WSCs and a fault prone section of overhead line near Hurlston which also impacts the WSCs security of supply.

Name of WSC project	KESWICK - LAIRTHWAITE
WSC project reference	60002761
Areas affected	Region southwest of Swinside
Number of WSCs	12
Year feeder last qualified	2019
Number of WSCs project is expected to benefit	12
Expected completion date	March 2028
Expected cost (dependent on detailed design)	£100k
Description	Network performance of this circuit has greatly improved in recent years due to both a reduction in fault rates and a successful roll out

	of network automation. It is therefore proposed to simply refurbish the overhead spur line which supplies the WSCs.

Name of WSC project	SILLOTH - CHERITEX / SILLOTH AIRFIELD
WSC project reference	60002765
Areas affected	Seaville (east of Silloth)
Number of WSCs	45
Year feeder last qualified	2020
Number of WSC planned project is expected to benefit	45
Expected completion date	March 2028
Expected cost (dependent on detailed design)	£200k
Description	Reconfiguration of this circuit was carried out in ED1 which has improved recent performance. It is therefore proposed to simply refurbish the overhead line which supplies the WSCs.

Name of WSC project	GIDLOW - WIGAN INFIRMARY (Previously Queensway)
WSC project reference	60002576
Areas affected	Region east of Standish and north of Aspull
Number of WSCs	202
Year feeder last qualified	2019
Number of WSC planned project is expected to benefit	45
Expected completion date	March 2028
Expected cost (dependent on detailed design)	£200k

Description	Reconfiguration of this circuit was carried out in ED1 which has improved recent performance of the feeder. However, it is proposed to refurbish the WSC overhead spur line which has been prone to recent fault activity.

10 Reactive projects

As detailed in section 5, tactical interventions are being introduced in response to new or emerging WSC issues throughout ED2. The qualifying criteria is based upon customers who have experienced a total of nine HV unplanned outages or more over the previous three years (including the current fiscal year) and at least two outages in each of the first two years. Therefore these customers are three faults or less away from qualifying as worst-served during the current fiscal year.

Project Number	Feeder	No of WSCs	LBE	Proposals Summary
60002581	Askerton – Fellend	25	£100k	- Install an RC ABS between Leapsrigg (632181) and Moss View (632126). - Survey main line between Knorren GVR and Burnside ABS (~6km) with a view to identify any required refurbishment works including tree cutting and suitable locations for bird diverters.
60000311	Bollington - Clarence Mill	153	£15k	- Protection grading issues between network GVRs and primary auto-reclose to be rectified. - Fix VPIN 58 issue (RTU Battery/Charger Fail) at GVR186 - Survey OHL between ABS183 and ABS086 to check issues with trees. Install OHL spacers to reduce the chance of future conductor clashing on this section.
60002580	Silloth - Harvest Pk	81	£70k	- Survey Old Mawbray OHL spur (~3km) to identify any required refurbishment works. - Install bird diverters between New Mawbray ABS and Pelutho West ABS (~2km).
60004438	Capontree - Capon Hill	25	£85k	- Survey OHL (~3.5km) beyond Dandy GVR to identify any required refurbishment works. - Resolve protection issues at Kirkhouse midpoint network breaker. - Resolve SEF protection issues at primary feeder breaker.
60004439	Silloth – North Hill	7	£100k	- All associated WSC faults are related to Hayrigg GVR protection zone which is restricted by small section conductor (fault level restrictions). It is proposed that this section is upgraded to enable auto-reclose at the existing GVR. - A full line survey is required to determine the condition of the OHL and if any other refurbishment work is required.

60004440	Tarleton – Booths Station Rd / Stanley Hs	4	£80k	- It is proposed that the Marsh Field Farm spur is restrung with covered conductor due to persistent bird strikes on this WSC section.
60004441	Handforth – Trackside	17	£15k	- Two network referrals have already been raised on this circuit which should improve the performance of the associated WSC section. - The first is to reinforce small section conductor which currently restricts the use of auto-reclosing for transient faults. - The second is to install covered conductor on the Mill Farm spur which is prone to bird strikes. - It has also been recommended that the area around Woodford Ln is surveyed for tree cutting and the remaining sections on the Woodford Lane – Newton Hall spur is assessed for bird diverters if required.

11 ED2 WSC proposals summary

The table below lists the ED2 WSC feeders and the identified seven poor performing backfeeds. As of June 2024, each has been studied to determine the potential scope of work and assigned to a high, medium, or low investment prioritisation category. High level costs are determined using our ED2 planning unit rates. It should be noted that detailed studies are still to be completed and the assumed scope of work may significantly change.

High investment category

Project No	Primary CB	Primary Circuit	Total WSC	Total Feeder Customers	Estimated Costs (£m)	Primary CB	HV Sw/Gr	RC GVR	RC Pts	Trip saver	OHL Enhanced Refurb (km)	HV Cable (km)
60002749	6090584CW12	AMBLESIDE - BORRANS CT	201	613	2.0	1	1	--	9	--	25.0	6.9
	6090394CW07	CONISTON - CONISTON HYDRO GEN (Backfeed)	--	762								
	6090584CW14	AMBLESIDE - SKELWITH BRIDGE/CROFT COTT ABS (Backfeed)	--	465								
60002751	6090434CW01	KIRKBY MOOR - WALL END VIA LOCAL RMU	134	1040	2.1	--	--	--	8	--	38.0	4.9
	6090394CW05	CONISTON - OLD STATION (Backfeed)	--	600								
60002750	6090574CF12	WINDERMERE – HEATHWAITE	151	4242	2.1	1	--	2	2	--	47.5	4.6
	6090414CF27	HAVERTHWAITE - HAVERTHWAITE LOCAL (Backfeed)	--	1017								
60002756	6093044CW10	ASPATRIA - HALL BANK ABS	156	682	1.1	--	--	--	2	3	13.5	4.2
60002748	6090414CF23	HAVERTHWAITE - HAVERTHWAITE ABS	307	643	2.2	1	--	1	2	--	35.6	7.5
	6090414CF22	HAVERTHWAITE - GREENODD SW STN (Backfeed)	--	632								
60002753	6090564CW06	WHASSET - DUGG HILL	72	1354	1.5	1	1	1	3	--	16.0	5.7
60002572	4000784CW93	RIBBLESDALE - WADDOW PK	28	746	1.5	1	--	--	2	--	32.5	3.0
	4004163CW22	LONGRIDGE - THORNLEY/CHIPPING PENNINE AREA (Backfeed)	--	782								
60002759	6090404CW10	GRANGE - LINGARTH/HAMPSFIELD ABS	113	601	1.2	--	1	2	3	--	19.0	3.5
60002758	6096604CW06	KIRKBY STEPHEN - ENTERBER ABS/WINTON/HARTLEY	149	1310	0.8	--	--	--	1	--	15.0	1.0
60002764	6096064CW11	PETTERIL BANK - HOPESHILL DR	109	1134	1.1	1	1	1	1	--	5.5	5.7
60002760	6093064CW08	HDA NO1 - WINSCALES AVE/LANDFILL GENERATION	70	2210	1.0	1	1	--	2	--	6.5	4.4
60002752*	6099204CW10	PREESALL - PILLING STN	68	677	1.3	1	--	1	2	--	8.0	6.2
	6099204CW03	PREESALL - LITTLE TONGUES LN	48	754								

* *Two WSC feeders out of Preesall will be combined into one WSC project as they are currently interconnected at Pilling Sw Stn.*

Medium investment category

Project No	Primary CB	Primary Circuit	Total WSC	Total Feeders Customers	Estimated Costs (£m)	Primary CB	HV Sw/Gr	RC GVR	RC Pts	Trip saver	OHL Enhanced Refurb (km)	HV Cable (km)
60002757	6093064CW07	HDA NO1 - LAMPLUGH RD/DEANCROSS GVR	155	1168	0.7	--	--	1	3	2	8.5	2.4
60002766	6090384CF03	ASKAM - DRUM CLOSURES SW STN	44	972	0.6	--	--	--	--	4	10.6	--
60002795	3016714CW10	GOWHOLE - NEW ST/SIGNAL BOX MARSH LN	111	3625	0.4	--	--	--	5	6	4.0	4.4
60002574	4002064CF12	HANGING BRIDGE - BANKS FM SOLLOM/RUFFORD MARINA	29	365	0.7	1	--	1	2	--	4.0	3.0
60002768	6090084CW13	DALTON - GREYSTONES LN/WOOD HEAD ABS	16	872	0.9	1	--	1	4	--	6.8	4.1
60002767	6099644CW05	INGLETON - INGLETON INDUSTRIAL	43	1022	0.5	--	--	--	--	4	4.8	--
	6099654CW06	HELWITH BRIDGE - HORTON RD END ABS (Backfeed)	--	545								
60002762	6090544CW05	MINTSFEET - KINGDOM HALL	53	893	0.9	--	--		3	--	17.5	2.5
60002763	6096024CF35	WILLOWHOLME - SPORTS PAV SHEEPMOUNT	9	2254	0.6	--	--	--	3	--	9.5	2.2
60002794	3026604CW05	SOUTHWEST MACC – IVYMEADE	58	2665	0.9	1	--	1	2	--	3.0	4.6

Low investment category

Project No	Primary CB	Primary Circuit	Total WSC	Total Feeders Customers	Estimated Costs (£m)	Primary CB	HV Sw/Gr	RC GVR	RC Pts	Trip saver	OHL Enhanced Refurb (km)	HV Cable (km)
60002573	4002134CW17	TARLETON - BOUNDARY LN/NEW HS NURSERIES	554	870	0.2	--	--	--	--	--	8.0	--
60002575	4002104CW03	ORMSKIRK - GREEN LN	2	1316	0.1	--	--	--	--	--	4.8	--
60002761	6093084CW12	KESWICK – LAIRTHWAITE	12	741	0.1	--	--	--	--	--	4.5	--
60002765	6096164CW05	SILLOTH - CHERITEX/SILLOTH AIRFIELD	45	130	0.2	--	--	--	--	--	7.0	--
60002576	2004083CW12	GIDLOW - WIGAN INFIRMARY (Previously Queensway)	202	1641	0.2	--	--	--	--	--	8.5	--

** Note that all low investment category circuits have undergone recent reinforcement projects that should significantly improve future network performance or have seen a significant improvement recent fault performance. However, recent fault rates suggest that some additional refurbishment work will be beneficial to improve WSC fault performance.*

No additional work required.

Primary CB Ref.	Primary Circuit	Total WSC	HV Feeder Customer no.	Performance Ranking	Comments
4000053CW23	CLAYTON - BLACKBURN RD	15	1548	190	Recent works on this WSC spur include installation of a new GVR, ASLs and bird diverters. It is envisaged that this will significantly improve fault performance.
6096174CF20	WESTLINTON - HOPESYKE SW STN	3	165	336	This circuit qualified between 2017/19. The fault rate has significantly improved in recent years.
3000063CW12	SHAW - SHAW PRY NETWORK	7	1740	402	This circuit qualified between 2015/17. The fault rate has significantly improved in recent years.
4002204CF37	SCARISBRICK - SCARISBRICK LOCAL	35	503	429	This circuit qualified between 2015/17. The fault rate has significantly improved in recent years.
3070083CW04	HOLLINWOOD - ALFORD ST PUMPING STN	19	2474	1194	This circuit qualified between 2017/19. The fault rate has significantly improved in recent years.

Current position as of July 2024 – (design work is ongoing so numbers likely to change)

Number of qualifying HV feeders (including poor performing backfeed circuits)	Total WSC	HV Feeder Customer no.	High Level Cost (£m)	Potential HV Cable (km)	OHL Refurbishment (km)
34	**2,939**	**39,343**	**25.0**	**80**	**360**

12 Project progress

Main Scheme No	ED2 Project - Primary Circuit	Total WSC Benefit	High Level Scoping Costs (£m)	Sub Project No	Sub Project Name	Project Status	Expected Completion Date	FY25 Costs	FY26 Costs	FY27 Costs	FY28 Costs	Actual Completion Date
60002749	AMBLESIDE - BORRANS CT	201	2	TBC	--	Planning	March 2028		--	--	--	--
60002751	KIRKBY MOOR - WALL END VIA LOCAL RMU	134	2.1	60003432	WSC ED2 Kirkby Moor-Wall End 1 of 9 Skelly Crag Cable	Planning	March 2028		--	--	--	--
				60003434	WSC ED2 Kirkby Moor-Wall End 2 of 9 Angerton Moss Cable	Planning	March 2028		--	--	--	--
				TCB	WSC ED2 Kirkby Moor-Wall End 3 to 9	Planning	March 2028		--	--	--	--
60002750	WINDERMERE – HEATHWAITE	151	2.1	TCB	--	Planning	March 2028		--	--	--	--
60002756	ASPATRIA - HALL BANK ABS	156	1.1	60004050	WSC ED2 UG Aspatria - Hall Bank ABS 1 of 2 (Cable)	Planning	March 2028	£4k	--	--	--	--
				TBC	WSC ED2 UG Aspatria - Hall Bank ABS 2 of 2 (OHL)	Planning	Sept 2027		--	--	--	--
60002748	HAVERTHWAITE - HAVERTHWAITE ABS	307	2.2	TBC	--	Planning	March 2028		--	--	--	--
60002764	WHASSET - DUGG HILL	72	1.5	60003479	WSC ED2 Whasset - Dugg Hill 1 of 9 Whasset-Leasgill Cable	Planning	March 2028		--	--	--	--
				60003478	WSC ED2 Whasset - Dugg Hill 2 of 9 Leasgill-Sampool Cable	Planning	March 2028		--	--	--	--
				60003960	WSC ED2 Whasset - Dugg Hill 3 of 9 OHL	Planning	March 2028		--	--	--	--
				TBC	WSC ED2 Whasset - Dugg Hill 4 to 9	Planning	March 2028		--	--	--	--
60002759	GRANGE - LINGARTH/HAMPSFIELD ABS	113	1.2	TBC	--	Planning	March 2028		--	--	--	--
60002758	KIRKBY STEPHEN - ENTERBER ABS/WINTON/HARTLEY	149	0.8	TBC	--	Planning	March 2028		--	--	--	--
	PETTERIL BANK - HOPESHILL DR	109	1.1	60004138	WSC ED2 Petteril Bank - Hopeshill Drive 1 of 3 (Cable)	Planning	March 2028		--	--	--	--
				TBC	WSC ED2 Petteril Bank - Hopeshill Drive 2 & 3 (OHL)	Planning	March 2028		--	--	--	--
60002760	HDA NO1 - WINSCALES AVE/LANDFILL GENERATION	70	1	60004049	WSC ED2 UG HDA No 1 - Winscales Ave 1 of 2 (Cable)	Construction	March 2028	£69k	--	--	--	--
				TBC	WSC ED2 UG HDA No 1 - Winscales Ave 2 of 2 (OHL)	Planning	March 2028	£4k	--	--	--	--
60002752	PREESALL - PILLING STN & LITTLE TONGUES LN	116	1.3	60004065	WSC ED2 Preesall-Pilling Stn 1 of 4 Preesall Cable Lay	Planning	March 2028		--	--	--	--
				60004066	WSC ED2 Preesall-Pilling Stn 2 of 4 Fishers Row Cable Lay	Planning	March 2028		--	--	--	--
				TBC	WSC ED2 Preesall-Pilling Stn 3 & 4 (OHL)	Planning	March 2028		--	--	--	--
60002757	HDA NO1 - LAMPLUGH RD/DEANCROSS GVR	155	0.7	TBC	--	Planning	March 2028		--	--	--	--
60002766	ASKAM - DRUM CLOSURES SW STN	44	0.6	TBC	--	Planning	March 2028		--	--	--	--
60002768	DALTON - GREYSTONES LN/WOOD HEAD ABS	16	0.9	TBC	--	Planning	March 2028		--	--	--	--
60002767	INGLETON - INGLETON INDUSTRIAL	43	0.5	TBC	--	Planning	March 2028		--	--	--	--
60002762	MINTSFEET - KINGDOM HALL	53	0.9	TBC	--	Planning	March 2028		--	--	--	--
60002763	WILLOWHOLME - SPORTS PAV SHEEPMOUNT	9	0.6	60004048	WSC ED2 Willowholme - Sports Pavilion 1 of 2 (Cable)	Planning	March 2028		--	--	--	--
				TBC	WSC ED2 Willowholme - Sports Pavilion 2 of 2 (OHL)	Planning	March 2028		--	--	--	--
60002761	KESWICK – LAIRTHWAITE	12	0.1	TBC	--	Planning	March 2028		--	--	--	--
60002765	SILLOTH - CHERITEX/SILLOTH AIRFIELD	45	0.2	TBC	--	Planning	March 2028		--	--	--	--
60002572	RIBBLESDALE - WADDOW PK	28	1.5	60002572	WSC ED2 Ribblesdale Waddow Pk Phase 1 (OHL)	Construction	March 2028		--	--	--	--
				60004168	WSC ED2 Ribblesdale Waddow Pk Phase 2	Planning	Sept 2026		--	--	--	--
				60004170	WSC ED2 Ribblesdale Waddow Pk Phase 3 (Cable)	Planning	March 2028		--	--	--	--
60002574	HANGING BRIDGE - BANKS FM SOLLOM/RUFFORD MARINA	29	0.7	TBC	--	Construction	March 2028	£3k	--	--	--	--
60002573	TARLETON - BOUNDARY LN/NEW HS NURSERIES	554	0.2	TBC	--	Construction	March 2028		--	--	--	--
60002575	ORMSKIRK - GREEN LN	2	0.1	TBC	--	Planning	March 2028		--	--	--	--
60002576	GIDLOW - WIGAN INFIRMARY (Previously Queensway)	202	0.2	TBC	--	Planning	March 2028		--	--	--	--
60002795	GOWHOLE - NEW ST/SIGNAL BOX MARSH LN	111	0.4	TBC	--	Planning	March 2028		--	--	--	--
60002794	SOUTHWEST MACC – IVYMEADE	58	0.9	60004172	WSC - SW Macc - Ivymeade - Underground element	Planning	Sept 2026		--	--	--	--
				TBC	WSC - SW Macc - Ivymeade - Overhead element	Planning	March 2028		--	--	--	--

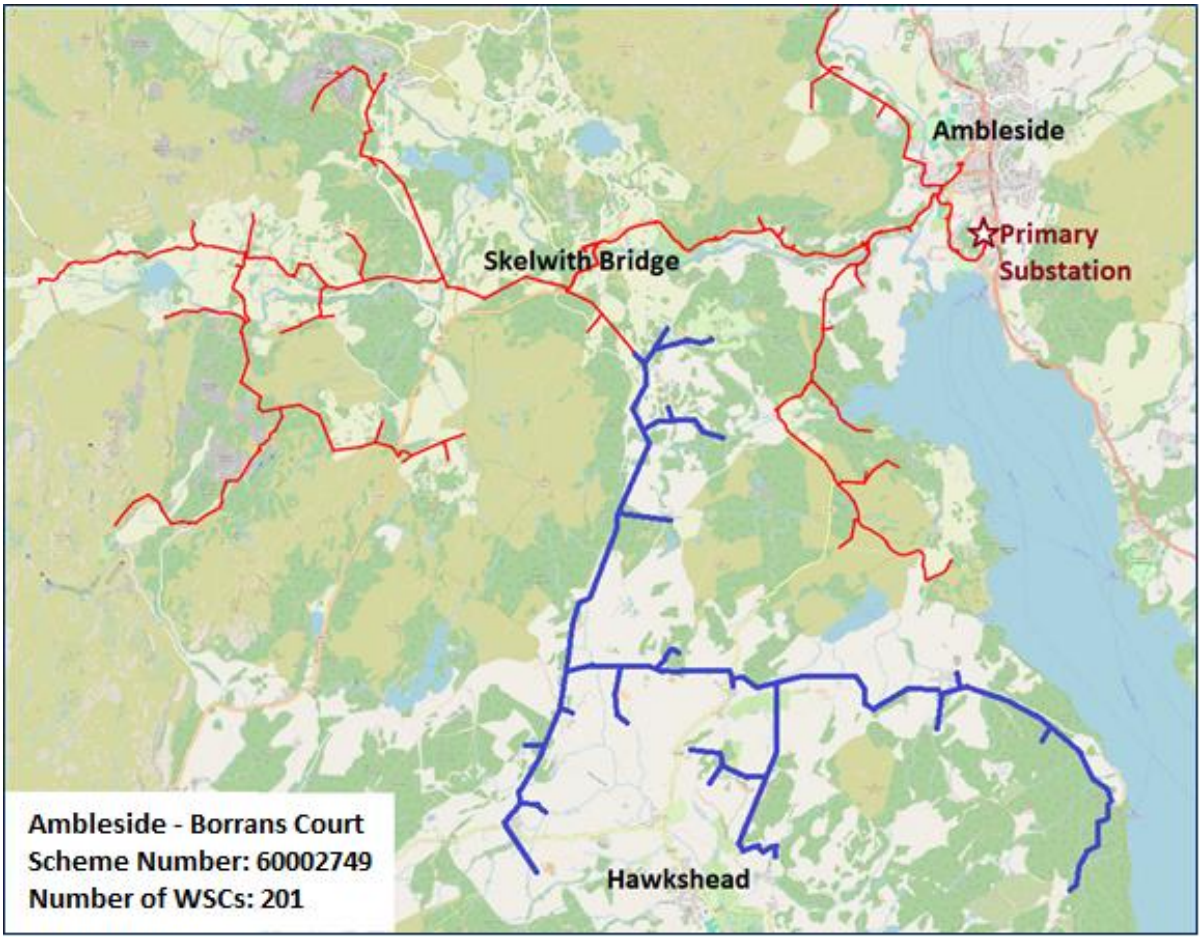
Scheme No	Reactive Project - Primary Circuit	Total WSC Benefit	High Level Scoping Costs (£k)	Project Status	Expected Completion Date	FY25 Costs	FY26 Costs	FY27 Costs	FY28 Costs	Actual Completion Date
60002581	ASKERTON – FELLEND	25	100	Construction	Sept 2025	£77k	--	--	--	-
60000311	BOLLINGTON - CLARENCE MILL	153	20	Construction	Sept 2025		--	--	--	--
60002580	SILLOTH - HARVEST PARK	81	70	Construction	Sept 2025	£66k	--	--	--	-
60004438	CAPONTREE - CAPON HILL	25	90	Planning	Sept 2026		--	--	--	--
60004439	SILLOTH - NORTH HILL	7	100	Planning	Sept 2026		--	--	--	--
60004440	TARLETON - BOOTHS STATION RD	4	80	Planning	Sept 2026		--	--	--	--
60004441	HANDFORTH - TRACKSIDE	17	20	Planning	Sept 2026		--	--	--	--

Appendix – Detailed information of the RIIO-ED2 WSC projects

This section provides a detailed description of the performance issues affecting each of the HV feeders in scope of the RIIO-ED2 WSC programme, including a map of the network, details of the interruptions, the proposed scope of the work planned alongside other options considered.

A.1 - AMBLESIDE - BORRANS COURT

The qualifying WSCs on the Ambleside – Borrans Court circuit are located south of Skelwith Bridge and north of Hawkshead as shown in the map below (the main circuit is shown in red with the WSC section highlighted in blue).



Analysis shows that the Ambleside – Borrans Court circuit saw more than forty faults during ED1, not including short duration interruptions of less than three minutes (SDIs). In general, these faults related to overhead line faults associated with fallen conductors, faulty insulators, and lines clashing with trees.

Approximately half of the faults had an impact on some, or all the worst served customers, while a third of these were related to faults upstream of the worst served customer section. Due to both lack of network automation on the WSC section and poor automation performance, these faults resulted in the loss of the whole HV circuit.

A large contributing factor to poor restoration performance on this circuit is due to the poor performance of its related backfeed circuits. In particular, the *Coniston – Coniston Hydro* circuit (which has seen a mixture of underground and overhead faults in ED1) and the *Ambleside – Skelwith Bridge* circuit (which has predominantly seen overhead faults). This has not only limited the interconnection between Ambleside and Coniston, but also limits automation efficiency as the network is regularly

switched to abnormal running arrangements. It was therefore proposed to include both backfeed circuits in the scope of works.

High level proposals

- To prevent further upstream faults from impacting the WSCs, it has been proposed to lay a new circuit from Ambleside to Skelwith Bridge, allowing for a dedicated underground feeder to the WSC section. This will require a new primary circuit breaker to be installed at Ambleside and a switchgear change at Skelwith Bridge switching station.

- To combat the impact of faults local to the WSCs it has been proposed to underground the most fault prone sections of overhead line while the remaining sections are to be refurbished.

- Additional ground mounted and overhead remote-control switches have been proposed to improve automatic restoration in the event of future faults.

Poor performing backfeed proposals (Ambleside – Skelwith Bridge)

- It is proposed to survey the main overhead line back to Ambleside primary for any required refurbishment work in addition to some undergrounding in the region of Jeffy Knotts Wood to avoid invasive trees.

Poor performing backfeed proposals (Coniston – Coniston Hydro)

- Additional RC switches have been proposed to improve automatic restoration in the event of future faults (including the normally open point interconnecting the WSC section).

- Refurbishment of the overhead line upstream of the interconnection point with the WSC circuit has been proposed to allow for a more reliable backfeed.

Optioneering

- Consideration was taken to simply refurbishing all the WSC section rather than partially undergrounding. This was however disregarded as some of the overhead line is positioned in particularly difficult locations to access (fell land and woodland). The location of this network not only contributes to excessive fault rates, but also impacts restoration times.

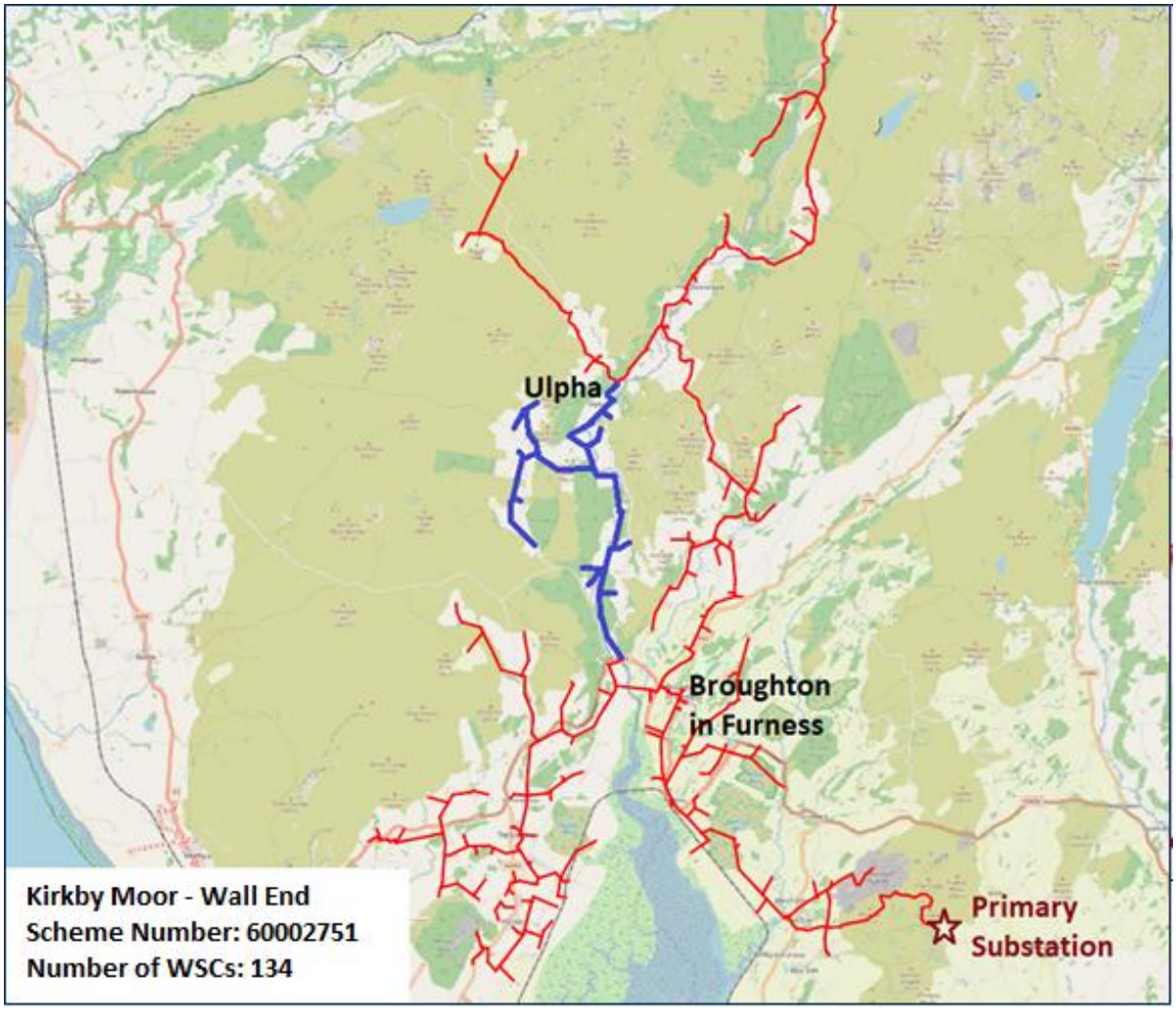
- It was also considered to overlay the existing circuit out of Ambleside primary rather than to install a new dedicated circuit. However, there is deemed to be a much wider network benefit to a new circuit as it will improve interconnection between the existing Borrans Court circuit, the new WSC circuit, and the existing Skelwith Bridge circuit.

A.2 - KIRKBY MOOR - WALL END VIA LOCAL RMU

The qualifying WSCs on this circuit are located within the Duddon valley between Ulpha and Broughton in Furness. Analysis shows that this circuit saw more than fifty faults during ED1 (not including SDIs). Predominantly, these faults related to overhead line faults, clashing with trees and HV cable faults.

Approximately half of the faults had an impact on some, or all the worst served customers, while 70% of the WSC faults were related to faults immediately within the worst served customer section (i.e. within Duddon Valley). Due to both lack of network automation on the WSC section and poor comms network coverage in the Duddon Valley region, automatic restoration performance is particularly poor. The circuit also shares a backfeed with the *Coniston – Old Station* circuit which has a particularly high fault rate. Both circuits tend to see unplanned outages at the same time during severe weather conditions.

To improve the comms coverage in the Duddon Valley, a new DMR radio system has recently been deployed, as there is negligible coverage from public communication networks around Ulpha. This now allows for the opportunity for much needed remote-control points at WSC substations.



The Wall End via Local RMU circuit is shown in the map above (the main circuit is shown in red with the WSC section highlighted in blue).

High level proposals

- To prevent future overhead faults within the WSC zone, and considering difficulties with undergrounding in the area, it is proposed to rebuild sections of the existing overhead line.

- The remaining sections of WSC network will be refurbished while additional automation has been proposed considering the newly commissioned comms network.

- Undergrounding of fault prone overhead sections of network upstream of the WSCs is also proposed to reduce the circuit's overall fault rate.

Poor performing backfeed proposals (Coniston – Old Station)

- It is proposed to survey the main overhead line back to Coniston primary for any required refurbishment work in addition to some undergrounding of specific fault prone sections.

Optioneering

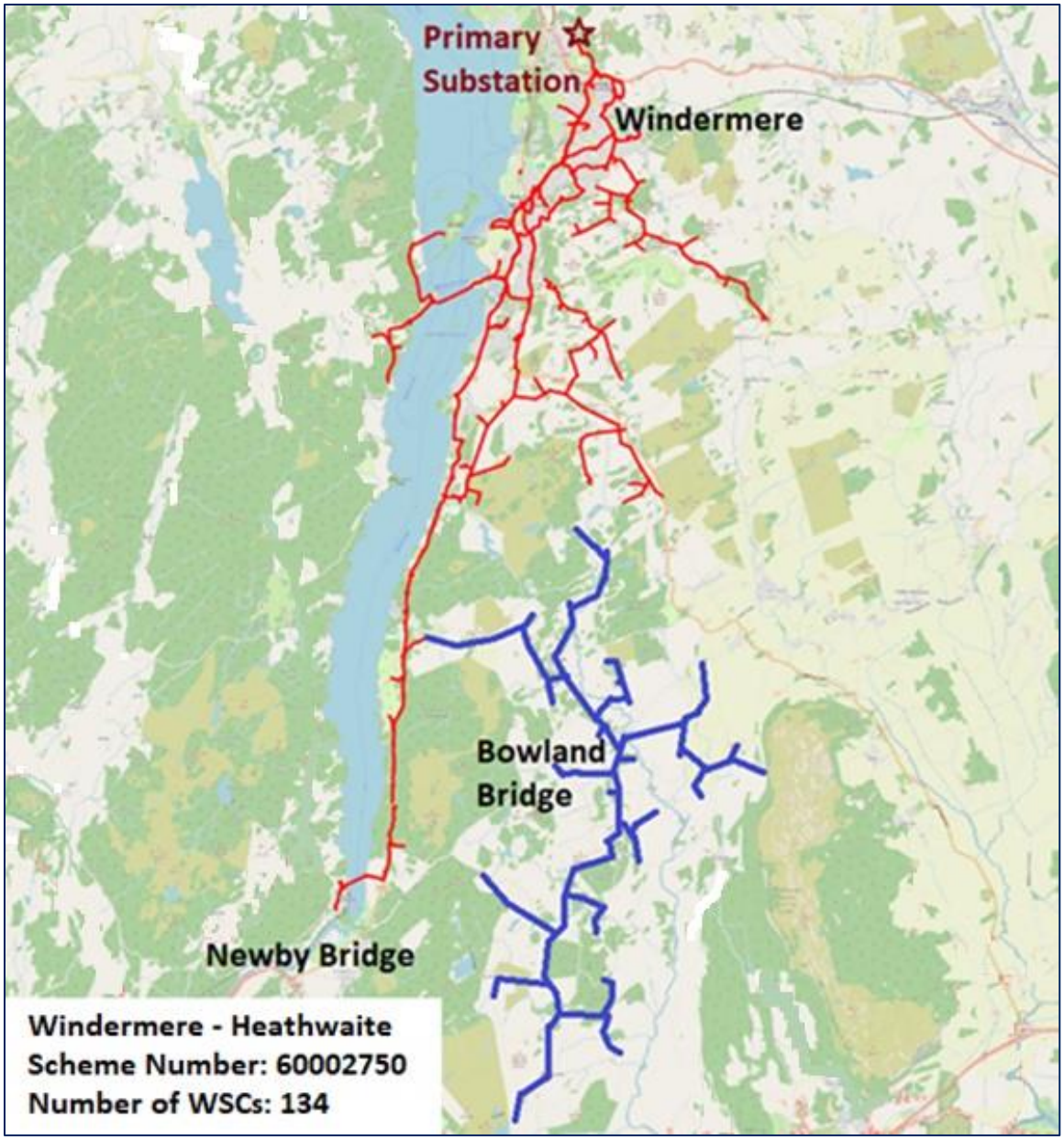
- Options to reconfigure the network by installing a new circuit out of the existing primary substation or by transferring the WSC section to another primary network were considered. However due to the location of Duddon Valley and the surrounding area, associated cable routes were deemed too expensive to justify. Additionally, primary board extensions at both Kirkby Moor and Coniston are not possible due to switchgear type and age. This would therefore trigger expensive switchboard replacements.

- Initial proposals looked at undergrounding the WSC section through Duddon Valley, however the overhead line crosses the Lake District National Park and heavily wooded areas which are designated as a Site of Special Scientific Interest (Duddon Valley Woodlands SSSI). Therefore consents would be extremely difficult to attain. Spans of overhead also cross the river Duddon which creates directional drilling issues, significant amounts of rock excavation and access issues for construction vehicles and plant associated with cable installation work. The environmental impact was therefore considered too high.

A.3 - WINDERMERE - HEATHWAITE

The qualifying WSCs on the Windermere – Heathwaite circuit are located to the southeast of Lake Windermere in the Bowland Bridge and Cartmel Fell regions. Analysis shows that this circuit saw more than 60 HV faults during ED1 (not including SDIs). Mostly, these faults related to overhead line faults, clashing with trees, persistent transient activity and HV cable faults. Approximately 40% of these faults had an impact on some, or all the worst served customers, while 75% of the WSC faults were related to faults within the immediate WSC section (i.e. beyond Park Cliffe GVR).

Restoration performance for the WSC section is particularly poor because there is only one available backfeed via the *Haverthwaite – Haverthwaite Local* circuit. This circuit is susceptible to faults during severe weather as is the WSC section. This means that both circuits are prone to faults at the same time, leading to prolonged restoration times. It is also worth noting that the Haverthwaite Local circuit is also a backfeed circuit to the *Grange – Lingarth / Hampsfield ABS* circuit (which is also an ED2 WSC circuit - see section 8.8 for details). These three circuits are regularly switched to abnormal running arrangements due to the number of associated faults, which typically prevents the automation from running correctly.



The Heathwaite circuit is shown in the map above (the main circuit is shown in red with the WSC section highlighted in blue).

High level proposals

- It is proposed that a new circuit is installed between Haverthwaite primary and Newby Bridge to allow for the worst served customer network to be reconfigured and split in two separate sections. This will limit the impact of future faults by allowing for additional protection zones to be created, whilst separating the WSC zone over the two circuits. This will require a new primary circuit breaker to be installed at Haverthwaite.

- In addition, the existing WSC overhead network will be refurbished, and problematic trees will be cut back.

- New remote control reclosers will be installed to limit the impact of future faults on the overhead sections and improve transient restoration performance.

- Installation of additional RC points will be utilised to improve future automatic restoration performance.

Poor performing backfeed proposals (Haverthwaite – Haverthwaite Local)

- The new proposed circuit out of Haverthwaite will not only allow for a more secure supply to the WSCs, but it will also allow for the existing Haverthwaite Local circuit to be reconfigured, which itself has also been close to qualifying as a WSC circuit in the past. The reconfiguration should also improve existing protection grading margins between existing network breakers.

- Further refurbishment works to the upstream network have been proposed to improve performance during severe weather.

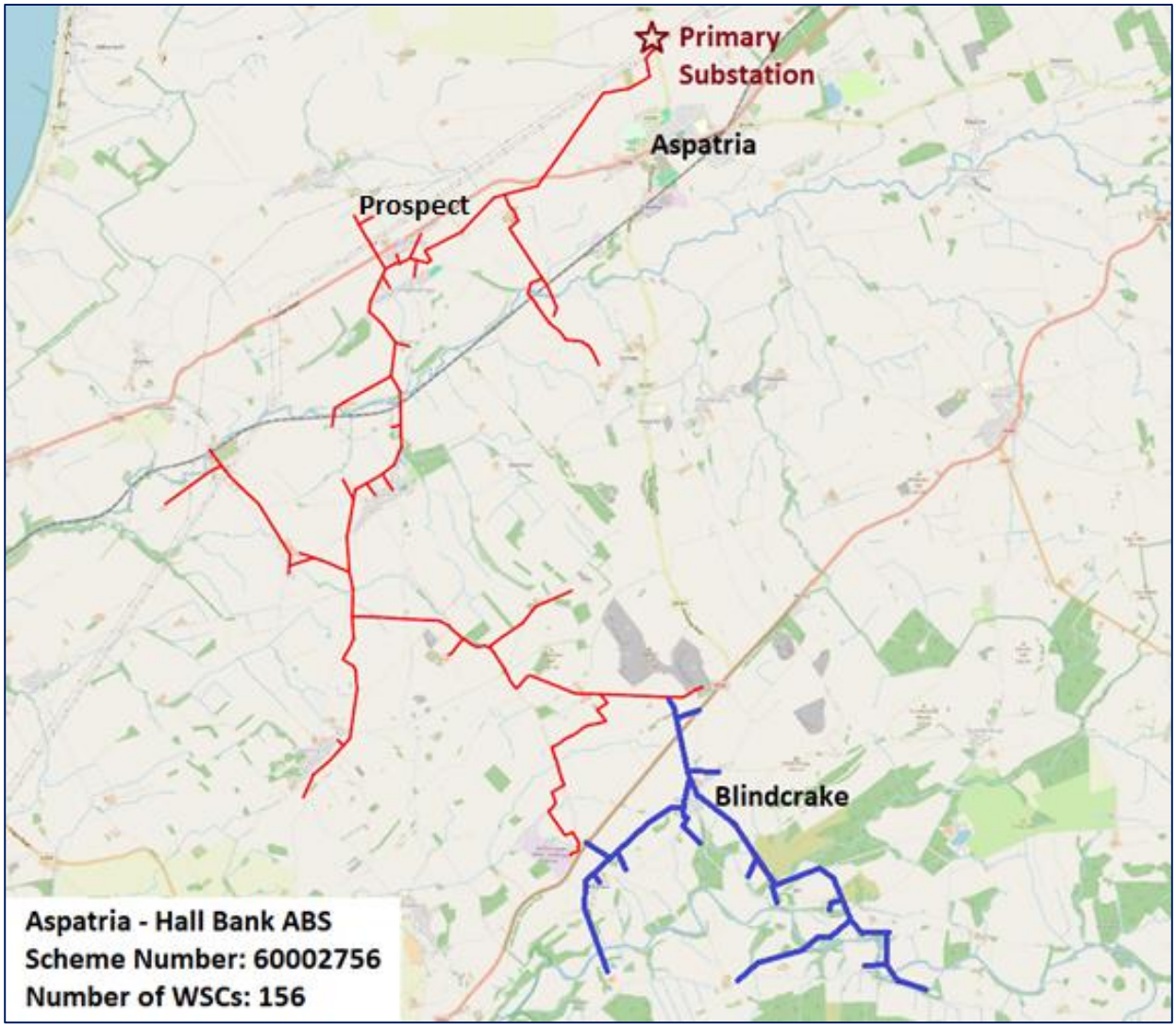
Optioneering

- The possibility of installing a new underground feeder out of Windermere was initially considered, however this would involve an extremely long cable lay, which proved impractical. A new feeder out of Haverthwaite was preferred as the cable route is deemed shorter and predominantly along public highway. There is also the added benefit of providing a more secure backfeed to the Grange – Lingarth / Hampsfield ABS WSC circuit.

- Undergrounding of the WSC section was also considered, however this would have been more expensive due to the length of the circuit whilst being less beneficial to the overall network as it does not address the poor automation performance.

A.4 - ASPATRIA - HALL BANK ABS

The qualifying WSCs on the Aspatria – Hall Bank ABS circuit are located in the Blindcrake area at the far end of the circuit, as shown in the map below (the main circuit is shown in red with the WSC section highlighted in blue).



Analysis shows that this circuit saw around 30 HV faults during ED1. Largely, these faults related to overhead line faults (largely insulators, jumpers and HV links). Approximately 60% of these faults had an impact on some or all the worst served customers, while 50% of these WSC faults were associated with the worst served customer spur section.

High level proposals

- Due to the high fault rate on the overhead section between the primary and Prospect, it is proposed to underground this section.
- In addition, it is proposed to conduct refurbishment of the WSC spur.
- Installation of additional RC points have been proposed to improve future automation performance.
- New RC reclosers have been proposed to limit the impact of future faults while improving transient issues.

Optioneering

- Initial proposals looked to lay a new circuit out of Aspatria to provide the WSCs with a more secure underground supply. However, site investigations highlighted that the existing primary switchboard could not be extended to provide the necessary circuit breaker. This option would therefore have required a primary switchgear change, making it considerably more expensive.

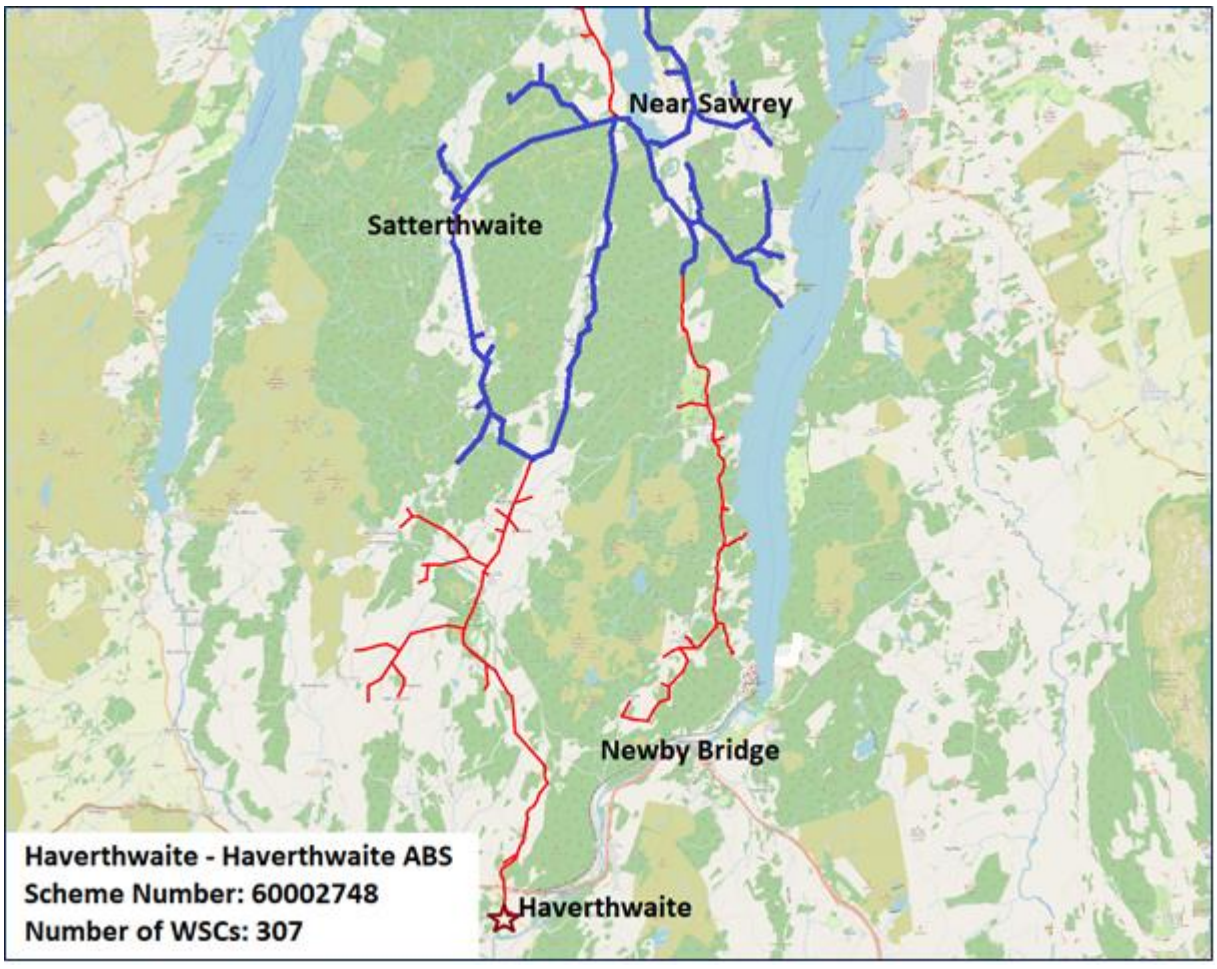
- Reconfiguring the network so that the WSC section was transferred onto an adjacent circuit out of either Aspatria or Embleton primaries was also considered. Analysis showed that the circuits available did not have a good enough fault history to ensure that the transfer would significantly improve fault rates for the WSCs. This option would also likely trigger further reinforcement to the circuits in question.

A.5 - HAVERTHWAITE - HAVERTHWAITE ABS

The qualifying WSCs on the Haverthwaite – Haverthwaite ABS circuit are in the Satterthwaite and Near Sawrey regions, to the west of Lake Windermere. Analysis shows that this circuit saw more than 50 HV faults during ED1 (not including SDIs). Predominantly, these faults related to condition based overhead line faults, clashing with trees and HV cable faults. It has also been prone to protection grading issues due to the existing configuration of the circuit. Approximately 80% of faults on this circuit had an impact on some or all the worst served customers.

One of the fundamental issues contributing to the poor performance of this circuit is down to the fact that the first section is sparsely populated overhead network that supplies a more heavily populated underground network. As the faults are clustered on the overhead network, most customers are liable to go off supply during a fault. This combined with protection grading issues restricts automation from restoring customers effectively.

The other issue compounding the poor performance is that this circuit shares backfeeds with three poor performing circuits. *Coniston – Coniston Hydro, Haverthwaite – Haverthwaite Local* and *Haverthwaite – Greenodd Sw/Stn*. The first two of these have already had proposals included on the Ambleside – Borrans Court project and the Windermere – Heathwaite project (see sections 9.1 and 9.3). Intervention on the Greenodd Sw/Stn circuit has therefore been included in these proposals.



The Haverthwaite ABS circuit is shown in the map above (the main circuit is shown in red with the WSC section highlighted in blue).

High level proposals

- It is proposed that a new circuit is installed out of Haverthwaite primary to allow for the worst served customer network to be split in two separate sections. This will limit the impact of

future faults and improve the performance of the automation systems. It was deemed most logical to separate the overhead section from the underground section, meaning that the new circuit will predominantly consist of underground network. This will also allow for the existing protection issues to be alleviated. To achieve this a new circuit breaker will need to be installed at Haverthwaite.

- As most faults that have impacted the worst served customers are within the Stricely Fell GVR protection zone, it is proposed to refurbish this section of overhead network.

- Installation of a new RC recloser has been proposed to limit the impact of future spur faults while improving transient issues.

Poor performing backfeed proposals (Haverthwaite – Haverthwaite Greenodd Sw Stn)

- Additional automation has been proposed to improve automatic restoration in the event of future faults (including the Normally Open Point interconnecting the WSC section). This is to include a minor change to the network running arrangement to distribute customers more efficiently between protection zones.

- Refurbishment of the overhead line upstream of the interconnection point with the WSC circuit has also been proposed to improve backfeed reliability.

Optioneering

- Multiple cable routes were considered out of Haverthwaite primary including routes alongside the existing Haverthwaite ABS and Greenodd Sw/Stn circuits. However, due to the associated distances and problematic terrain that these overhead circuits cover, installation of cable circuits on these routes were deemed impractical. The same issues also excluded undergrounding of these existing overhead networks.

- As the Windermere – Heathwaite proposals (see section 9.3) has also allowed for a new circuit out of Haverthwaite primary, it was proposed to utilise a similar cable route for the first leg out the primary. Therefore, resultant excavation works in the area can be kept to a minimum as multiple cable ducts can be installed at the same time. This will reduce disruption to customers, installation costs and traffic management requirements.

A.6 - WHASSET - DUGG HILL

The qualifying WSCs on the Whasset – Dugg Hill circuit are located northwest of Levens. Analysis shows that this circuit saw more than 60 HV faults during ED1 (not including SDIs). Forty percent impacted the WSCs with 30% of these WSC faults due to upstream protection zone breaker trips (causing automation failures). There are also signs that some of the protection devices do not always grade correctly, meaning more customers are impacted than designed. Altering the network running arrangement to reduce the number of breakers in series will allow for more reliable protection grading.

Generally, these faults are related to insulator failures, snapped poles, persistent transients and fallen conductors. Some of the transients and fallen conductors are believed to be associated with bird strikes as several dead birds were spotted during recent site visits.

The Dugg Hill circuit is shown in the map above (the main circuit is shown in red with the WSC section highlighted in blue).

High level proposals

- To prevent further upstream faults from impacting the WSCs it is proposed that a new cable circuit is installed between the primary and Leasgill Sw/Stn. The network can then be reconfigured to split the existing circuit in two. This will require a new circuit breaker to be installed at the primary and will reduce the impact of future faults while allowing for improved protection grading and automation performance.

- A further cable lay between Leasgill Sw/Stn and Low Sampool ABS will enable the overhead network supplying the WSCs to be split, thus allowing for additional reclosers to reduce the impact of overhead faults. A switchgear change at Leasgill Sw/Stn will be required to allow for the two new cable circuits to be installed.

- Additional ground mounted remote-control actuators will be required to the maintain optimal automatic restoration systems.

- Refurbishment of the mainline overhead sections beyond Leasgill Sw/Stn is required to reduce the overall fault rate of the circuit, including some rebuilding with covered conductor to mitigate bird strike issues.

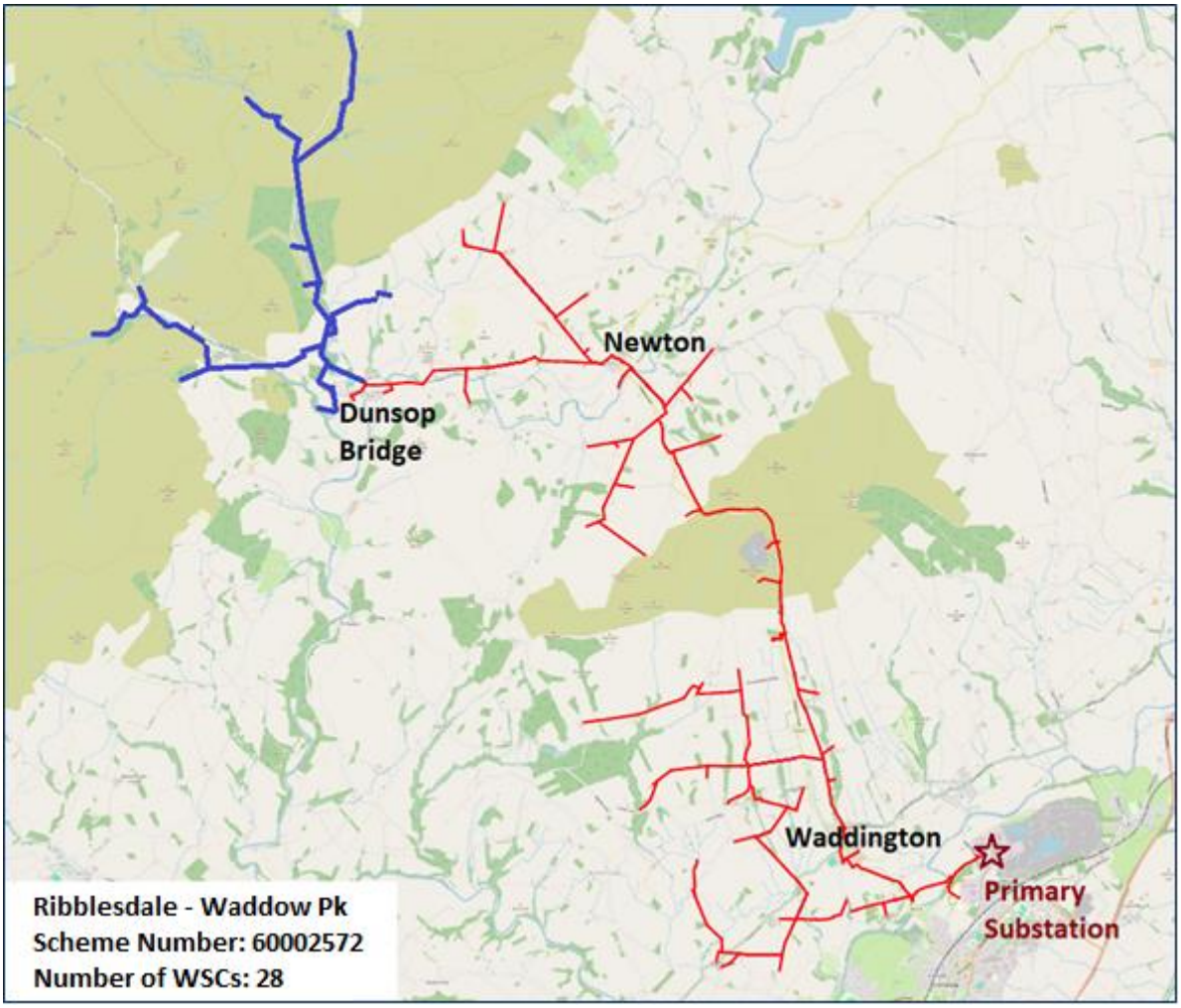
Optioneering

- Undergrounding of the existing overhead sections feeding the WSCs was considered. However, due to some of the land being local flood plains with several river crossings, it was decided that overhead line rebuilding and refurbishment was a more practical solution.

- Initially, the backfeed circuit to the WSC section (Kendal – Helme Dr O/D) was classified as a poor performing backfeed having seen over forty faults in ED1. However, further analysis found that recent performance of this backfeed has been reasonably good. This is because most faults associated with the backfeed circuit were situated on unrelated sections of overhead line (i.e. not associated with the mainline back to the primary). Refurbishment works on this circuit were therefore discounted.

A.7 - RIBBLESDALE - WADDOW PK

The qualifying WSCs on the Ribblesdale – Waddow Pk circuit are located northwest of Dunsop Bridge. Analysis shows that this feeder has seen over forty faults in ED1 with roughly 50% impacting the WSCs. Of the WSC faults, 75% occurred within the local protection zone (i.e. Dunsop GVR). Predominantly, these faults related to fallen conductors, insulator failures, bird strikes and persistent transient activity.



The Waddow Park circuit is shown in the map above (the main circuit is shown in red with the WSC section highlighted in blue). The area surrounding Dunsop Bridge is isolated from alternate HV networks and only has one available backfeed via the *Longridge – Thornley Chipping Pennine Area* circuit. This circuit is classed as a poor performing backfeed and has regularly been configured abnormally due to fault activity in recent years.

High level proposals

- It is proposed that a new circuit is installed between Ribblesdale primary and Waddington to allow for the worst served customer feeder to be split into two separate circuits. This will require the installation of a new primary breaker and will limit the impact of future faults upstream to the WSCs.

- Installation of additional overhead and underground remote-control has been proposed to allow for optimal restoration performance.

- Existing WSC overhead line sections are to be refurbished to reduce the overall circuit fault rate.

Poor performing backfeed proposals (Longridge – Thornley Chipping Pennine Area)

- Refurbishment of the overhead line upstream of the interconnection point with the WSC circuit will reduce the amount of time that the backfeed is unavailable to the WSC section.

Optioneering

- Undergrounding of the existing overhead sections feeding the WSCs was considered to allow for a more secure supply. However, the existing overhead line crosses the River Hodder, River Dunsop and Langden Brook. An alternate route along public highway would make it difficult to pick up customer services and would involve excessive diversions, increasing costs significantly. The required consents for these diversions would potentially delay delivery due to the number of customers involved.

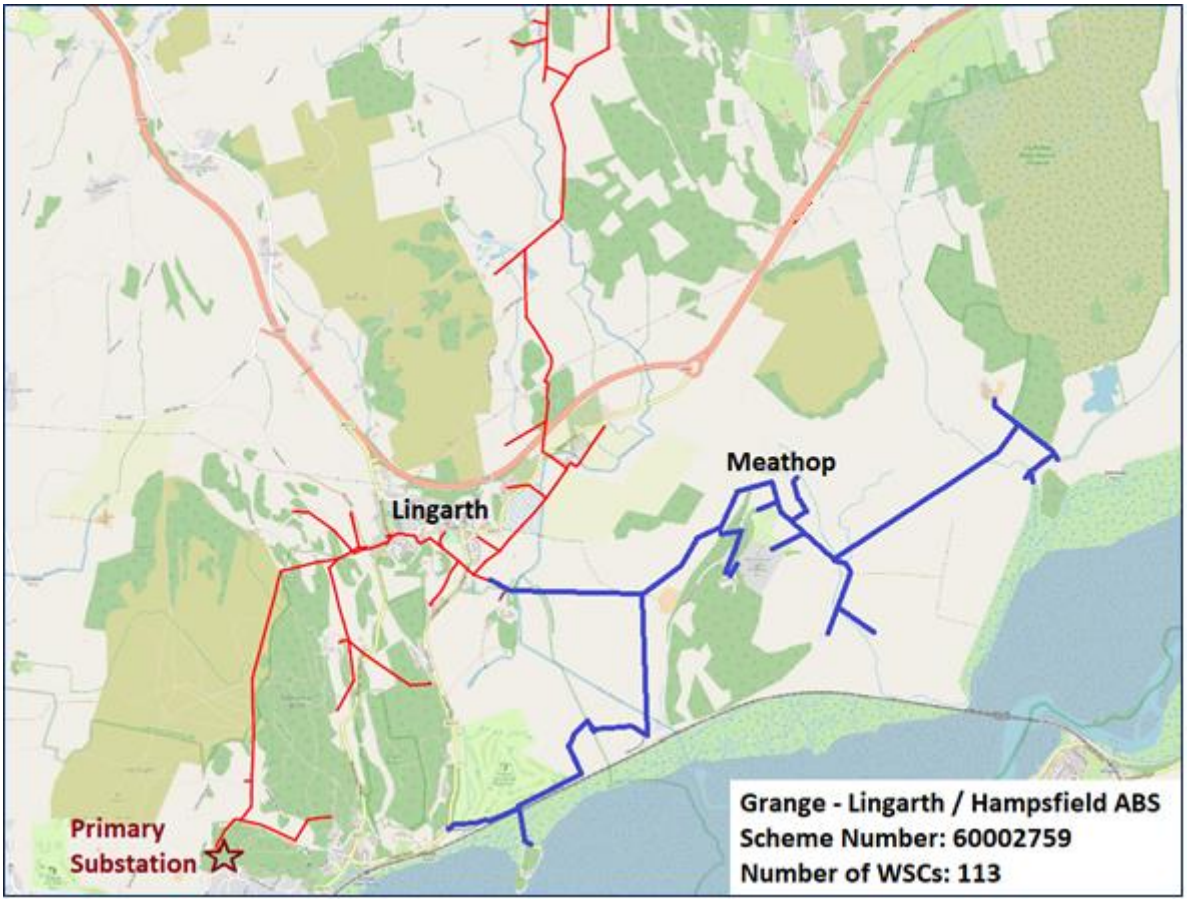
- A longer cable route out of the primary to Browsholme Rd was considered to reduce the amount of overhead line supplying the WSCs. However, the fault rate of the overhead line north of Waddington was not deemed high enough to justify the additional cable costs.

A.8 - GRANGE - LINGARTH / HAMPSFIELD ABS

The qualifying WSCs on the Grange – Lingarth / Hampsfield ABS circuit are in and around the Meathop and Lindale area. Analysis shows that this feeder has seen around thirty faults in ED1 with roughly 70% impacting some or all the WSCs. Of the WSC faults, 70% occurred within the local protection zone (i.e. Castle Head GVR). Generally, these faults related to condition based overhead line faults, particularly fallen conductors, insulator failures and lines clashing with trees.

Most of the worst served customers are located on a radial spur line which cannot be backfed for a local fault. This limits automation potential and increases restoration times. Local switching points for manual operation has also been flagged as an issue due to access restrictions (mainly due to waterlogged fields during winter months).

It is worth noting that this circuit shares backfeeds with *Haverthwaite Local* and *Whasset – Dugg Hill* circuits. These circuits have already been included in WSC ED2 proposals (see sections 9.3 and 9.6), both of which include scope for significant refurbishment and network reconfiguration works.



The Lingarth / Hampsfield ABS circuit is shown in the map above (the main circuit is shown in red with the WSC section highlighted in blue).

<u>High level proposals</u>

- It is proposed to underground the feeder from Lingarth while also looping the WSC radial network into the mainline. This will enable network automation systems to restore the WSCs for further faults and speed up manual restoration times. Relocation of existing pole mounted switching points to sites with better access has also been recommended.

- Further refurbishment of the wider overhead network is required, including cutting of invasive trees, to reduce fault rates on this circuit.

- Network protection grading issues are to be rectified at several pole mounted reclosers. It is likely that the existing protection relays will need to be replaced as they are nearing end of life.

Optioneering

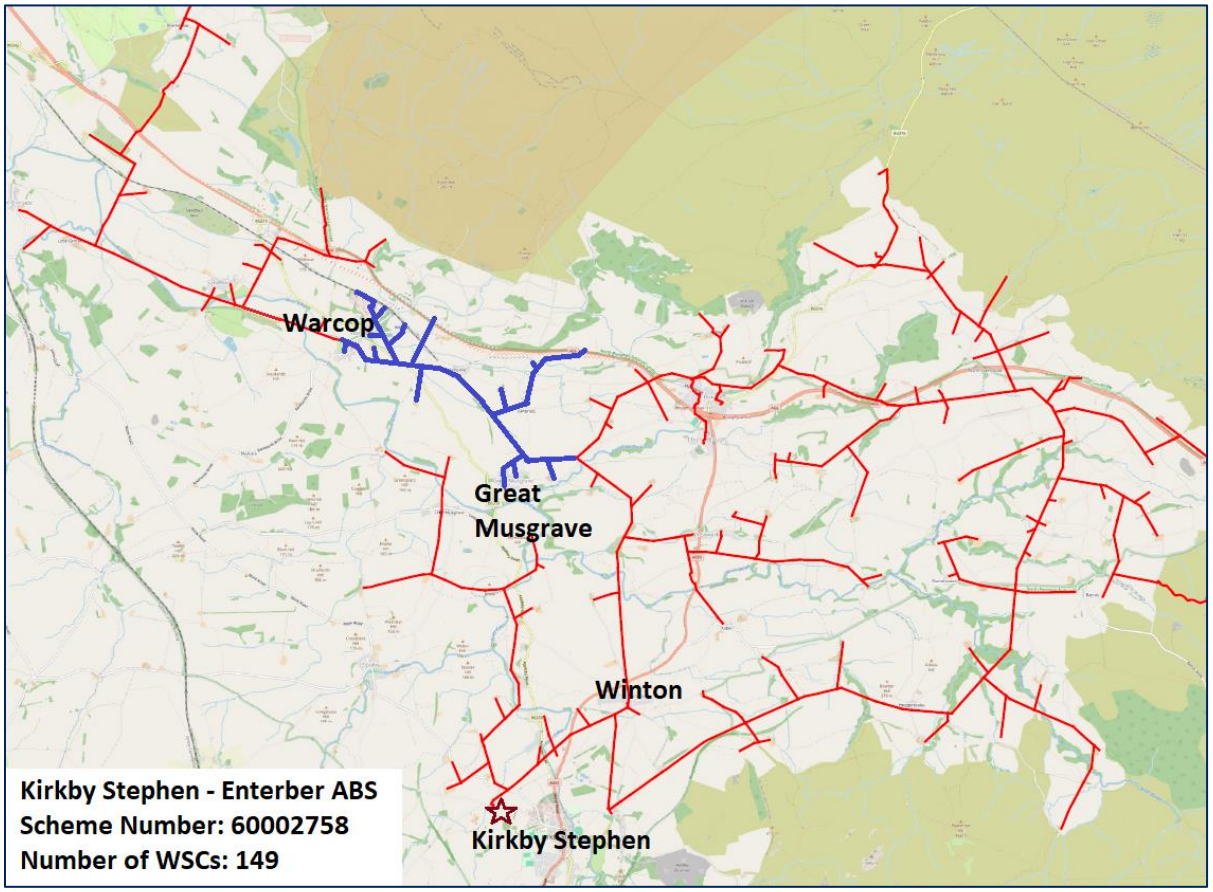
- As the primary switchgear cannot be extended or double banked, the option to install a new circuit out of the primary was dismissed as it would have required a costly switchgear change.

- An alternate option would have been to reconfigure the network so that the WSC section is supplied from an adjacent circuit. However, as most faults affecting the WSCs were related to the immediate WSC spur, it was proposed to refurbish the spur while looping it into the existing circuit. This not only allows for the WSCs to be backfeed for future faults, but it also allows for the WSC section to be split into two separate protection zones, thus reducing the impact of faults.

A.9 - KIRKBY STEPHEN - ENTERBER ABS / WINTON / HARTLEY

The qualifying WSCs on the Kirkby Stephen – Enterber ABS circuit are located between Warcop and Great Musgrave. Analysis shows that this feeder has seen over fifty faults in ED1 with roughly 40% impacting some or all the WSCs. Of the WSC faults, 80% occurred within the local protection zone (i.e. Hallgarth GVR).

Predominantly the WSC faults have been related to fallen conductors, insulator failures, HV cable faults and LV faults that were required to be made dead via HV isolation.



The Enterber ABS / Winton / Hartley circuit is shown in the map above (the main circuit is shown in red with the WSC section highlighted in blue).

High level proposals

- It is proposed to refurbish the OHL between Hallgarth GVR and Chapel Garth substation including any spur lines as this is where the WSCs reside. It is also proposed to refurbish the mainline beyond Chapel Garth which impacts WSC performance.

- Replacement of an old manual Sectionaliser with a new RC Sectionaliser will allow for the control room to remotely isolate this section of overhead previously suspectable to reports of LV faults. Additional refurbishment / rebuilding of the LV overhead line out of Sandford West PMT (663022) / Sandford Hall (661237) is proposed as there have been known issues on this network that have impacted WSCs.

- Finally, it is proposed to overlay the cable on the Warcop Camp spur which has seen three faults in ED1.

Optioneering

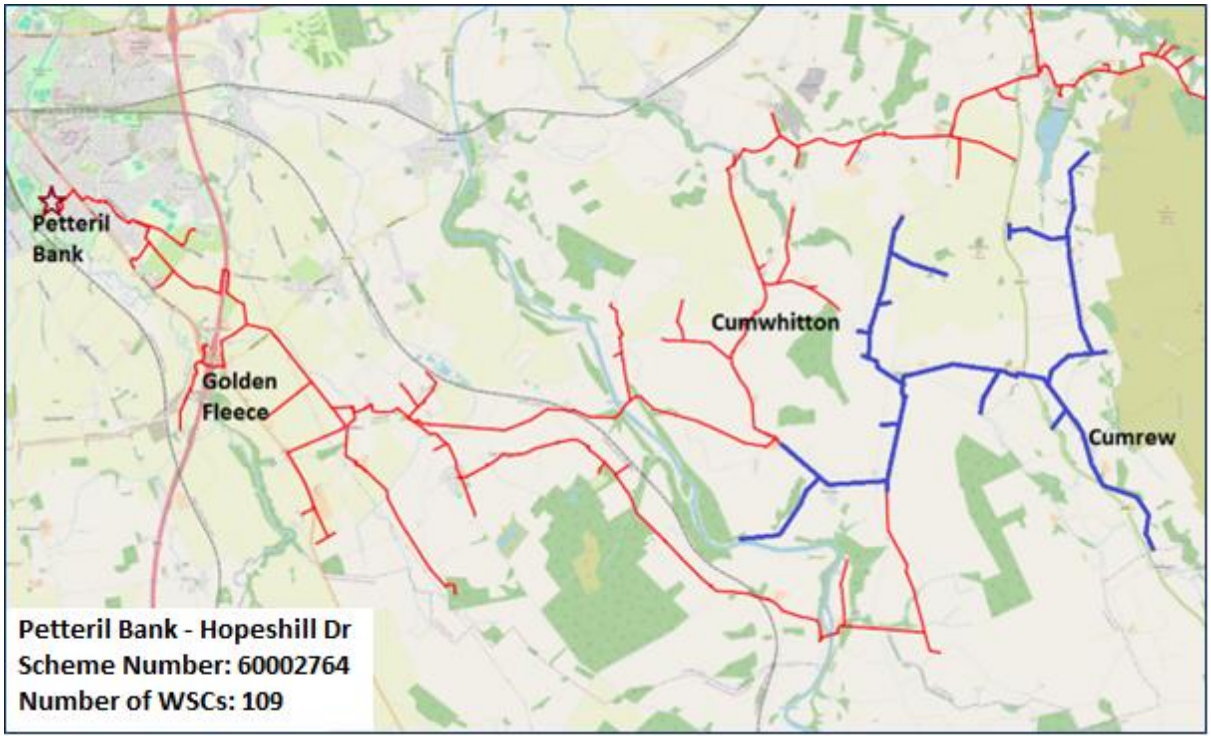
- As this circuit is on the boundary of ENWL network there is limited options to reconfigure the circuit without installing a considerable amount of new circuitry. This is limited further by the fact that the existing primary switchboard cannot be extended or double banked due to the age / type of switchgear. Therefore the option to transfer the WSC section to an adjacent circuit was discounted.

- Initial high-level proposals included a provisional ~6km of underground cable to relocate / split the Hallgarth GVR protection zone with the aim of limiting the impact of future faults. However, more detailed analysis suggests that as the majority of WSC faults are within the Hallgarth GVR protection zone, it will be more beneficial to carry out enhanced refurbishment of the existing OHL beyond this GVR. A feasible cable route out to this section also looks to be problematic and will most likely not be achievable within the ED2 period.

A.10 - PETTERIL BANK - HOPESHILL DRIVE

The qualifying WSCs on the Petteril Bank – Hopeshill Dr circuit are located between Cumwhitton and Cumrew. Analysis shows that this feeder has seen over forty faults in ED1 with roughly 80% impacting some or all the WSCs. Of the WSC faults only 35% occurred within the local protection zone (Piperstile GVR) with the remaining faults upstream of the WSC section.

Largely the WSC faults have been related to fallen overhead lines, insulator failures, cable faults and persistent transient activity. Historic protection grading issues has also restricted automation from restoring the WSCs during upstream faults.



The Hopeshill Drive circuit is shown in the map above (the main circuit is shown in red with the WSC section highlighted in blue).

High level proposals

- It is proposed that a new circuit is installed out of Petteril Bank primary to allow for the worst served customer feeder to be split into two separate circuits. This will require a new primary circuit breaker and should limit the impact of future faults upstream of the WSCs section while improving protection grading issues.

- Some small section cable will need to be replaced around Golden Fleece to allow for the new proposed running arrangement. A switchgear change at Carleton substation is also required to allow for a ring main unit.

- Most faults in the WSC section have been located beyond the Foulpool air-break switch (near Cumrew). It has therefore been proposed to refurbish this section of network.

- Installation of additional overhead and underground remote-control is required to allow for optimal automation performance.

- Installation of new RC reclosers have also been proposed to limit the impact of future faults while improving transient issues.

Optioneering

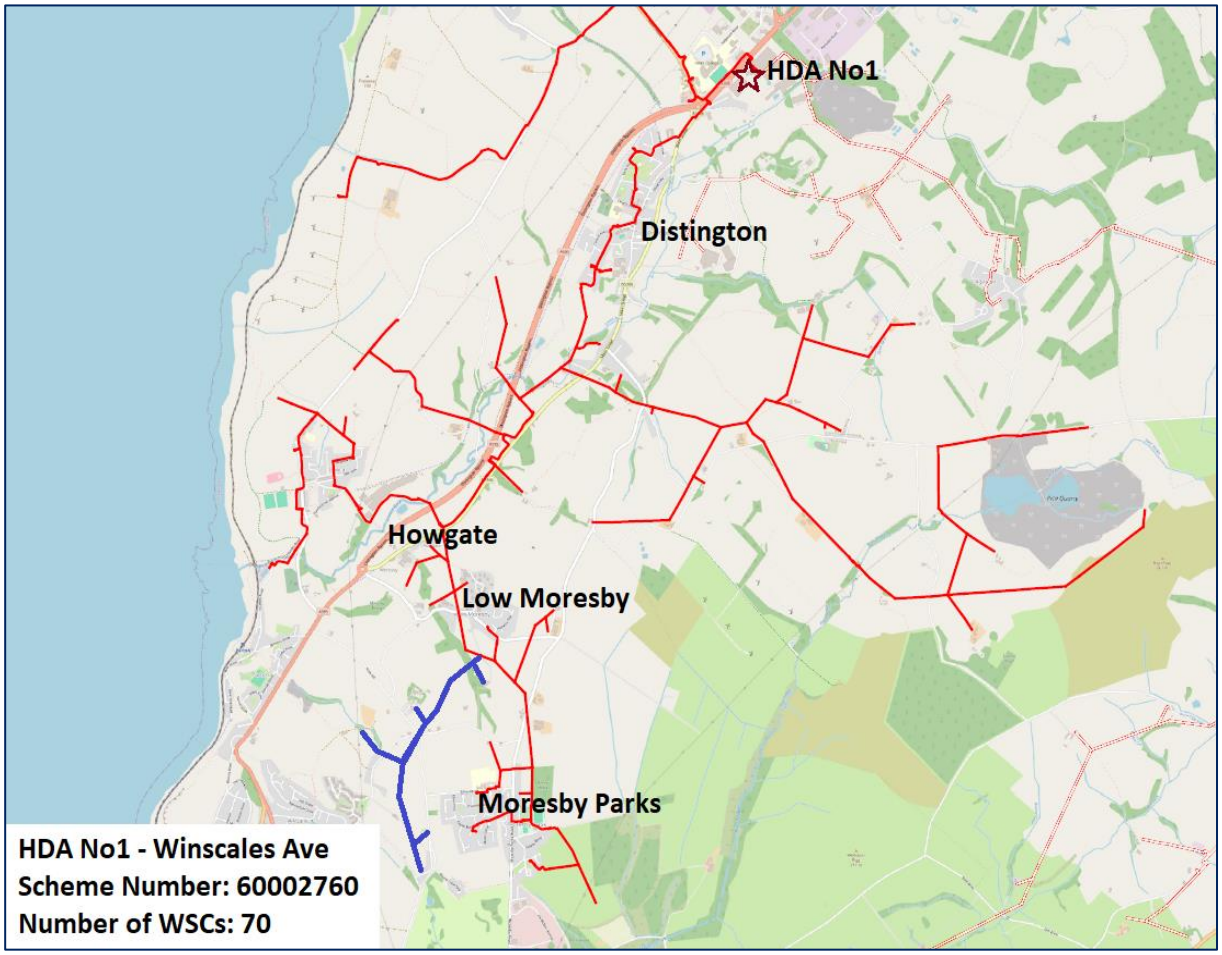
- Undergrounding of the existing overhead sections feeding the WSCs was considered to allow for a more secure supply. However, a cable route along local public highway would be particularly tricky to deliver based on the number of customers supplied on this section. Several customer services would have to be diverted, leading to issues with consents. These works would likely not be achievable within the ED2 period.

- Multiple cable routes out of Petteril Bank were considered. However, the proposed route was chosen as it coincided with some planned cable works on a local connection project around Golden Fleece. Spare cable ducts can therefore be installed to enable both projects to be delivered while minimising excavation works, disruption to customers, cable installation costs and traffic management requirements.

A.11 - HDA NO1 - WINSCALES AVE / LANDFILL GENERATION

The qualifying WSCs on this circuit are located between Low Moresby and Moresby Parks. Analysis shows that this circuit saw around 30 HV faults during ED1. Mostly, these faults related to overhead line faults (including insulators, jumpers and fallen conductors).

Approximately 50% of these faults had an impact on some, or all the worst served customers, while roughly 65% of these were related to faults within the worst served customer section (i.e. beyond Howgate / Moresby GVR).



The Winscales Ave / Landfill Generation circuit is shown in the map above (the main circuit is shown in red with the WSC section highlighted in blue).

High level proposals

- It is proposed that a new circuit is installed out of HDA No1 to allow for the worst served customer feeder to be split into two separate circuits. This will require a new primary circuit breaker and should limit the impact of future faults upstream of the WSCs section.

- To enable the new circuit into Howgate switching station it is envisaged that the existing HV switchboard will need to be replaced. Installation of additional ground mounted RC at this site will be required to allow for optimal automation performance (including at a newly proposed normally open point).

- It is also proposed to refurbish the WSC overhead section between Moresby switching station and Moresby Parks.

Optioneering

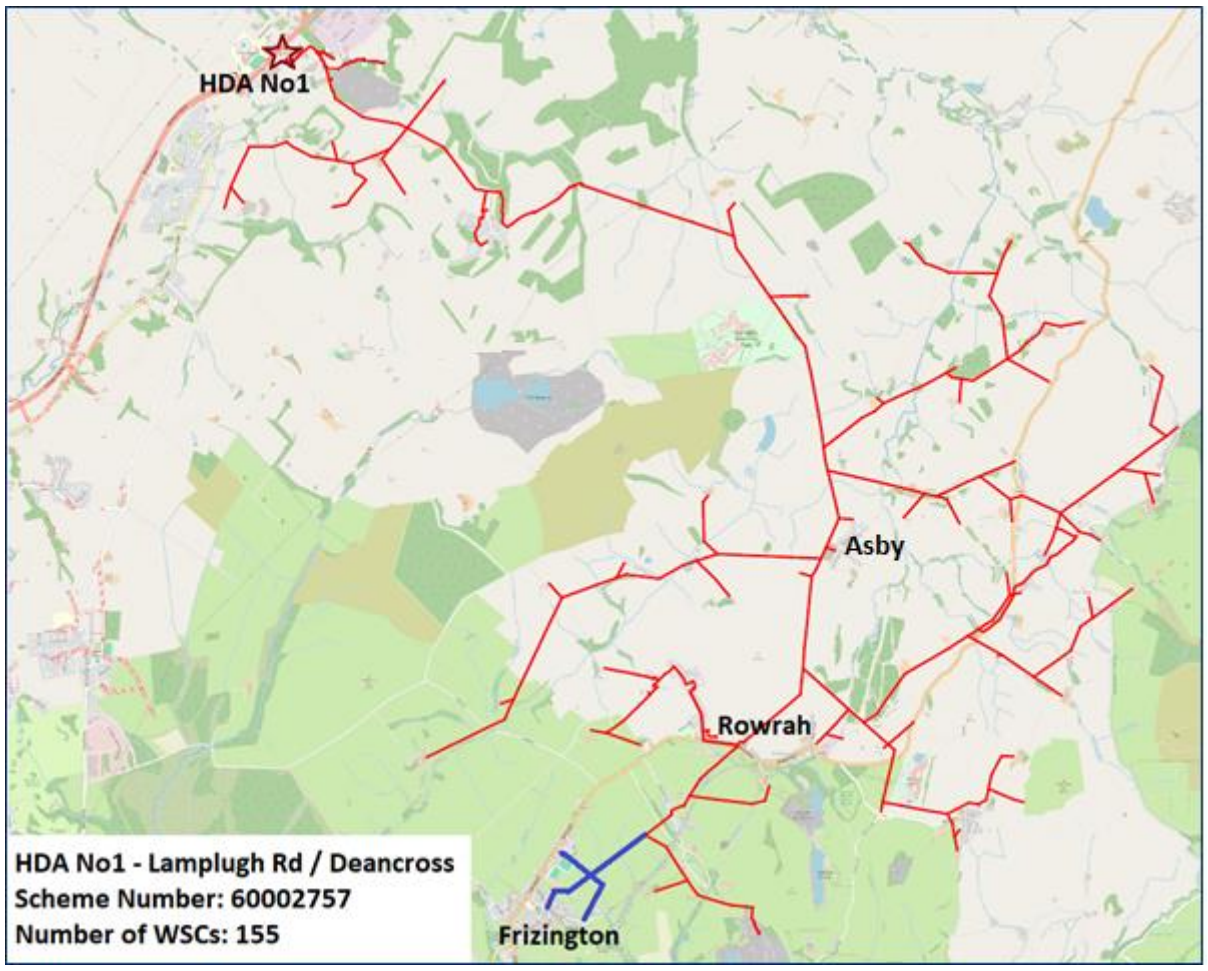
- Initial proposals looked to transfer the WSC section off the existing Winscales circuit and onto a closer HV circuit out of HDA No1. This would potentially have been a more cost-effective solution as the associated cable length would have been considerably shorter. However, this was abandoned when more detailed studies showed that the associated voltage step due to local generation would have been out of statutory limits.

- Undergrounding of the WSC section was disregarded due to the sizable diversion required along public highway and difficulties associated with picking up customer supplies. Therefore enhanced refurbishment was deemed a more cost-effective solution.

A.12 - HDA NO1 - LAMPLUGH RD / DEANCROSS GVR

The qualifying WSCs on this circuit are located between Rowrah and Frizington. Analysis shows that this circuit saw around 30 HV faults during ED1. Primarily, these faults related to condition based overhead line faults (largely insulators, jumpers, fallen conductors and persistent transient activity). Approximately 50% of these faults had an impact on some, or all the worst served customers, while ~65% of these were related to faults within the worst served customer section (i.e. beyond Howgate / Moresby GVR).

Records show there have been historic protection issues on this circuit. However, since network protection settings have been modified in ED1, the number of faults impacting the WSCs has reduced. Due to this recent improvement in performance it was recommended that this circuit was moved from the high investment category to the medium investment category.



The Lamplugh Rd / Deanscross GVR circuit is shown in the map above (the main circuit is shown in red with the WSC section highlighted in blue)

High level proposals

- Recent fault activity that has impacted the WSCs seems to be mainly situated on the network between Asby and Rowrah. It is therefore proposed to underground this section of overhead line.

- As a result of the proposed undergrounding, existing auto-reclosing equipment will need to be relocated in addition to further network automation points being installed.

- Replacement of auto sectionalising links with Fuse Savers has been proposed to provide better co-ordination between spur and mainline protection.

- It is also proposed to refurbish the WSC overhead section beyond Rowrah.

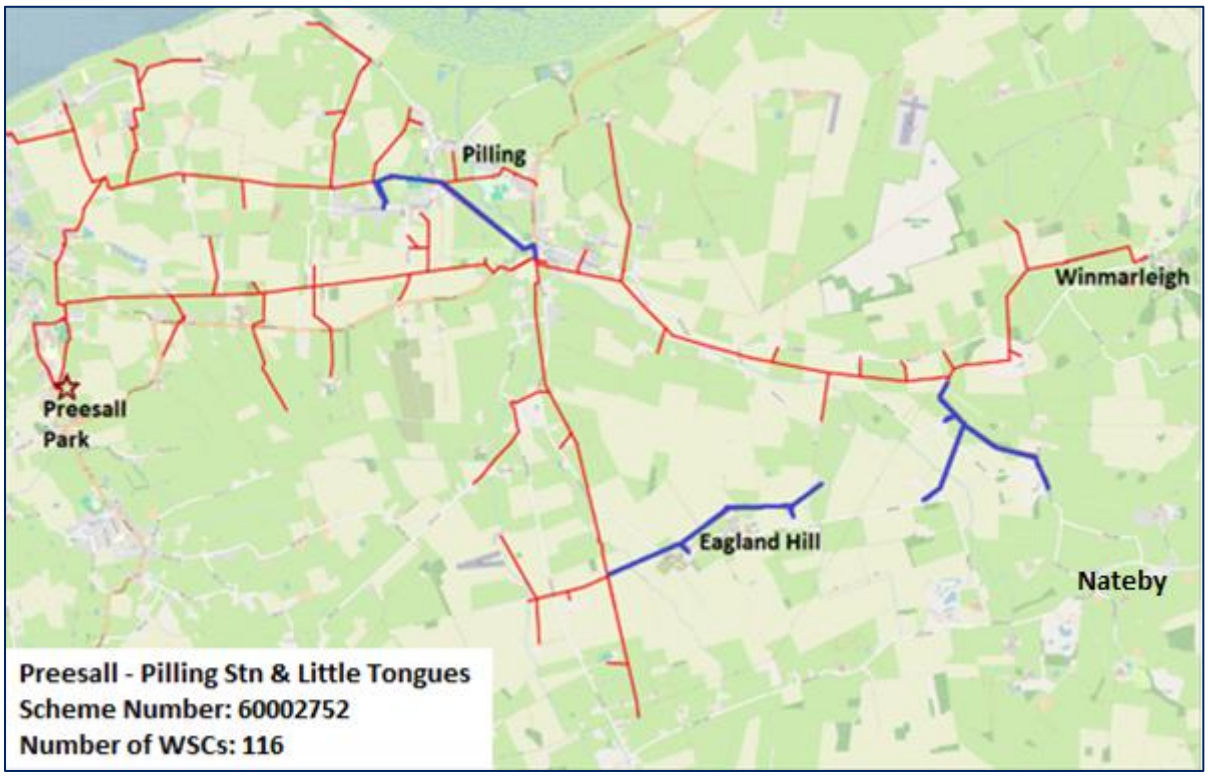
Optioneering

- Before this circuit was reduced to a medium investment category it was anticipated that a sizeable amount of the upstream overhead line would be undergrounded. However, this was changed based on the recent improvements in WSC fault rates.

- It was also considered to reconfigure the network so that the WSC section was transferred onto an adjacent circuit. Analysis showed that the circuits available did not have a good enough fault history to ensure that the transfer would significantly improve fault rates for the WSCs. Additionally, this would likely trigger additional reinforcement works.

A.13 - PREESALL - PILLING STN & LITTLE TONGUES LN

The qualifying WSCs on the Pilling Station circuit are located northwest of Nateby and the WSCs on the Preesall – Little Tongues Ln circuit are located just south of Pilling as shown in the map below (the main circuits are shown in red with the WSC sections highlighted in blue). These two circuits standby to each other as automated backfeeds.



All the worst served customers have been affected by faults within their immediate protection zones and faults in upstream protection zones. Out of the combined forty-eight faults that have impacted the WSCs, 30% were due to primary circuit breaker trips where automation failed to trigger.

The majority of WSC faults have been caused by fallen conductors, bird strikes and failures of insulators / jumpers. Records also suggest that there have been historic grading issues on the Little Tongues Ln circuit that has impacted both restoration performance and transient performance.

High level proposals

- To prevent further upstream faults from impacting the worst served customers it is proposed that a new cable circuit is installed from Preesall primary to Pilling Station. This will require a new primary breaker to be installed at Preesall and some reconfiguration works carried out at Pilling Station.

- The reconfiguration will allow for a new recloser to be installed on the existing Pilling Station circuit with the aim of improving transient fault restoration.

- Additionally, the overhead section between School Ln – Frank Jones Caravan Park is to be undergrounded, while refurbishment of the two WSC sections on the Pilling Station circuit is to be carried out.

- Changes to network protection settings are to be investigated to alleviate on going protection issues.

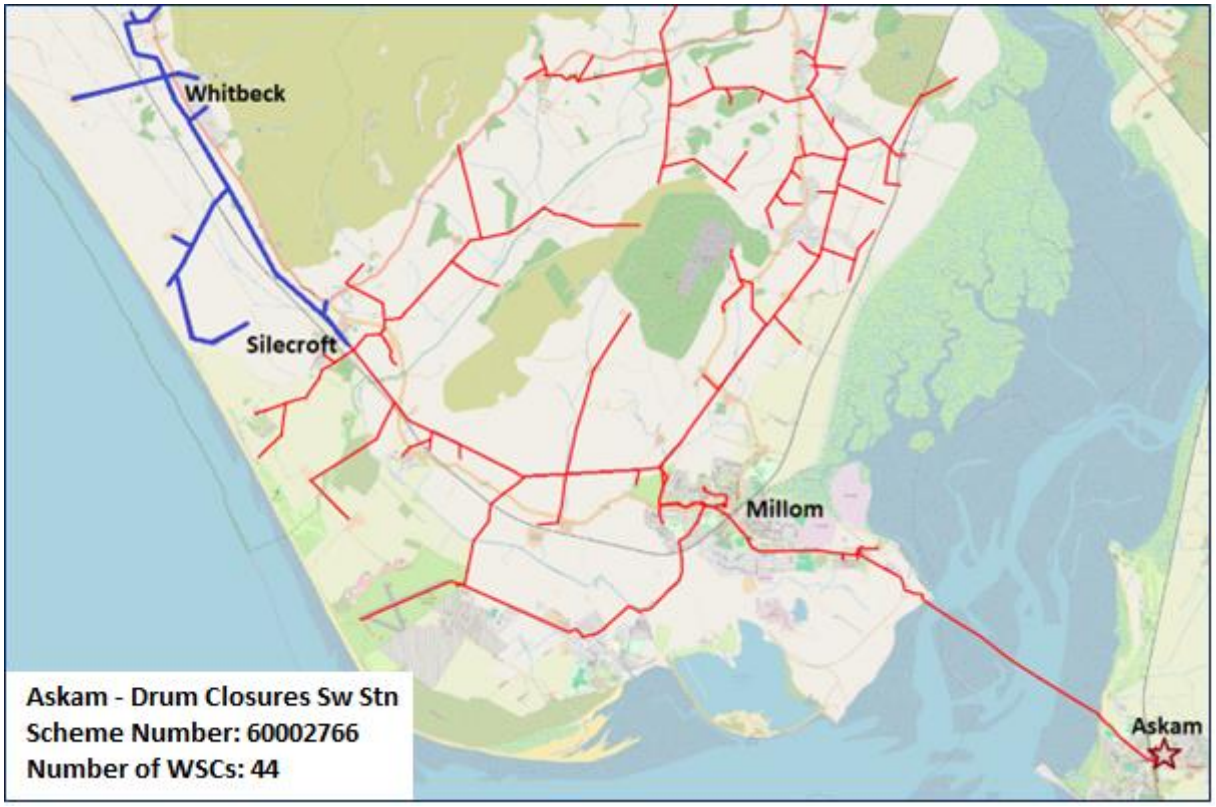
Optioneering

- Undergrounding of the existing overhead circuit from Preesall to Pilling Station was considered to improve the circuit fault rate. However, a cable route like the one proposed for the new circuitry would be required with added costs to pick up customers supplies which are set back from the main public highway. Consents to pick up customer supplies would likely prove to be a restricting factor where some sections of network would have to remain as overhead line. This was therefore deemed to be a less attractive option. Installation of the new circuit has the added benefit to providing a secure underground alternate supply to both WSC circuits.

- It was also considered to transfer parts of the WSC networks onto adjacent circuits that have better historic fault performance. However, Preesall has a mix of 6.6kV and 11kV circuits which cannot be interconnected. This limits opportunity for reconfiguration, while several circuits in the immediate area do not have a good enough fault history to suggest that transfers will significantly improve performance for the WSCs.

A.14 - ASKAM - DRUM CLOSURES SW STN

The qualifying WSCs on this circuit are located between Whitbeck and Silecroft. Records suggest that there were around 40 HV faults on the Askam – Drum Closures Sw Stn circuit in ED1. Generally, these faults related to overhead line faults (largely insulators, jumpers, links, fallen conductors and persistent transient activity). Approximately 70% of faults had an impact on some, or all the worst served customers, while roughly 30% of these were related to faults within the worst served customer section (i.e. beyond Silecroft GVR).



The Drum Closures circuit is shown in the map above (the main circuit is shown in red with the WSC section highlighted in blue).

High level proposals

- It is proposed to refurbish the overhead line upstream of the WSC section which has seen a high number of faults.
- Two sections of overhead line have been proposed for reinforcement with covered conductor due to either their proximity to trees or history of bird strikes.
- Two spur lines feeding WSCs have been proposed for rebuilds due to the number of condition-based faults.
- Installation of Fuse Savers on targeted spurs has been proposed to provide better co-ordination between spur and mainline protection.

Optioneering

- Initial high-level scoping suggested that some of the mainline supplying the worst served customers should be undergrounded to try and reduce the overall fault rate of the circuit. However, more detailed analysis showed most faults are in fact related to faults on spur lines.

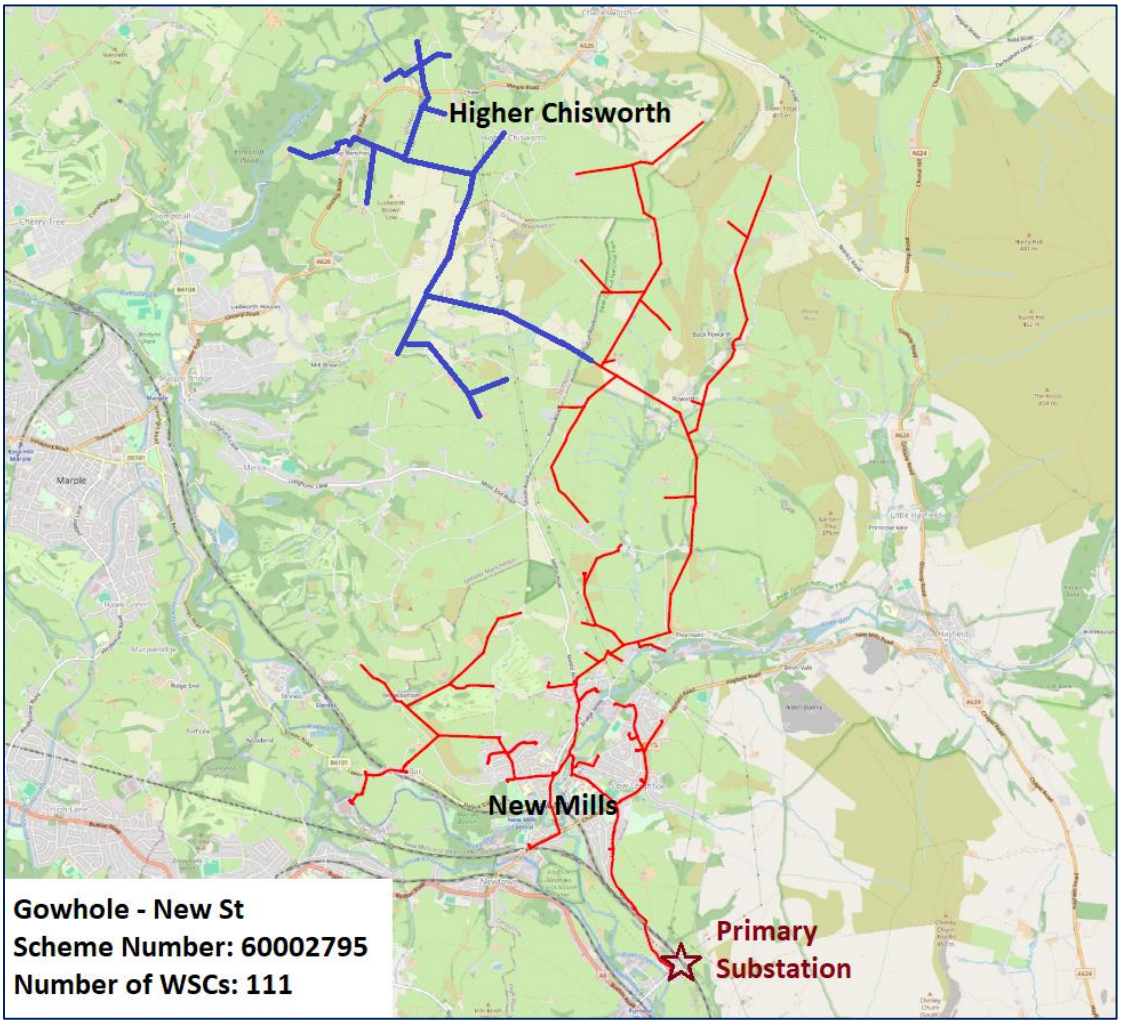
Therefore, proposals were altered to concentrate on refurbishment and rebuilding of these spurs.

- Ideally this circuit would have benefited from a new circuit out of the primary to split the overhead section like in some of the previous proposals. However, this idea was excluded in the preliminary scoping phase as the primary switchboard cannot be extended and a new cable would have to be installed across the estuary, between Askam and Millom.

A.15 - GOWHOLE - NEW ST / SIGNAL BOX MARSH LANE

The qualifying WSCs on this circuit are located on the overhead network south of Higher Chisworth on the outskirts of Marple.

Analysis suggests that there were around 30 HV faults on this circuit in ED1. Predominantly, these faults related to cable faults, persistent transient activity and fallen conductors. Approximately 80% of these faults had an impact on some, or all the worst served customers, while roughly 30% of these were related to faults within the worst served customer section (beyond Intakes Farm Sectionaliser).



The New St circuit is shown in the map above (the main circuit is shown in red with the WSC section highlighted in blue).

High level proposals

- As this circuit supplies around 3,500 customers, it is proposed that a new circuit is installed out of Gowhole primary. This will allow for the worst served customer feeder to be split into two separate circuits. However, as site visits have determined that the existing primary board cannot be extended to provide an additional breaker, it is proposed to double bank the new feeder onto an adjacent circuit breaker (Gowhole – Albion Rd / Lo-Cost circuit).

- To allow for the double banked arrangement some small section cable will need to be overlaid and some network reconfiguration will be required to improve network reliability.

- As the majority of WSC faults are within Intakes Fm Sectionaliser protection zone, it has been proposed to conduct refurbishment of the entire WSC spur line.

- Installation of additional overhead and underground remote-control is required to allow for optimal automation performance.

- It is also proposed to install new Fuse Saver units on the Whitebottom Fm and Boarfold Scout Camp spurs to allow for better co-ordination between spur and mainline protection.

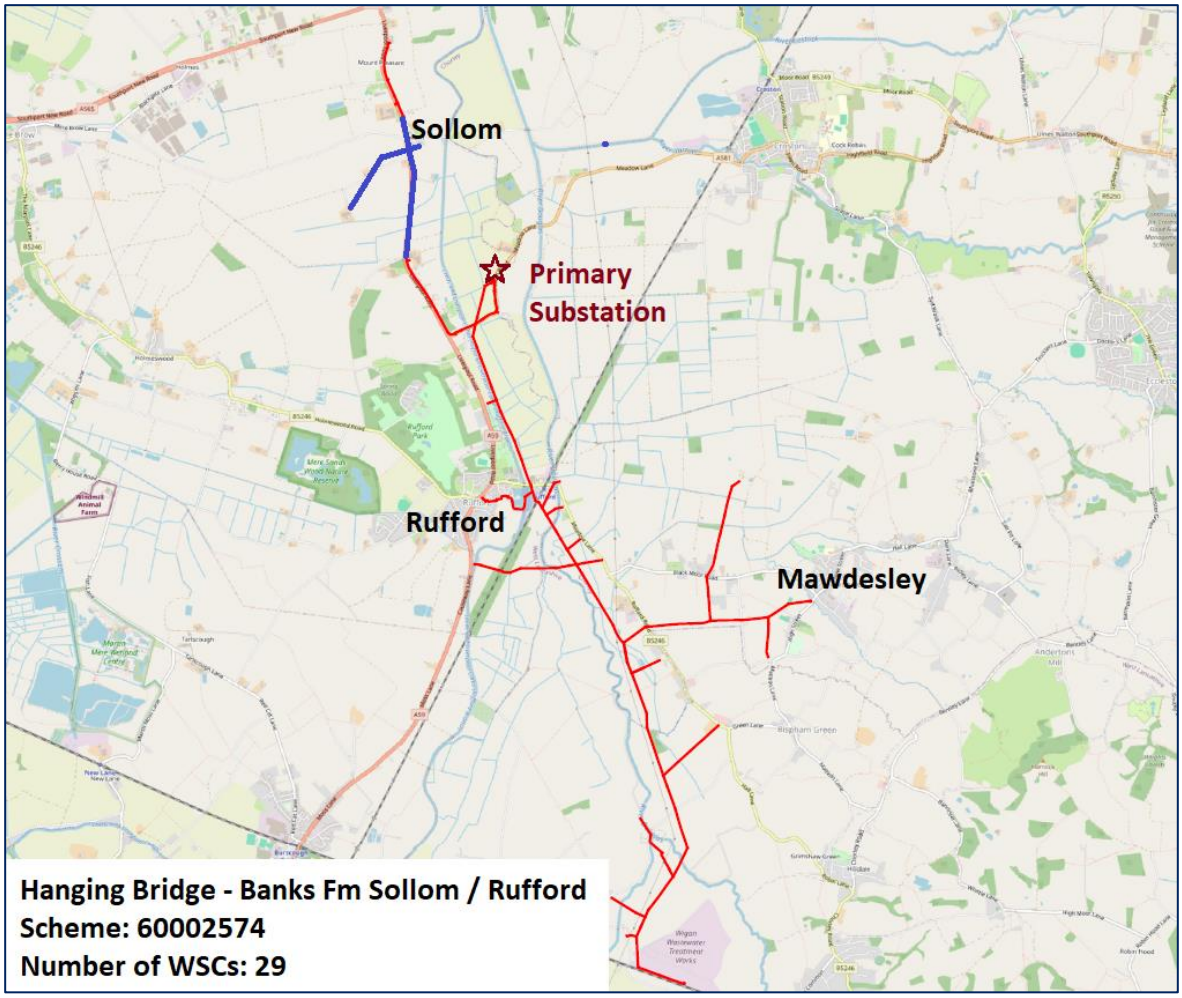
Optioneering

- Multiple cable routes were considered out of Gowhole primary. However, we are currently undertaking a programme of work to overlay first legs out of specified primaries to mitigate capacity issues due to increased load from the adoption of low carbon technologies. The proposed new cable route chosen follows the existing Albion Rd/Lo-Cost circuit which meets the criteria for first leg reinforcement. Hence, there are synergies between the two projects that will allow for the reinforcement works at the same time as the proposed cable works. This will minimise excavation, disruption to customers and overall project costs.

- Undergrounding of the overhead mainline towards Higher Chisworth and the WSC customer spur were considered. However, refurbishment and remote control was deemed to be a more cost-effective solution.

A.16 - HANGING BRIDGE - BANKS FM SOLLOM / RUFFORD MARINA

The qualifying WSCs on this circuit are located near Sollom, between Hanging Bridge and Tarleton as shown in the map above (the main circuit is shown in red with the WSC section highlighted in blue).



Analysis suggests that there were around 30 HV faults on this circuit in ED1. In general, these faults related to persistent transient activity, fallen conductors, insulator failures and bird strikes. Approximately 50% of these faults had an impact on some, or all the worst served customers.

A recent board change at Hanging Bridge primary allowed for reduced numbers of feeder breakers by permitting double banked circuits at the new circuit breakers. As a result the fault performance has been impacted, specifically on the Banks Fm Sollom / Rufford Marina circuit which has seen multiple primary breaker trips in recent years. Faults on the overhead line network between the primary and Sunnyside Meadow Ln have impacted the WSCs in combination with faults on the Sollom spur.

High level proposals

- It is proposed to install a new primary circuit breaker to allow for the double banked configuration to be removed from the system. This will reduce the number of trips at the primary, limiting the impact of future faults.

- In addition, it is proposed to install a new cable circuit between Windgate and Park Lane to transfer some of the existing Mere Farm GVR network onto the Banks Farm Sollom circuit while allowing for an additional automated backfeed. The Mere Farm GVR overhead section was originally included in the WSC EJP document to Ofgem (as Hanging Bridge - Holmeswood). Conversely, it was later removed after data cleansing found two of the 12 WSC faults counted as SDIs. This was owing to local network automation being able to restore the customers in

less than three minutes. However, as WSC customer work is now proposed on the adjacent Banks Fm Sollom feeder, it allows for the majority of the Mere Fm GVR section to be relocated to what will be a better performing circuit.

- To enable the new interconnector, a small section of overhead line adjacent to Mere Brow Lane will need to be reinforced due to thermal constraints.

- Installation of additional overhead and underground remote-control is required to allow for optimal automation performance.

- Refurbishment of the existing overhead line out of the primary and on the WSC spur has also been proposed to reduce the number of future faults.

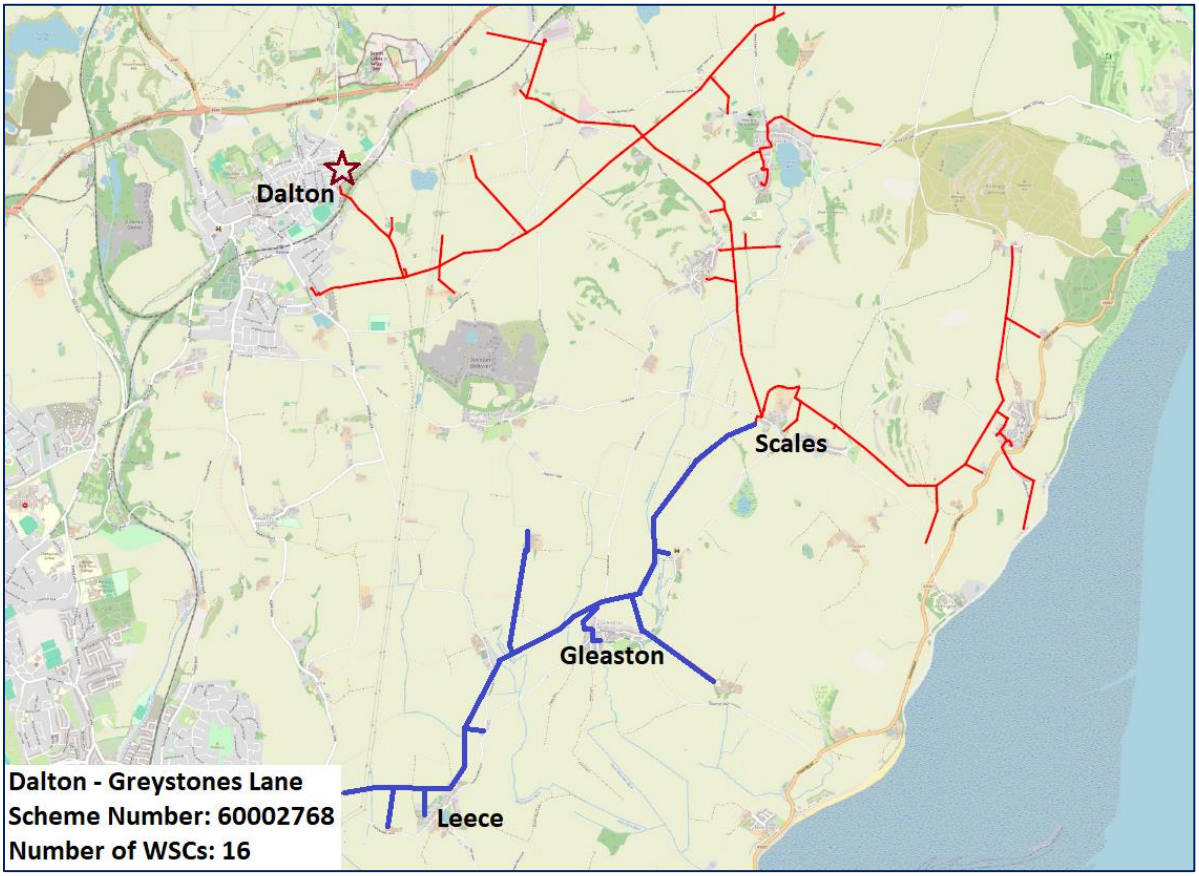
Optioneering

- Due to the double banked arrangement at the primary breaker, the WSC section has been impacted by faults on the adjacent overhead network. Initial proposals looked at undergrounding this section of overhead as opposed to un-banking the circuits. However, this was deemed to be less cost effective while not providing the additional network benefits in terms of overall fault performance and released network capacity.

- Various cable routes to the Mere Farm GVR section were considered, including partial undergrounding of the adjacent circuit to Holmeswood switching station which has seen high fault rates in recent years. However, realistic cable routes to achieve this would have to be diverted along Holmeswood Rd / The Marshes Ln. This would therefore involve a much longer and costly cable run.

A.17 - DALTON - GREYSTONES LN / WOOD HEAD ABS

The qualifying WSCs on this circuit are located around Gleaston, between Scales and Leece. Analysis suggests that there were around 30 HV faults on this circuit in ED1. Predominantly, these faults related to fallen conductors and insulator failures. Of these WSC faults, approximately 50% were associated with the WSC section (i.e. beyond Low Town GVR), with 50% on upstream network.



The Greystones Lane circuit is shown in the map above (the main circuit is shown in red with the WSC section highlighted in blue).

High level proposals

- To prevent further upstream faults from impacting the worst served customers it is proposed that a new cable circuit is installed from Dalton primary to Greystones Lane substation. This will require a new primary breaker to be installed at Dalton and some reconfiguration works at Greystones Lane.

- To allow for the new circuit running arrangement, some reinforcement of existing small section cable will need to be carried out on Greystones Lane and Long Lane.

- Refurbishment of the WSC overhead section between Scales switching station and Leece is required due to the high number of faults on this section.

- Installation of additional overhead and underground RC is required to allow for optimal automation performance.

Optioneering

- Undergrounding of the existing overhead sections feeding the WSCs was considered to allow for a more secure supply. However, an alternate route along public highway would make it

difficult to pick up customer services and would involve excessive diversions, increasing costs significantly. The required consents for these diversions would delay delivery due to the number of customers involved.

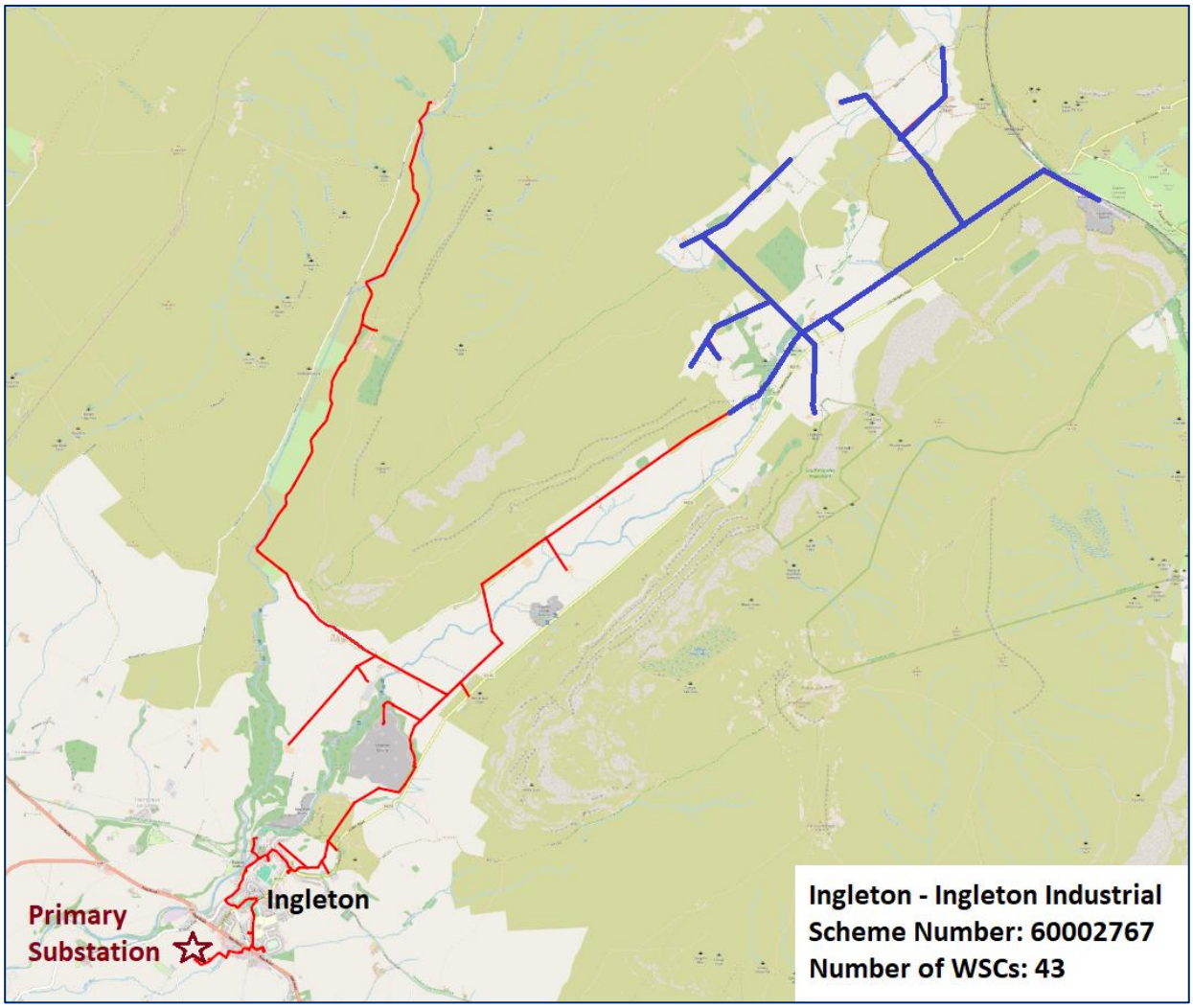
- A longer cable route out of the primary to Scales was considered to reduce the amount of overhead line supplying the WSCs. However, the fault rate of the overhead line in the region of Stainton Quarries was not deemed high enough to justify the additional cable costs.

A.18 - INGLETON - INGLETON INDUSTRIAL

The qualifying WSCs on the Ingleton Industrial circuit are located near Ribblehead Quarry, north of Helwith Bridge.

Analysis suggests that there were around 30 HV faults on this circuit in ED1. In general, these faults related to persistent transient activity, fallen conductors, insulator failures and faulty jumpers. Approximately 65% of these faults had an impact on some, or all the WSCs, while the majority of these were related to faults within the WSC section (i.e. beyond Twistleton Sectionaliser).

The main backfeed to the Twistleton Sectionaliser protection zone is via the *Helwith Bridge - Horton Road End ABS / Helwith Bridge Quarry ABS* circuit. This circuit is a poor performing backfeed with most faults occurring beyond Selside Rd GVR protection zone (particularly on spur lines off the mainline).



The Ingleton Industrial circuit is shown in the map above (the main circuit is shown in red with the WSC section highlighted in blue).

High level proposals

- As the majority of WSC faults are beyond Twistleton Sectionaliser it is proposed to focus on this section of line with regards to enhanced refurbishment. Several sections are to be rebuilt with covered conductor to limit transient activity due to invasive trees.

- An additional section of upstream overhead line is also to be rebuilt with covered conductor which runs through heavily wooded areas while the entire Ingleton - Ingleton Industrial feeder is to be surveyed for cutting back encroaching trees.

- It is also proposed to install new Fuse Saver units on the selected spurs to allow for better co-ordination between spur and mainline protection.

Poor performing backfeed proposals (Helwith Bridge - Horton Rd End ABS / Helwith Br Quarry ABS)

- It is proposed to carry out enhanced refurbishment works on the spur lines beyond Selside Road GVR to eliminate future faults from tripping out the backfeed circuit. This should improve future automation performance.

Optioneering

- Undergrounding of the existing overhead sections feeding the WSCs was considered to allow for a more secure supply. However, detailed analysis showed that most faults have occurred in the immediate WSC section, and the fault rate of the overhead line west of Chaple-le-Dale was not deemed high enough to justify the additional cable costs. Additionally, the overhead line in question crosses the River Doe multiple times and would likely require directional drilling to enable cable crossings.

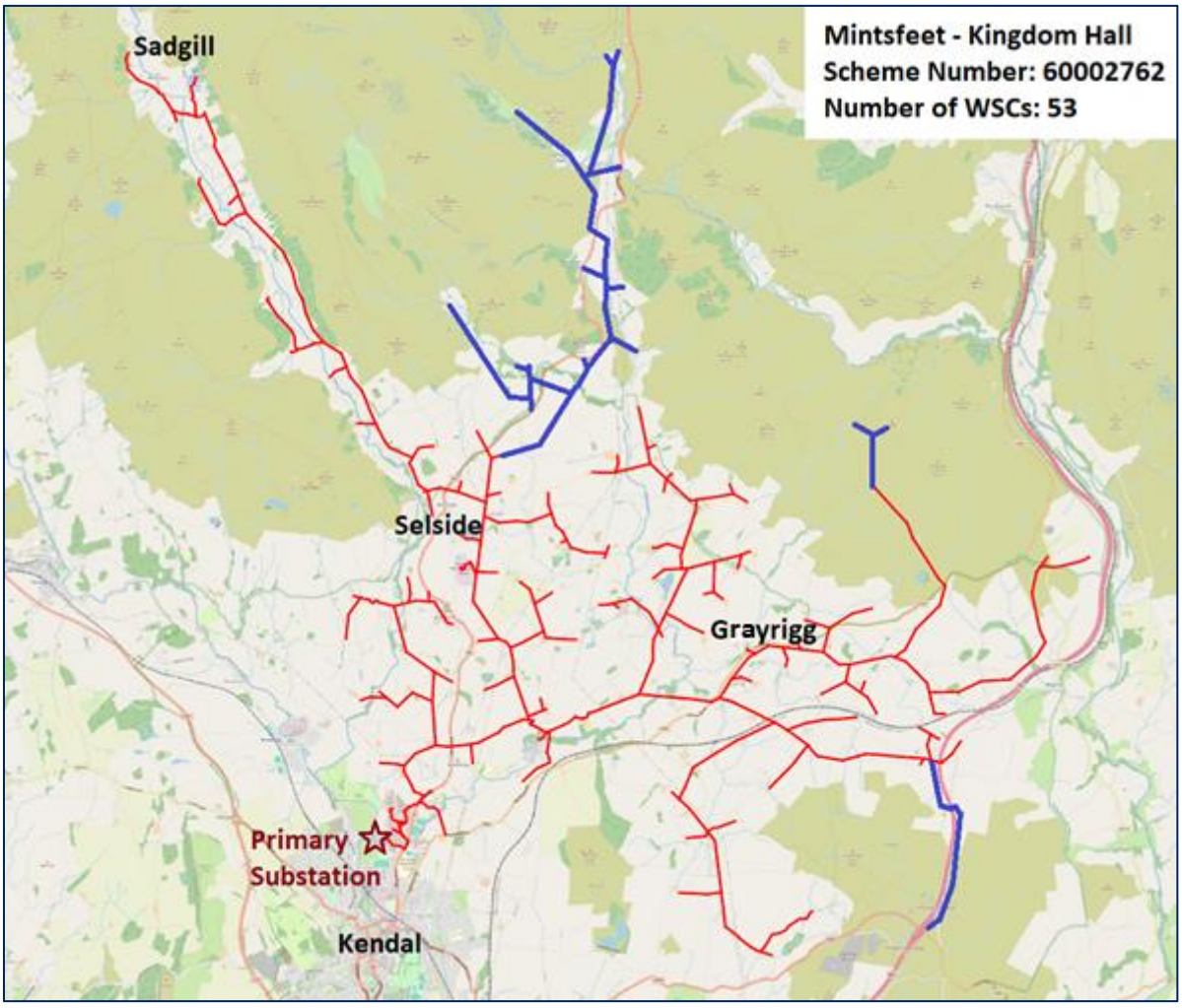
- Undergrounding of the Helwith Bridge - Horton Rd End ABS / Helwith Br Quarry ABS backfeed circuit was also considered to improve automation reliability. However, the poor performance of this circuit was found to be mainly down to poor spur performance which is cleared by the mainline GVR. Enhanced refurbishment was therefore the preferred option.

A.19 - MINTSFEET - KINGDOM HALL

The qualifying WSCs on the Kingdom Hall circuit are located on three separate spurs. The Cooper Hs Sectionaliser spur, the Lambrigg Park spur and the spur supplying GPO Radio tower. The three regions are shown in the map below.

Analysis suggests that there were around 60 HV faults on this circuit in ED1. Largely these faults related to fallen conductors, insulator failures / jumper failures and persistent transient activity. Approximately 60% of these faults had an impact on some, or all the worst served customers.

It is worth noting that the associated restoration times on this circuit are particularly poor due to the number of customers situated on long overhead spur lines. In particular, the sections beyond Mealbank / Selside GVR, Grayrigg Foot GVR and Field End GVR.



The Kingdom Hall circuit is shown in the map above (the main circuit is shown in red with the WSC section highlighted in blue).

High level proposals

- The Cooper Hs Sectionaliser spur has seen the most faults in the last three years (WSC spur north of Selside). Considering this spur has a substantial proportion of the WSCs it is recommended that significant refurbishment work is targeted on this section of network while an interconnector is installed between this spur and an adjacent circuit out of Shap primary (Shap Granite Sw/Stn circuit). This interconnector will allow for automatic restoration of the WSCs for the loss of upstream network.

- A second interconnector is also proposed to loop in the Grayrigg spur.

- Further overhead refurbishment of the network beyond Wythmoor ABS has been proposed which contains WSCs on the Lambrigg Park spur.

- Additional overhead remote-control has been proposed to improve automation efficiency on the WSC sections.

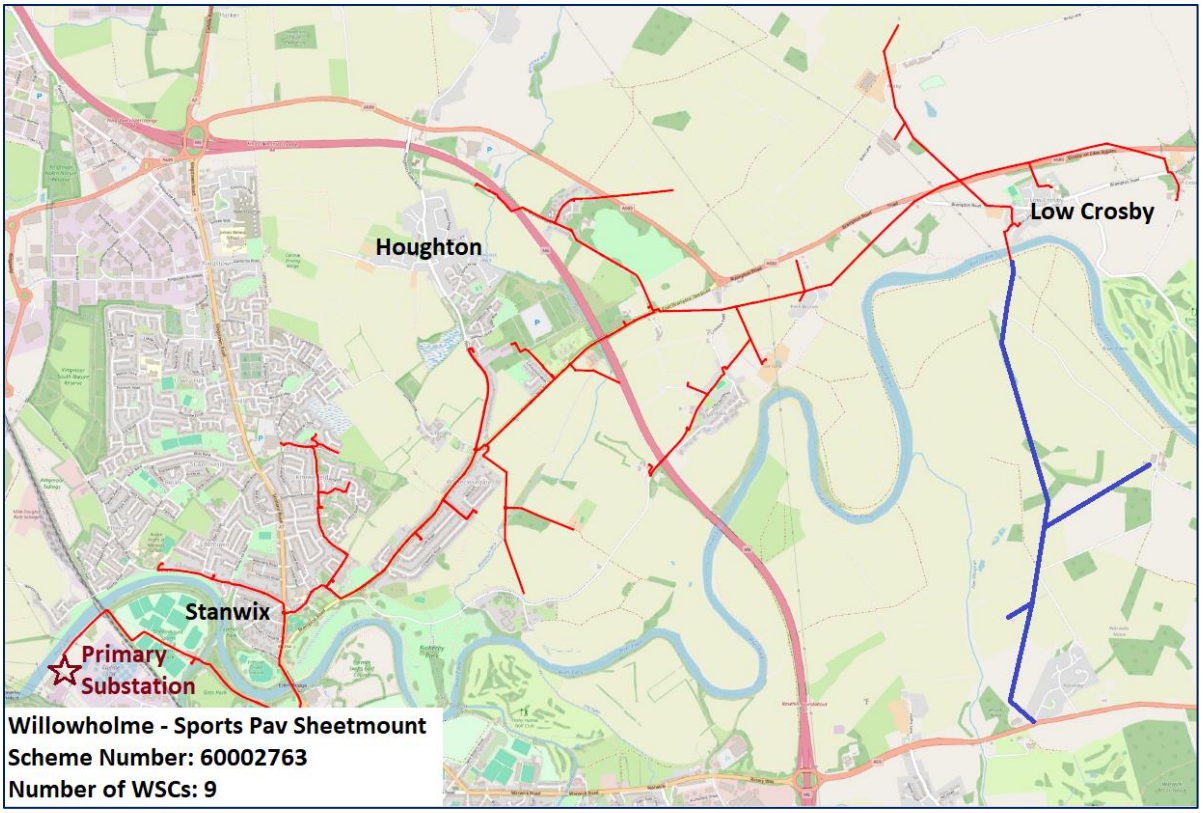
Optioneering

- Initial high-level proposals assumed only one worst served customer and allowed for a ~3km cable lay. It was assumed that this cable lay would be used to split the Selside / Grayrigg overhead sections to reduce the impact of upstream faults on the worst served customers and this circuit was notionally classed as medium priority. However, this proposal has now been altered considering there are now three separate WSC spurs with the majority of WSC faults located within the immediate GVR protection zones. As a result it has been proposed to reclass this circuit as a high priority circuit.

- Proposals also looked at laying a new circuit out of Mintsfeet to move the majority of WSCs onto a more reliable cable fed network. However, site visits confirmed that the existing primary board cannot be extended and does not allow for double banked cable configurations.

A.20 - WILLOWHOLME - SPORTS PAV SHEEPMOUNT

The qualifying WSCs on the Sports Pav Sheepmount circuit are located south of Low Crosby. Records suggest that there were over 20 HV faults on this circuit during ED1. The circuit is shown in the map below (the main circuit is shown in red with the WSC section highlighted in blue).



Currently two of the four normally open points on this circuit are not automated. This is impacting restoration performance, especially the backfeed at Whoof House which is the main alternate supply to the WSC section. It is proposed that all NOPs on this circuit are fitted with remote control to improve automation performance.

High level proposals

- It is proposed to overlay fault prone cable sections of the existing circuit. Analysis shows that fault locations have been on older type of cable (0.15 sq. inch and 0.1 copper cable sections). It is therefore proposed to overlay these sections (~2.25km of faulty cable in total).

- Refurbishment of the WSC overhead section beyond Brunswick Road End switching station is required due to the high number of faults on this section.

- It is proposed that all NOPs on this circuit are fitted with RC to improve automation performance.

- Additional ground mounted RC has been proposed to improve automation efficiency.

Optioneering

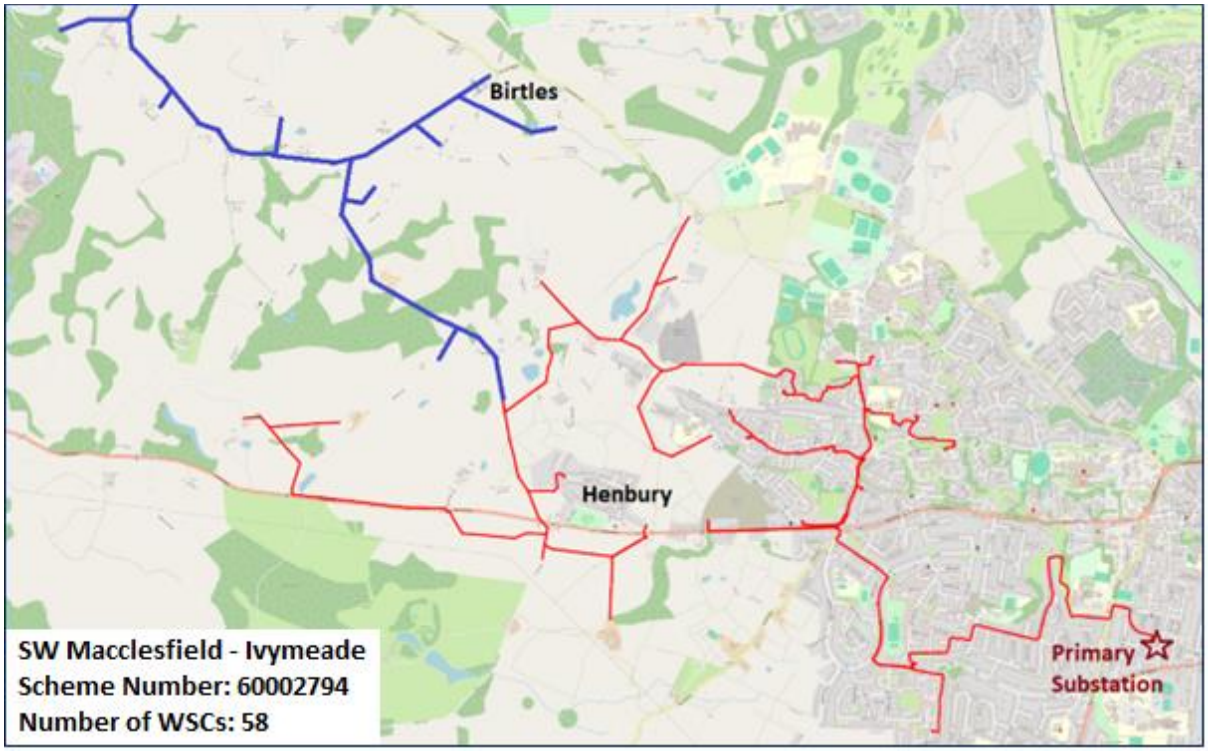
- Initial high-level proposals on this circuit considered installing a new primary breaker at Willowholme to allow for a new ~3.6km feeder to split the existing circuit in two. However, when considering that there have been five cable faults between the primary and Hadrian's Camp substation it would require a cable lay of >4km to lay a cable beyond this point. The

assumed cable route would also involve crossing national rail track and the River Eden which would likely increase costs and impact timescales for project delivery. More importantly, this option would not reduce the overall fault rate associated with cable faults, where the existing Sports Pav circuit would still be at risk (and would still supply >1,000 customers). Therefore cable overlays were deemed to be the preferred option.

- Undergrounding of the WSC overhead section was excluded due to the excessive diversion route that would be required, the difficulty in picking up customer services and issues with crossing the River Eden.

A.21 - SOUTHWEST MACCLESFIELD - IVYMEADE

The qualifying WSCs on the Ivymeade circuit are located southwest of Birtles. Historic fault records suggest that there were 21 HV faults on the Southwest Macclesfield – Ivymeade circuit in ED1 and were mainly due to persistent transient activity, trees, fallen conductors, and faulty jumpers.



The Ivymeade circuit is shown in the map above (the main circuit is shown in red with the WSC section highlighted in blue).

High level proposals

- To prevent further upstream faults from impacting the worst served customers it is proposed that a new cable circuit is installed from Southwest Macclesfield primary to Henbury to split the existing circuit in two. This will require a new primary breaker to be installed at the primary.

- To enable the new circuit, some reconfiguration works will be required at Henbury as well as on the overhead network supplying the WSCs.

- Refurbishment of the WSC overhead section beyond GVR179 on Hamble Way is required due to the high number of faults on this section.

- An additional section of upstream overline is also to be rebuilt with covered conductor which runs through wooded area.

- Installation of new RC reclosers will limit the impact of future faults on the overhead sections and improve transient restoration performance; an additional ground mounted RC has also been proposed to improve automation efficiency.

Optioneering

- Multiple cable routes were considered out of Southwest Macclesfield primary. However, ENWL are currently undertaking a programme of work to overlay first legs out of specified primaries to mitigate capacity issues due to increased load from the adoption of low carbon

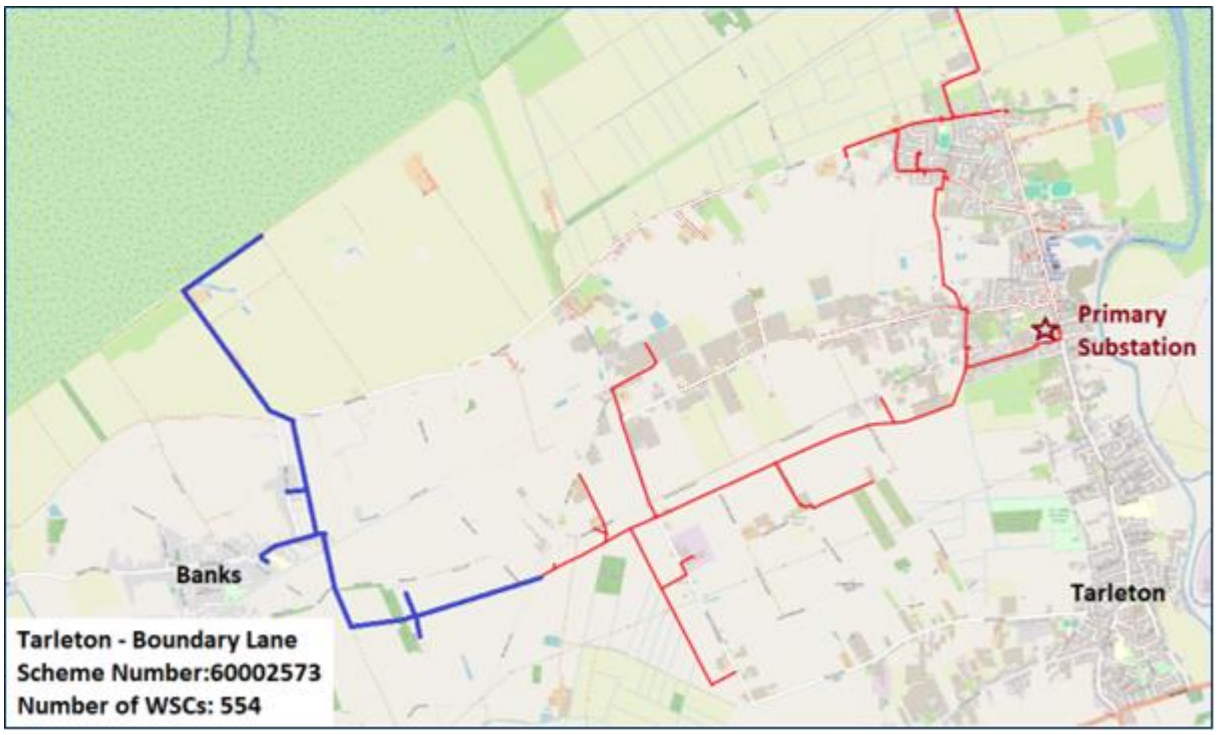
technologies. The proposed cable route taken follows in full or in part HV cable routes which meet the criteria for first leg overlays. Hence, there are synergies between these projects that will allow for the reinforcement works at the same time as the proposed cable works. This will minimise excavation, disruption to customers / public and overall project costs.

- Initial proposals considered some undergrounding of the WSC section, however as faults were found to be associated with wooded areas (faults due to clashing with trees) the use of covered conductor was deemed to be the most cost-effective solution.

A.22 - TARLETON - BOUNDARY LN / NEW HS NURSERIES

The qualifying WSCs on this circuit are located northeast of Banks. Analysis suggests that there were around 60 HV faults on this circuit in ED1. Predominantly, these faults related to fallen conductors, jumper failures, windborne material on overhead lines and HV cable faults. Approximately 50% of these faults had an impact on some, or all the worst served customers.

However, it is worth noting that some of these faults occurred on sections of network which are no longer supplied via the Boundary Lane feeder. Originally there were ~550 worst served customers on this circuit before an ED1 reinforcement project split this circuit at Chapel Ln (Banks) by laying a new feeder out to Greaves Hall Housing. The remaining WSCs on the Tarleton – Boundary Lane circuit are situated beyond Ferguson Growers GVR and are shown in the map below (the main circuit is shown in red with the WSC section highlighted in blue).



High level proposals

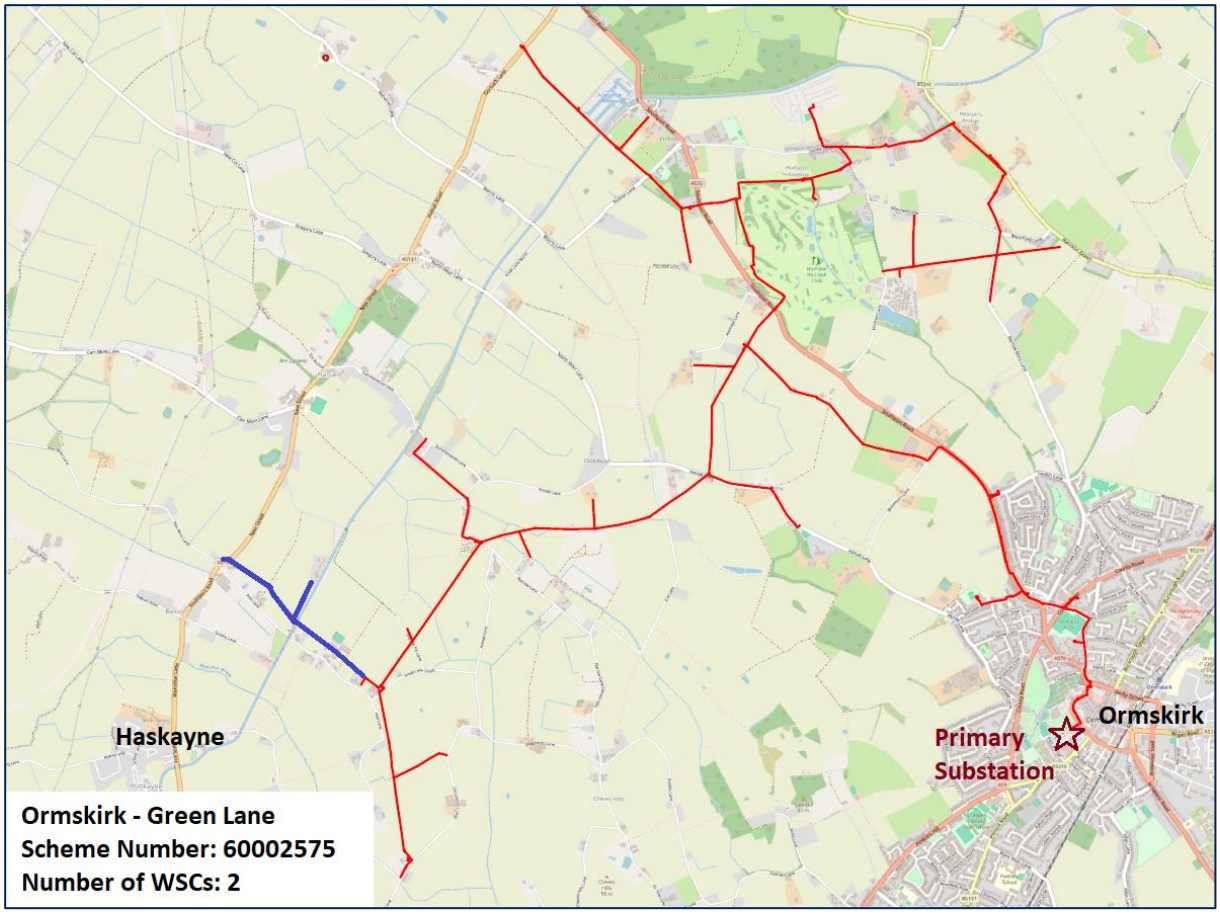
- It is proposed to refurbish the upstream overhead line supplying the WSCs which has seen a high number of faults in recent years.

Optioneering

- This circuit was originally classed as low priority as ED1 reinforcement has been previously conducted, greatly reducing the size of the circuit. Refurbishment of the existing WSC spur has recently been carried out, which should reduce local fault rates. However, recent fault data suggests that the upstream overhead network is still prone to faults resulting in these customers requalifying as WSCs. Therefore, further refurbishment has been proposed.

A.23 - ORMSKIRK - GREEN LN

The qualifying WSCs on the Ormskirk – Green Lane circuit are located northeast of Haskayne as shown in the map below (the main circuit is shown in red with the WSC section highlighted in blue).



Fault records suggest that there have been 18 HV faults on the Ormskirk – Green Ln circuit since 2019. The causes of these faults have been mostly due to faulty insulators, fallen conductors, fallen HV poles and faulty fuse mounts.

High level proposals

- It is proposed to refurbish the overhead line from Asmall GVR to Plex Moss OD Low Substation which supplies the WSCs.

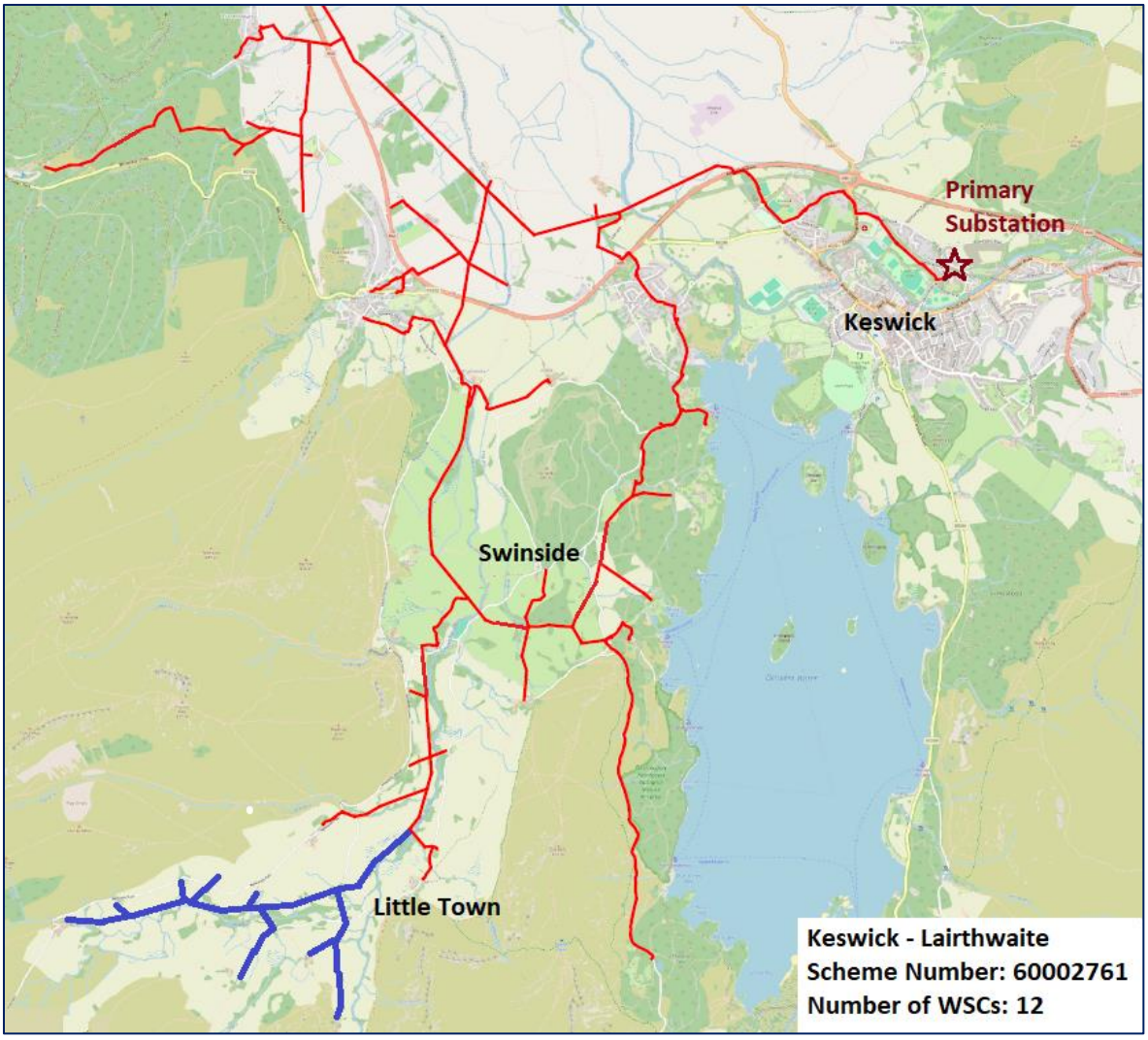
- It is also proposed to refurbish the overhead line on the Hurlston ABS spur which has seen recent high fault rates causing the loss of much of the circuit (including the WSC section).

Optioneering

Initial proposals considered installing a new circuit out of Ormskirk primary to split the existing circuit. However, further investigations identified that Asmall GVR has been recently installed as part of a quality of supply programme, which now provides an additional protection zone on the associated overhead line. Considering most recent faults affecting the WSCs have been within the new GVR zone, a new circuit was deemed to be too expensive considering the limited performance benefit that it would deliver. Therefore refurbishment of new GVR section has been proposed instead.

A.24 - KESWICK - LAIRTHWAITE

The qualifying WSCs on the Lairthwaite circuit are located on the Newlands spur which is situated to the southwest of Keswick as shown in the map (the main circuit is shown in red with the WSC section highlighted in blue).



Discounting short duration interruptions (SDIs) the WSC customers have seen ten faults since 2019. However, recent fault performance seems to have significantly improved with only three interruptions in the last three years.

High level proposals

- Due to the recent improvement in fault performance on this circuit, it is proposed to simply carryout refurbishment of the WSC spur to minimise future faults on the immediate network. RC switches either side of the spur are already installed and should be able to restore the WSCs automatically for faults on the wider network.

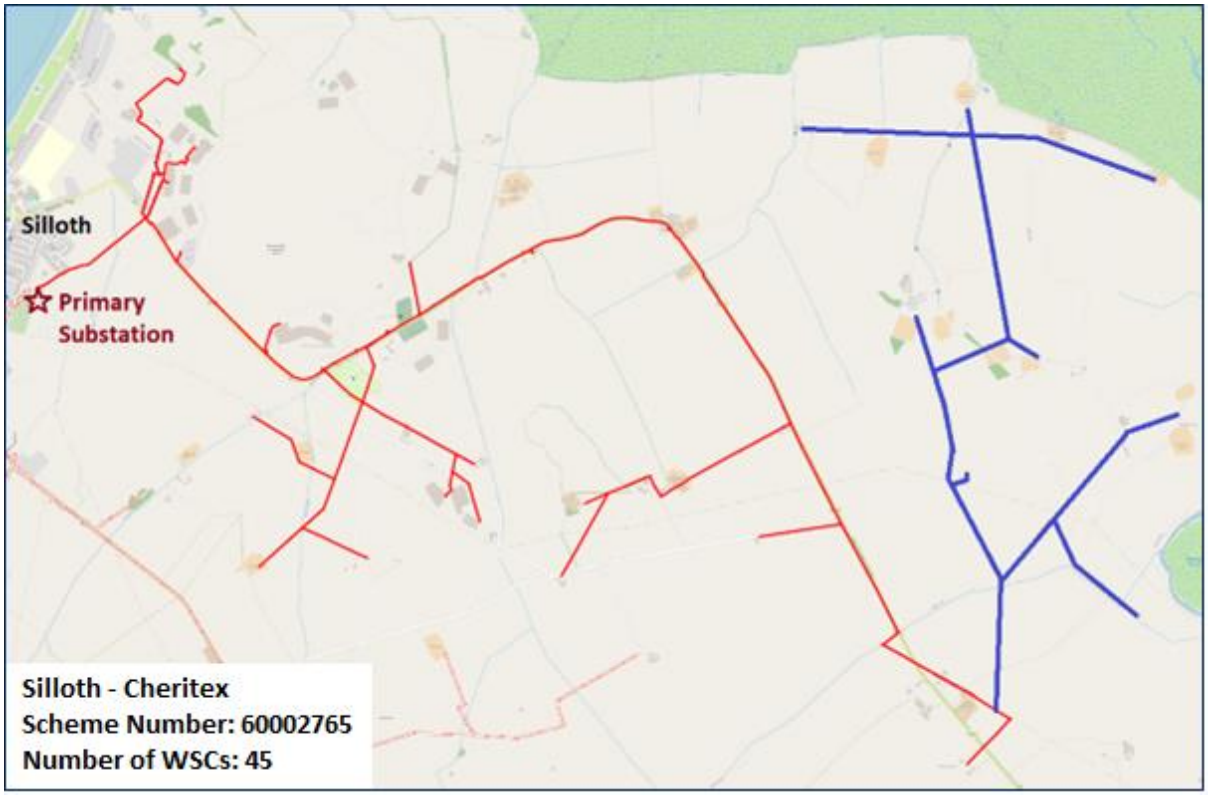
Optioneering

- This circuit was originally classed as medium priority as per the ED2 WSC targeting and methodology. However, due to the recent improvement in WSC fault performance it was recommended that this circuit was downgraded to a low priority circuit. As a result the high-level proposals to lay a new 3km feeder out of Keswick primary to split the existing circuit have been aborted.

A.25 - SILLOTH - CHERITEX / SILLOTH AIRFIELD

The qualifying WSCs on the existing Silloth – Cheritex / Silloth Airfield circuit are located on the Seaville spur. It is worth noting that a previous ED1 reinforcement project has now split this circuit into two separate circuits. As a result, downstream faults that previously impacted the Seaville spur are no longer an issue during normal running conditions.

Fault records suggest that there have been nine HV faults on the feeder since 2019 when discounting faults on parts of the network which have now been transferred off this circuit (i.e. after ED1 network reconfiguration).



The Cheritex circuit is shown in the map above (the main circuit is shown in red with the WSC section highlighted in blue).

High level proposals

- It is proposed to refurbish the WSC spur to reduce the impact of local overhead faults.

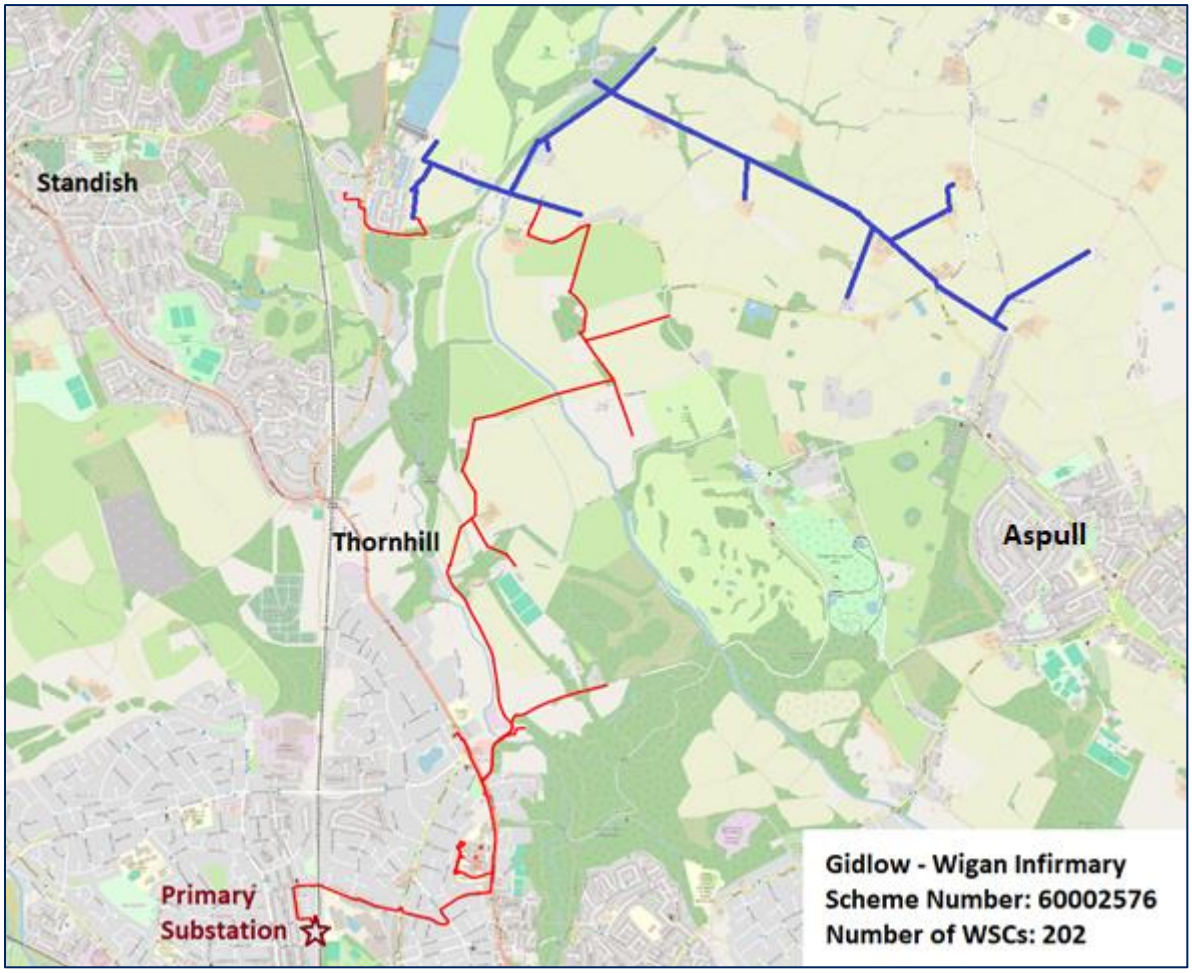
Optioneering

- This circuit was originally classed as low priority as ED1 reinforcement has been previously carried out, greatly reducing the size of the circuit. However, recent fault data suggests that the overhead network local to the WSCs is still prone to faults. Therefore refurbishment of this section has been proposed.

A.26 - GIDLOW - WIGAN INFIRMARY (Previously Queensway)

The qualifying WSCs are located beyond Sennicar Lane GVR (east of Standish and north of Aspull). It should be noted that this GVR was previously supplied via the *Gidlow – Queensway* feeder, however an ED1 reinforcement project relocated this section of network onto the Wigan Infirmary / Marlyebone Park circuit.

Fault records suggest that there have been 12 HV faults on the feeder since 2019 when discounting faults on parts of the network which have now been transferred off this circuit (i.e. after ED1 network reconfiguration). Most of these faults were associated with the overhead line beyond the GVR. Causes include issues with livestock, faulty insulators, fallen conductors and persistent transient activity.



The Wigan Infirmary circuit is shown in the map above (the main circuit is shown in red with the WSC section highlighted in blue).

High level proposals

- It is proposed to refurbish the WSC section beyond Sennicar Lane GVR to reduce the impact of local overhead faults.

Optioneering

- This circuit was originally classed as low priority as ED1 reinforcement has been previously conducted, greatly reducing the size of the circuit. However, recent fault data suggests that the overhead network local to the WSCs is still prone to faults. Therefore refurbishment of this section has been proposed.