RIIO-ED2 Engineering Justification Paper (EJP)

OHL Clearances

Investment Reference No: 418_SSEPD_NLR_OHL_CLEARANCES

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Investment Summary Table

Table 1 below provides a high level summary of the key information relevant to this Engineering Justification Paper (EJP) and the investment associated with removing overhead line (OHL) clearance issues.

Table 1: Investment Summary

Engineering Justification Paper (Non-Load)						
Name of Programme	OHL Clearances					
Primary Investment Driver	ESQCR Compliance and Safety					
Investment category	418_SSEPD_NLR_OHL_CLEARANCES					
Output type	OHL_CLEARANCES					
Cost	£60.5m					
Delivery Year	RIIO-ED2 (2023 – 2028)					
Reporting Table	CV18: OH Clearances					
Outputs in RIIO ED1 Business Plan?	No					
Spend Apportionment	**Licence Area**	**ED1**	**ED2**	**ED3+**		
	SEPD	-	**£34.26m**	-		
	SHEPD	-	**£26.23m**	-		
RIIO-ED2 Spend (£m) – OHL Clearances						
CV18 OH CLearances RIIO-ED2 Spend (£m)	**Year**	**2024**	**2025**	**2026**	**2027**	**2028**	**Total**
	SEPD	£4.12m	£5.50m	£6.87m	£8.88m	£8.88m	**£34.26m**
	SHEPD	£2.62m	£4.20m	£5.77m	£6.82m	£6.82m	**£26.23m**
RIIO-ED2 Volumes – OHL Clearances						
CV18 OH CLearances RIIO-ED2 Volumes (sites resolved)	**Year**	**2024**	**2025**	**2026**	**2027**	**2028**	**Total**
	SEPD	1729	2306	2883	3747	3747	**14,412**
	SHEPD	1369	2189	3009	3558	3557	**13,682**

1 Executive Summary

Our ***Safe and Resilient (Annex 7.1)*** sets out the methodology used to determine the Non-Load baseline for capital expenditure. This encompasses capital investment on the network that will improve network safety and meet compliance; namely the Electricity, Safety, Quality and Continuity Regulations (ESQCR) 2002.

We will invest **£26.23m** in SHEPD and **£34.26m** in SEPD to deliver necessary safety compliance as per ESQCR to address 13,682 Overhead Line (OHL) clearances in SHEPD and 14,412 OHL clearances in SEPD as identified by our most recent Light Detection and Ranging (LiDAR) flights over the respective networks. The proposed works are planned for completion within the ED2 regulatory period. We are currently undertaking LiDAR flights over our SHEPD network and propose to share our findings with Ofgem at draft determination when we receive the latest data in March 2022.

We are committed to ensuring that our network is safe, reliable and meets the minimum standards as set out in ESQCR 2002 . This paper confirms the need for Ex-Ante allowance to resolve OHL conductor clearances. The spans that we propose to address are targeted using our latest LiDAR data combined with our risk-based approach to manage and rectify conductor clearances on the network.

Our risk-based approach to OHL clearances ensure that we are managing the risk to the public, industry, contractors and our operational staff by targeting the areas with the highest risk. The total number of OHL clearance infringements identified using LiDAR was 25,547 in SHEPD and 39,623 in SEPD. If our strategy were to address all OHL clearances this would cost £129.74m for both licence areas combined; however, with our risk-based approach we are mitigating risks, managing safety and ensuring the impact on customer bills is mitigated. This approach will save c. **£69.24m**.

We are making a clear step change in the way we inspect and record the data associated with our OHL network. This step change involves shifting from foot patrols with manual measurements to a (LiDAR technology to measure conductor heights. This drives improvements with the accuracy and consistency of our data collection.

Investment in this category is required as it is driven by compliance with ESQCR and public safety. We have several options to address conductor clearances infringements and will always consider the most cost effective and co-ordinated solution. The options considered to mitigate OHL clearance infringements are as follows (starting from lowest cost to most expensive):

- Risk assess and monitor clearance infringements (Low and Medium Risk sites only)
- Remove the hazard below Overhead Line (OHL)
- Re-tension OHL conductor
- Replace line insulators to increase conductor height
- Replace OHL conductor
- Replace pole with larger pole
- Underground the OHL
- Deviate the OHL

This investment represents a total spend of **£60.50m** throughout RIIO-ED2 across both licence areas.

2 Introduction

This Engineering Justification Paper (EJP) describes our proposed non-load related investment plan to address Overhead Line (OHL) Clearances during RIIO-ED2.

The primary driver considered within this paper is safety as determined by the Electricity Safety, Quality and Continuity Regulations (ESQCR) 2002.

Section 3 provides high-level background information for this investment and explains the importance of ensuring that we operate a safe and reliable electricity distribution network for our customers, public, contractors and employees by managing and reducing OHL clearances infringements over the course of RIIO-ED2.

Section 4 establishes an overview of the drivers associated with this investment (safety and compliance).

Section 5 sets out how the chosen RIIO-ED2 investment strategy has been informed through our stakeholder engagement activities. With reference to this EJP, our stakeholders have informed the investment strategy chosen to improve network safety by indicating the level of risk they are willing to accept when balancing two key metrics: network safety and affordability.

Section 6 provides a summary of the corresponding intervention options which can be deployed as a solution to mitigate the OHL clearances infringements that have been identified.

Section 7 provides detailed analysis then describes the cost and volumes arising from the preferred intervention options. This section also describes how we have established the cost efficiency of the plan with reference to the unit costs that have been chosen, and the deliverability of the plan with respect to our ability to remove the volume of OHL clearance infringements during RIIO-ED2 for the cost allowance requested.

Section 8 concludes the EJP and confirms the overall strategy that we are driving with the associated options taken forward to mitigate 13,682 OHL clearance infringements in SHEPD and 14,412 in SEPD for a total cost of **£60.50m**.

3 Background Information

This section of the EJP provides background information on our OHL Clearance strategy. This includes a description of what defines an OHL clearance infringements, the importance of addressing OHL low clearances on the network and the approach used to identify clearance infringements that require intervention during RIIO-ED2.

3.1 OHL Clearance Infringements

ESQCR 2002 was established to provide clear guidance on minimum OHL heights to the ground / objects / buildings and categorise the different levels of risk associated with the OHL network. Identifying and addressing the conductor clearances, in line with ESQCR, ensures that the public, industry, contractors and our operational staff remain safe when undertaking daily activities or work around our OHL assets. Managing our OHL conductor clearances ensures that we are operating and maintaining a safe and reliable network; as per our ***Safe and Resilient (Annex 7.1)***.

There are two types of conductor clearance; vertical, which is the lowest point between our OHL and the ground, and horizontal, which is the shortest point between the OHL and a climbable object. As per ESQCR there are minimum requirements for clearances, where the minimum requirements are not met, we will inspect the location, undertake a risk assessment and where necessary, we will plan for remedial works to be undertaken to mitigate the clearance concern.

Our OHL networks crosses large regions of the UK and the environment around our assets can change through the anticipated life expectancy of our OHL assets. There are several factors that give rise to clearance infringements and have the potential to change the risk. Some of the reasons for OHL clearance infringements arising or the risk changing are as follows:

- New Infrastructure under the OHL i.e. driveways, tracks, roads etc
- Build-up of third-party materials below / in proximity to OHL
- Change of land purpose around OHL i.e. recreational sports, farming etc
- Component failure caused by external factors i.e. weather events

As the environment continually changes around our network, we ensure that we plan regular inspections, regularly update our risk assessments and where necessary, we invest to mitigate OHL clearances to meet statutory requirements and maintain a safe & reliable network for the public. Our approach ensures that we are driving safety and compliance whilst managing overall expenditure.

3.2 OHL Inspections

Historically, we have undertaken OHL foot patrol to determine if there are any OHL defects or conductor clearance infringements; these are identified as the lowest point between the conductor and ground / object. This involved the OHL patroller using a handheld device or using insulated rods to record line heights.

To enhance our inspections, we commissioned Light Detection and Ranging (LiDAR) flights across our entire SEPD and SHEPD network areas. LiDAR locates our OHL network, maps out the environment around the OHL and records the vertical and horizontal clearances around our OHL network. LiDAR can inform both our OHL clearance (CV18 – OHL Clearances) and Tree Cutting (CV29 – Tree Cutting) strategies. For the purposes of this EJP, we are only considering the OHL conductor clearance infringements that are identified using the LiDAR data.

There are some key benefits that LiDAR can provide over physical inspections, these are:

- The precision of the measurement is significantly improved
- Measurements & records are applied consistently across the entire network
- LiDAR flights can cover our entire network in a single year
- LiDAR can records areas that are difficult to access or navigate on foot
- Measurements and data can be mapped in a detail three-dimensional model environment

Figures 1 – 4 provide an illustrative view of the three-dimensional modelled environment that is generated from the LiDAR data.

Figure 1: Lidar Data in Caydence

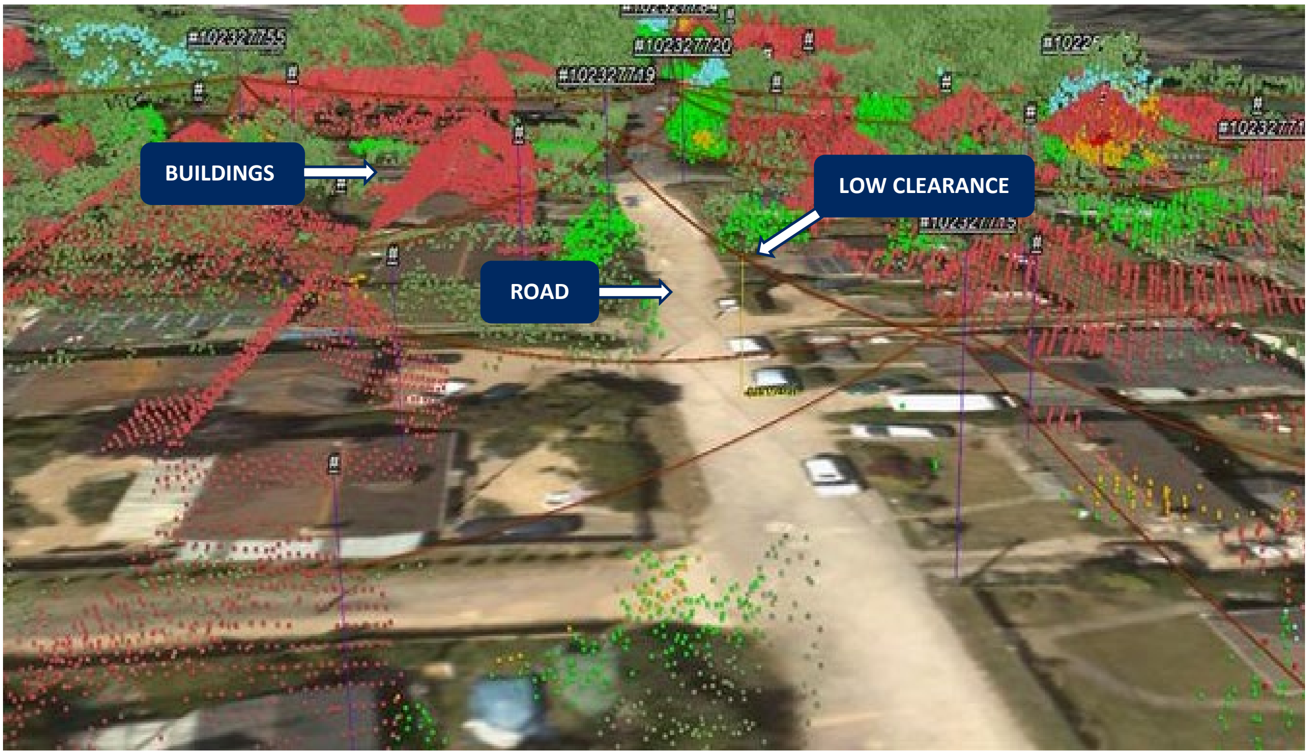

Figure 2: OHL Conductor Clearance infringements - Over Road

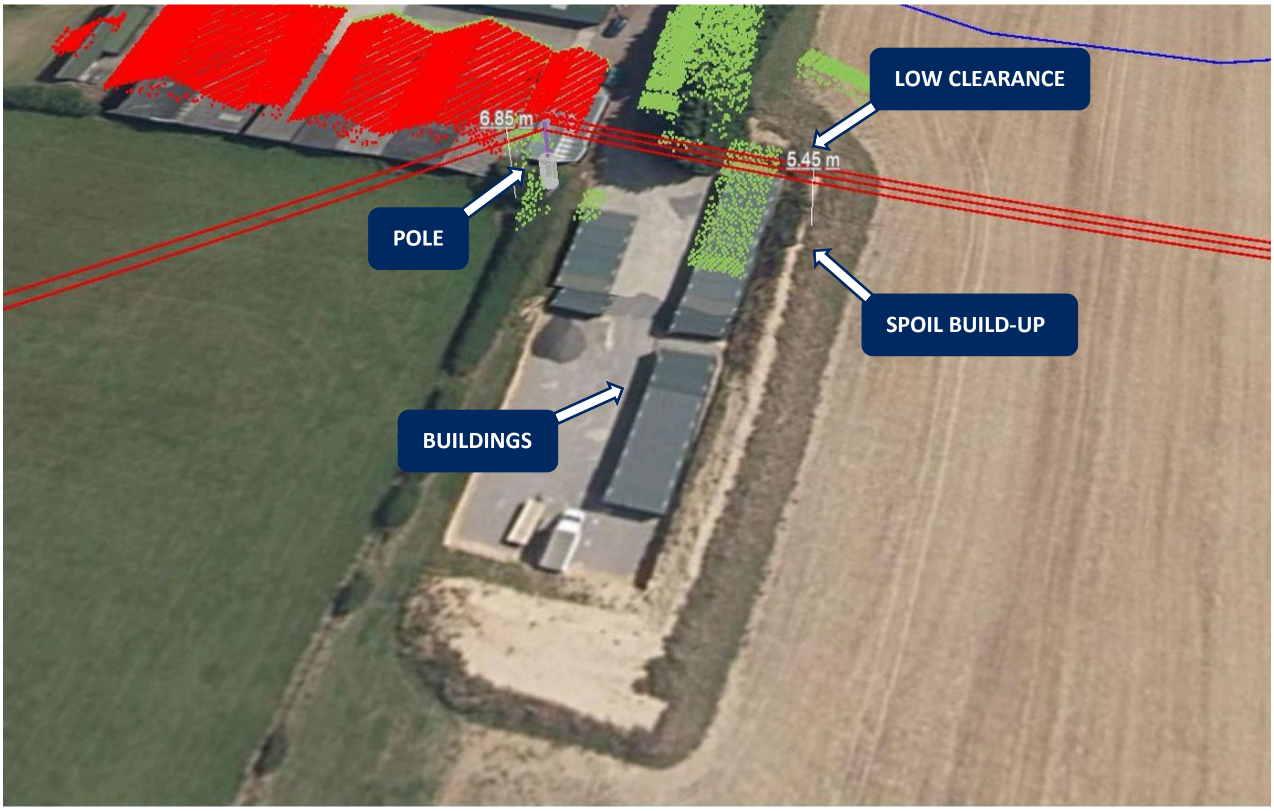

Figure 3: OHL Conductor Clearance infringements – Spoil Build-up due to Third Party

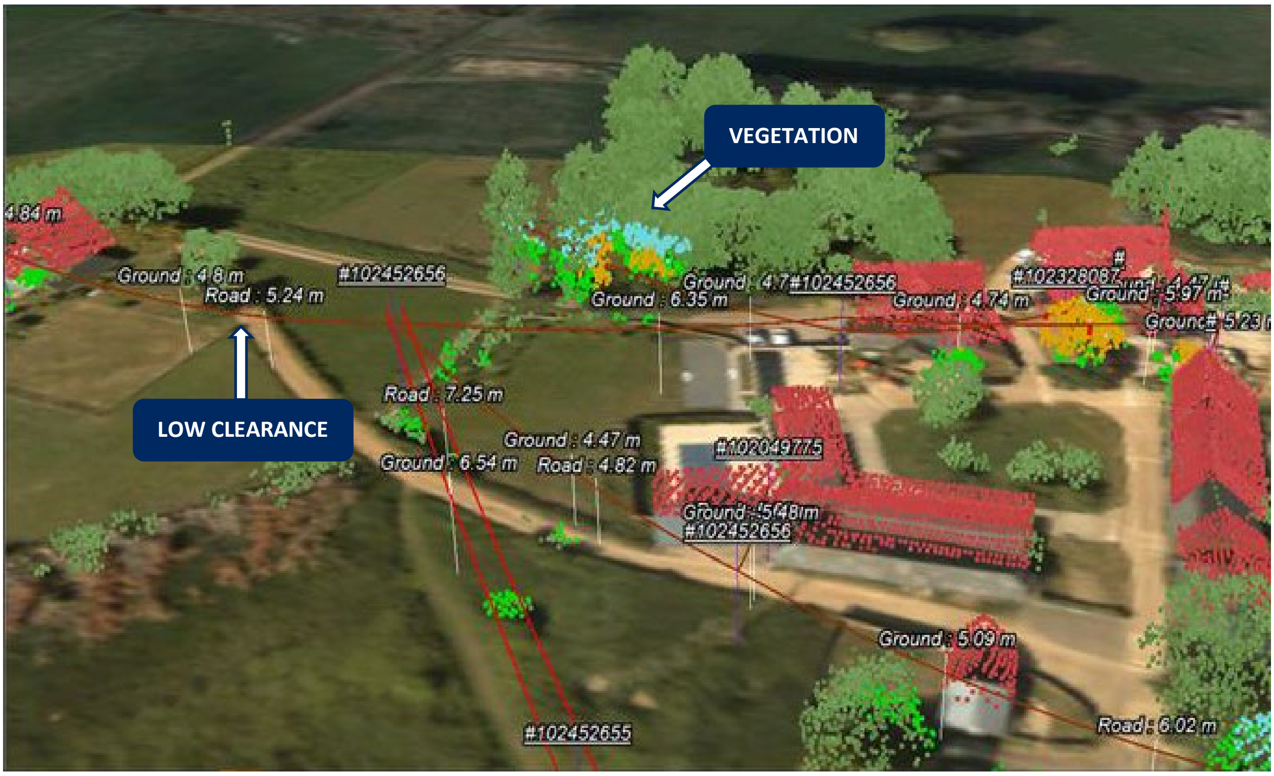

Figure 4: OHL Conductor Clearance infringements – Farm Access Track

Another distinct advantage of LiDAR generating a three-dimensional model is the fact that the clearance concern can be easily identified, and mitigation methods can be proposed by understanding the local environment around the OHL. Previously the data received by inspectors would be limited to a handful of photos and would most likely entail a site visit to better understand the environment and determine a solution.

As highlighted by the sample images above, there is a diversity of clearance issues and each one will be mitigated through a variety of investment options. These investment options are discussed in Section 6.

To drive cost efficiencies, we have staggered our LiDAR flights over SEPD and SHEPD by a single year. To have multiple aircraft and associated scanners to achieve a single year turnaround for both license areas is not cost effective or practical. In addition, moving from one DNO area to the other in the same year would have also presented cost risks as it would force flights into the winter; therefore, exposing us to a higher risk of costly downtime due to poor weather and visibility.

LiDAR is a key tool, in particular in our SEPD region, where tree cutting costs are higher as a result of vegetation density and growth rates. We therefore flew LiDAR in SEPD 2020/21 as a priority and we are updating our SHEPD LiDAR data from 2017/18 now with the results being available in March / April 2022. A secondary benefit from LiDAR is that it also informs our OHL clearance infringements strategy; not just informing our tree cutting strategy. As such, the flight priority and data gathering is aligned for our tree cutting and OHL Clearances strategies.

3.3 LiDAR Data

Based on our latest LiDAR data, the following table highlights the number of spans flown, total clearances identified, and our proposed volume of clearance mitigation planned for ED2.

Table 2: OHL Spans Flown and OHL Clearance infringements Identified

Network	Year	Total Spans	Total OHL Clearance Infringements	Total OHL Clearances Targeted for ED2
SEPD	2020/21	457,124	39,623	14,412
SHEPD	2017/18	479,506	25,547	13,682

As highlighted in Table 2, we are proposing to utilise the latest LiDAR data for SHEPD which was flown in 2017/18. The results of our current flight are not due to be received until March 2022. Based on our analysis of the previous SEPD flight, flown in 2016/17, and the latest flight in 2020/21 we have identified an increase in the volume of clearances between the flights. As such, we are anticipating a similar variation in the volumes for SHEPD and would propose that the results in March 2022 are presented for Ofgem's consideration as part of the ED2 allowance ahead of final determination.

3.3.1 Managing Safety & Risk

As discussed in Section 3.2 above, LiDAR drives a more efficient and cost-effective inspection programme compared with our previous foot inspection programme as it covers the entire network in a single year. However, the key difference between foot inspections and LiDAR is the fact that the foot inspections identified clearance infringements as and when each OHL span was inspected. As such, the identification of clearances could be managed in a set period from the date the clearance was identified; this was between 3 weeks and the next routine OHL refurbishment depending on the level of risk. However, as LiDAR can fly our entire network in a single year with all clearance infringements being identified in a single inspection, we cannot manage the clearances in the same manner as before.

As part of our inspections, we record the land use around our OHL assets using the land use code as defined by ESQCR 2002. Each land use code represents a different level of risk. Due to the volume of clearances identified from the recent LiDAR flights we are prioritising those that are Very High or High risk. Where the risk is identified as being low or medium, we will undertake a site-based risk assessment to ensure no immediate mitigation is required. This is in-line with our risk assessment policy, RA-NET-OHL-001. Our proposal will enable us to address all very high and high clearances, as identified by the most recent LiDAR flights, by the end of RIIO-ED2.

As per the risk assessment methodology, where the LV network has insulated OHL conductor the associated risk with a clearance infringement is reduced; this is in line with ESQCR 2002. As a result, we have also applied a reduction factor for LV OHL clearances that reflects the percentage of our LV network that has insulated conductor.

Although we are proposing targeted investment on the highest risk sites, where other work is being undertaken on the OHL network, such as OHL refurbishment, LV Ariel Bundled Conductor (ABC) replacement, Load Reinforcement etc, we will ensure that the package of works include the rectification of clearance infringements.

Our proposal for ED2 targets the mitigation of 28,094 very high- and high-risk clearances at a cost of **£60.50m**. If we were to specifically target all clearances, regardless of risk, our plan would target 65,170 clearances at a cost of £129.74m. Our risk based approach ensures that we are prioritising the safety of the public, industry, contractors and our operational staff whilst managing the level of investment and ability to deliver the necessary mitigations. The land use code and associated risk matrices can be seen in Appendix 2.

4 Introduction to Investment Under Consideration

This EJP is intended to inform the proposed interventions to meet and continue compliance to the ESQCR regulations and improve quality of supply during RIIO-ED2 for in terms of OHL Clearances.

4.1 Primary Investment Drivers

The primary investment driver for OHL Clearances is to meet ESQCR compliance, our internal policies and ensure that our OHL network is safe and clear of potential interference from the public.

The primary investment driver described above correlates to the following Cost and Volumes (CV) table within the RIIO-ED2 Business Plan Data Tables (BPDT).

- **CV18 – OHL Clearance:** The investment in the OHL network with the primary driver to improve safety by removing the risk associated with conductor clearance infringements.

4.2 Secondary investment drivers and associated CV tables

Whilst this investment pack is intended to inform the investment to mitigate conductor clearance infringements for safety related purposes, the investment options described within this EJP are also coordinated with several secondary investment drivers.

It is important to ensure that these secondary investment drivers are also considered carefully alongside the primary drivers to identify potential efficiencies and to prevent double counting within our RIIO-ED2 business plans.

OHL refurbishment is the secondary investment driver which influences this EJP and the investment options that are chosen. This secondary driver correlates to the following CV table within the BPDT:

- **CV7b – Asset Replacement Non-NARM:** This investment drives the replacement of assets due to health related investment. .
- **CV8 – Refurbishment non-NARM:** This investment focuses on the refurbishment of assets where there is no additional health improvement associated with the investment.

To drive efficient co-ordination of deliverables and reduce the impact of planned outages on customers, where possible. To do this, we will look to address OHL clearance infringements as part of other investments on the network, for example, our OHL maintenance and refurbishment programs. However, not all clearances will be resolved through project allignment, in those instances targetted investment will be required.

When selecting the investment option for each individual project, the following factors are considered to ensure the optimal solution is identified which best represents value for money for network consumers and customers:

- **Number of Customers and Network Outages:** When assessing the investment options available it is important to consider the number of consumers and customers that would be impacted by an outage to undertake the work as part of a scheduled work programme.

- **Wider Network Investment**: Understanding the overall programme of works, such as non-load, load and environmental investment is important to ensure that our overall investment is efficient and co-ordinated throughout ED2 and beyond.

5 Stakeholder Engagement

In preparation for our RIIO-ED2 business plan, several stakeholder engagement sessions have been undertaken to better understand what will be important to our network customers during RIIO-ED2 and to ensure the views of our stakeholders are reflected in the cost and volumes we are proposing for each asset category in line with our ***Enhanced Engagement (Annex 3.1)***.

Below is a summary of the key outcomes from this engagement from some of our critical stakeholders. The summary below provides details of our stakeholder feedback on our Asset Management Strategy and their views on the importance of maintaining a safe network.

Consumer Feedback

- Keeping SSEN staff and the public safe around its assets is considered a key priority for stakeholders and customers.
- Safety was ranked as 3rd out of 10 high level priorities tested with domestic customers and SMEs in the ED2 consumer priorities survey.

Civil Services

- Civil service representatives were supportive of improving communication channels between SSEN and them to enable effective sharing of safety related information.
- SSEN were encouraged to engage with local liaison officers to help build wider partnerships and get safety messages into communities.

Developers

- Developers have experience with infrastructure works that require codes of practice to be in place, as an example, when working in proximity overhead lines, as this would impact what kind of vehicles can cross.
- Several infrastructure representatives noted that SSEN are ‘leading the way on safety’ compared to competitors

Agricultural Representatives

- There was general support for SSENs current approach to engaging with the agricultural industry in relation to working safely in proximity to network infrastructure.
- Those operating large industrial machinery encouraged daily reminders, stating “daily reminders would be helpful, the cab stickers are great.” SSEN have committed to reissuing cab stickers on a wider scale to promote working safely in proximity to OHLs.

Summary of Findings

A wide range of stakeholders confirmed that they strongly support our stance regarding safety; with safety being our number one priority. Stakeholders were encouraged by our approach to safety and were willing to work in partnership and share information. Through our wide stakeholder engagement events safety featured high in stakeholder feedback.

6 Summary of Options Considered

This section of the report sets out the investment options that are considered when assessing the investment options to improve network safety. As described below, this approach is taken to ensure the correct investment options are chosen to reflect both least regret and represent best value for money for network customers.

The investment options described below range from no additional investment to full network replacement. By analysing the primary investment drivers in a holistic manner for each individual project, we can arrive at the optimal investment decision which avoids unnecessary spend whilst achieving safety compliance.

The options described below are chosen with the aim to achieve an optimal balance of intervention throughout RIIO-ED2 to minimise the cost whilst delivering improvements in network safety.

6.1 Summary of Options

Table 3 below provides a high-level summary of the investment options under consideration along with the advantages and disadvantages associated with each. A more detailed description of each option is then provided within the proceeding sub-sections.

Table 3: Ranked Order of Investment Options for OHL Clearances

Option	Description	Advantages	Disadvantages	Results
1. No Intervention but subject to Risk Assessment	Through risk assessments, we will determine whether remedial works are required. No intervention is chosen for those sites classified as Low and Medium Risk at LV and 11kV. This option would not apply to High and Very High risk OHL clearances at LV and 11kV, or any sites at 33kV and above.	No additional CAPEX required where the safety risk is determined through risk assessment to be Low or Medium Allows us to focus intervention on OHL clearances with more substantial safety risk to the public.	Does not remove the safety risk associated with OHL clearance infringements entirely.	This is the chosen investment option for Low and Medium risk OHL clearances at LV and 11kV
2. Re-tension OHL span or Re-conductor OHL span	Reduce the conductor sag by increasing the tension. Where this is not feasible, due to conductor condition, install a new conductor on the span.	This will remove the OHL Clearance issue and is one of the lower cost options to remedy the issue.	If reconductoring the span, we may need to reconductor between section poles which could be several spans.	One of the chosen investment options for RIIO-ED2 deployment
3. Increase pole height or larger insulators	Where possible replace the insulators to increase the height of the conductor if this is not possible, fully replace the pole.	This will remove the OHL Clearance issue.	The cost is more than re-tension or re-conductor the span. May require section 16 consent to install taller poles over 10% of the tallest pole on the circuit. Planning permission may also be required.	One of the chosen investment options for RIIO-ED2 deployment
4. Underground OHL or Deviate	If the clearance infringement cannot be resolved through options 2 – 4, we will either deviate the OHL or underground the OHL to remove the infringement.	Undergrounding removes the Clearance i infringement now and will no longer be a risk in the future.	The cost compared to other options is significantly more, especially for undergrounding. Third parties may mandate we do this, especially for LV service issues.	One of the chosen investment options for RIIO-ED2 deployment
5. Remove hazard created by Third Party	Where a third party has caused the infringement i.e. building too close or under the network or placed spoil under our OHL; we can issue a danger notice for them to remove the hazard.	There is no associated cost.	Disputes can be drawn out and we may have to take action to avoid an incident occurring.	One of the chosen investment options for RIIO-ED2 deployment

6.2 Option 1: No Intervention Subject to Risk Assessment

In this option we propose to risk assess, as per RA-NET-OHL-001, and manage all Low and Medium risk sites at LV and 11kV.

Given the number of sites with OHL clearance infringements, as identified via our LiDAR surveys, this approach will allow us to focus on and prioritise sites to improve safety for the public and our employees. Sites with a Very High or High risk and all sites at 33kV and above will be addressed as part of our targeted investment on OHL clearances issues; the mitigation will be undertaken using one of the other options discussed herein.

6.3 Option 2: Re-tension OHL span or Re-conductor OHL span

If the conductor is in good condition and easily accessible, we will undertake conductor re-tensioning, or we will re-conductor the line to remove the clearance infringement. Re-tensioning the line will increase the height of the lowest point within the limits of ESQCR to ensure that the span is made safe. Where the conductor cannot be re-tensioned, we will replace the full span with new conductor and increase the height of the lowest conductor point within statutory limits where possible.

6.4 Option 3: Increase pole height or larger insulators

Where re-tensioning or re-conductoring is not feasible, we will consider increasing the height of the pole by replacing the pole, installing taller insulators or via additional brackets etc. This will increase the overall conductor height and the height of the lowest point. We will look to undertake the least cost option, which is increasing the insulator heights or brackets, however, for some OHL networks the conductors may be installed horizontally or the infringement may be on a span with section poles; for those instances pole replacement is the only option.

6.5 Option 4: Underground or Deviate OHL

Where the OHL clearance cannot be mitigated by adapting existing infrastructure or clearing vegetation, then the only option left is to fully replace the existing span. Two methods can be used, either deviating the OHL span to avoid the clearance infringements or fully undergrounding the span to remove the potential for future infringements altogether. Deviating the OHL is likely to be the cheapest option, however, there will be instances where diverting the OHL is not practical or possible e.g. next to roads or where 3rd party landowner consents are not forthcoming etc. To mitigate the risk then we will propose to underground the concerned span(s).

6.6 Option 5: Remove hazard created by Third Party

As per our policy, where a third party has altered the ground level and reduced clearance to below statutory height, we should attempt to persuade the third party to restore the previous ground level.

Where the third party is unwilling or unable to restore the previous ground level, we will consider recovering our costs for the work we are required to do. This decision will depend on the circumstances prevailing at the time and will be judged in each individual case. (Note since the introduction of the ESQC Regulations a landowner has a legal obligation to inform us before undertaking work which would reduce our clearances). The risk assessment shall be applied and may include the installation of temporary barriers etc. This may have to go ahead in advance of the conclusion of discussions with the landowner.

6.7 Summary of Options

Every OHL span on our network that has been identified as having a clearance infringement and meets our criteria for investment will require different mitigation methods to be employed. By using a variety of methods, we will ensure that the solution proposed is cost effective, enduring, considers the environment around the asset and mitigates the associated risk. The options put forward for the OHL clearance infringement mitigations have been successfully implemented throughout DPCR5 and RIIO-ED1; unlike some other investments in our RIIO-ED2 plan, there is no single option that will mitigate every infringement effectively.

7 Detailed Analysis

This section of the report provides further detail on the investment strategy that we have developed for OHL clearance infringements over RIIO-ED2 across the chosen investment options through consultation with stakeholders.

7.1 Overview

As previous discussed, the primary driver for investment is to improve safety and reduce the likelihood of third parties coming into contact with our OHL network where clearances infringements have been identified. This section of the report describes the investment strategy that we have chosen for removing OHL clearances and improving network safety through targeted investment.

7.2 OHL Clearance Strategy

We have undertaken LiDAR surveys across our entire network to better understand where there are OHL clearance infringements and we have used the data to determine the number of interventions we must undertake during RIIO-ED2 using a risk based approach. As discussed in Section 3, LiDAR has superseded our previous approach of undertaking prior foot patrols to collect information regarding clearance to our overhead lines. The change in approach is driven by the fact that LiDAR is an approved system, it is consistent and very accurate; thus removing the subjective nature of foot patrol inspections. We will be undertaking LiDAR flights every 4 years to ensure that we are continually managing and recording changes to our network and its surrounding areas. As an indication of the extent of the network LiDAR flights cover 457,124 spans in SEPD and 479,506 spans in SHEPD (this was also highlighted in Table 2 within this EJP).

With ESQCR as the baseline, we have developed policies, procedures, risk assessments and work instructions for designing and building our overhead line network. Over time, and due to external factors, our network can be found to be outside of compliance. Our risk based strategy allows us to take a pragmatic approach to ensure safety is driven as the top priority, whilst balancing the overall level of investment required to mitigate OHL clearance infringements that have been identified in very high and high risk area; as per ESQCR 2002. For all medium and low risk site we will undertake necessary risk assessments and monitor; we only undertake mitigation methods where the risk assessment confirms that it is the only viable option.

As part of the risk assessment approach, where our OHL network has insulated conductor there is a change in the associated risk. To account for this, we have applied an adjustment factor to our LV OHL in line with our recorded volume of insulated conductor to bare wire conductor in both licence areas. Table 4 below confirms the split of conductor types and the factor applied to the volume of OHL clearances infringements identified by LiDAR.

Table 4: LV OHL Clearance Adjustment Factor

Licence Area	Bare Wire LV Conductor	Insulated LV Conductor	Adjustment Factor (%)
SEPD	5,420	5,507	49.6
SHEPD	3,458	500	87.4

Through our thorough analysis of the LiDAR data we have cross reference other approved platforms i.e. MAXIMO and Trimble, to align span references in LiDAR data to land use codes recorded in all systems. Through this assessment we have matched 83% of spans to land use codes in SHEPD and 92% in SEPD. Where no matches have been made, we have had to take a pro-rata approach for HV & EHV volumes where spans are identified as having an OHL clearance infringement with no land use code assigned. For all blanks associated with 132kV and LV infringements we have determined that all blanks must be addressed. For LV in particular, this decision is due to LV networks being in closer proximity to the public so there is a greater risk; the adjustment factor has also been applied to these volumes.

Tables 5 & 6 represent the volume of OHL clearance infringements that we have identified from the LiDAR flights and the volumes that we will address through our application of a risk-based approach with the adjustment factors, as per Table 4, applied to the LV volumes. For our land use code and associated risk matrices please see Appendix 2.

Table 5: Conductor Clearance Volumes Identified by LiDAR

	Volumes Identified by	
Voltage	**SHEPD**	**SEPD**
LV	15,783	36,729
11kV	8,621	2,694
33kV	1,143	176
66kV	N/A	0
132kV	N/A	24
Total	**25,547**	**39,623**

It must be noted that the volumes identified by LiDAR in Table 5 are used to populate the "Outstanding sites to be resolved" table within the CV18 – OHL Clearance cost and volumes table. See section 7.6 for more detail on how this information is used.

Table 6: Conductor Clearance Volumes to be Addressed in ED2 through Risk Based Approach

	ED2 Risk Based Approach	
Voltage	**SHEPD**	**SEPD**
LV	6,515	11,919
11kV	6,838	2,334
33kV	329	135
66kV	N/A	0
132kV	N/A	24
Total	**13,682**	**14,412**

7.3 Cost Benefit Analysis

As ESQCR mandates that OHL clearance infringements are managed to ensure the safety of the public there has been no CBA undertaken for this investment proposal. Several options, as per those discussed in Section 6 will be assessed as part of every OHL clearance infringement that we propose to resolve in RIIO-ED2 and we will ensure that we are driving the most cost efficient and co-ordinated solution as part of our span-by-span assessment.

7.4 Number of Sites to be Resolved

Table 87 and 8 confirm the number of spans being targeted to resolve OHL clearance infringements for both SHEPD and SEPD. The volumes have been driven by LiDAR data, informed by our policies and are aligned to our Safety Strategy.

Table 7: SHEPD Sites Resolved – CV18 Volumes for RIIO-ED2

Asset Category	Unit	2024	2025	2026	2027	2028	Total
LV Sites Resolved	#	652	1,042	1,433	1,694	1,694	**6,515**
HV Sites Resolved	#	684	1,094	1,504	1,778	1,778	**6,838**
EHV Sites Resolved	#	33	53	72	86	85	**329**
Total	#	**1,369**	**2,189**	**3,009**	**3,558**	**3,557**	**13,682**

Table 8: SEPD Sites Resolved – CV18 Volumes for RIIO-ED2

Asset Category	Unit	2024	2025	2026	2027	2028	Total
LV Sites Resolved	#	1,430	1,907	2,384	3,099	3,099	**11,919**
HV Sites Resolved	#	280	373	467	607	607	**2,334**
EHV Sites Resolved	#	16	22	27	35	35	**135**
132kV Sites Resolved	#	3	4	5	6	6	**24**
Total	**#**	**1,729**	**2,306**	**2,883**	**3,747**	**3,747**	**14,412**

As demonstrated in Section 6, there are several options available to mitigate OHL clearance infringements where some methods require asset replacement and disposal, whereas there are other methods that require no physical asset intervention.

To determine the volume of additions and disposals we anticipate being required in SHEPD and SEPD to resolve **13,682** and **14,412** OHL clearances respectively; we have used our current performance in RIIO-ED1. By using the ratio of asset interventions per clearance and balancing this with the cost proportion of asset interventions against total spend, we have forecast the total volumes required across various asset categories. Tables 9 & 10 provide the total additions and disposals proposed for RIIO-ED2.

Table 9: SHEPD – CV18 Total Additions & Disposals Volumes for RIIO-ED2

Asset Category	Unit	Total Additions	Total Disposals
LV Main (OHL) Conductor	km	113.80	76.57
LV Service (OHL)	Each	1,136	1,183
LV Poles	Each	941	977
LV Main (UG Plastic)	km	15.44	-
LV Service (UG)	Each	308	-
Cut Out (Metered)	Each	158	77
6.6/11kV OHL (Conventional Conductor)	km	22.66	15.14
6.6/11kV Poles	Each	1,561	1,447
6.6/11kV UG Cable	km	15.44	-
33kV Pole	Each	325	200

Table 10: SEPD – CV18 Total Additions & Disposals Volumes for RIIO-ED2

Asset Category	Unit	Total Additions	Total Disposals
LV Main (OHL) Conductor	km	111.60	110.00
LV Service (OHL)	Each	3,435	1,487
LV Poles	Each	2,400	1,963
LV Main (UG Plastic)	km	2.74	-
LV Service (UG)	Each	54	-
Cut Out (Metered)	Each	1,265	261
6.6/11kV OHL (Conventional Conductor)	km	1.36	1.36
6.6/11kV OHL (BLX or similar Conductor)	km	3.30	3.30
6.6/11kV Poles	Each	895	924
33kV OHL (Pole Line) Conductor	km	2.47	0.26
33kV Pole	Each	45	43
33kV UG Cable (Non-Pressurised)	km	0.34	-

7.5 Number of Sites to be Resolved as Part of Other Work

Our proposed delivery strategy, as per ***Deliverability Strategy (Annex 16.1)***, we will mitigate OHL clearances through targeted investment and we will also aim to aligns work programs to capture this sub-set of work as part of a package. Where we are undertaking works on the OHL network for example, OHL maintenance / refurbishment, we will include the OHL clearance intervention as part of the work to ensure that we are reducing OHL clearances whilst maximising the work undertaken during outages, improving work force and cost efficiency.

Although our delivery plan will look to package work, our understanding[1] is this alignment of work does not constitute "Resolved as part of Other Work". Our understanding is that volumes within this section would be for something along the lines of OHL dismantlement or network undergrounding for new connections i.e. works that mitigate the issue without the primary intention of addressing the concern. As such, we have forecast no volumes under this section; however, where instances do occur during ED2 we will report them accordingly.

7.6 Outstanding Sites to be Resolved

As highlighted in Table 5 & 6 above, there are more OHL clearances that are on the network than are being proposed for intervention in RIIO-ED2 due to our risk-based approach. Our understanding is that the Number of sites to be resolved must report all outstanding sites and the context of the word "resolved" means fully removed as a OHL clearance concern. As confirmed, our risk-based approach proposes that all medium and low risk sites with OHL clearance infringements are managed through risk assessment and monitoring. As such, we are reporting the total number of OHL clearances in our CV18 – OHL Clearance cost & volumes table and those remaining under "outstanding sites to be resolved" will be the total number of low and medium sites identified in the most recent LiDAR flight.

[1] *Regulatory Instructions and guidance: Annex B - Cost and Volumes*

Table 11: Conductor Clearance Volumes to be Addressed in ED2 through Risk Based Approach

	Outstanding Medium & Low Risk Sites	
Voltage	**SHEPD**	**SEPD**
LV	9,268	24,810
11kV	1,783	360
33kV	814	41
66kV	N/A	0
132kV	N/A	0
Total	**11,865**	**25,211**

Table 11 confirms the final volume that will be recorded within the CV18 – OHL Clearance cost and volumes table under Outstanding Sites to be Resolved. This is aligned to all of the medium and low risk sites identified.

The volumes identified by LiDAR have been used to inform the number of outstanding sites in 2021/22; which is the year after the most recent regulatory reporting pack (RRP), which was submitted to Ofgem in July 2021. As there are outstanding sites reported in the 2020/21 RRP, these sites have been removed from the total number of LiDAR sites identified for resolution so that the total across 2020/21 and 2021/22 reconciles with the total number of sites identified. This is required as the sites outstanding in 2020/21 are accounted for in the total volume identified by the LiDAR flights.

7.7 Unit Costs

We have a successful track record of rectifying OHL clearance infringements on the network as shown by our DPCR5 and RIIO-ED1 deliverables. As every clearance infringement is specific to the span, as evidenced in the number of options that can be employed, we have undertaken a review of our unit cost performance in DPCR5 as the volumes of intervention were greater than RIIO-ED1 and the attributable unit costs were consistent. Using DPCR5 unit rates, we have corrected the rates to reflect 2020/21 costs in line with all of our other rates applied within the RIIO-ED2 business plan. Although past performance has been considered, we are proposing to drive cost efficiencies through our procurement contracts, contracting agreements and aligning work programmes across the plan. For further information on the unit cost analysis undertaken for please see the ***Cost Efficiency*** (***Annex 15.1)***.

Tables 12 & 13 below reflect the proposed expenditure throughout RIIO-ED2 in SHEPD and SEPD based on our unit cost assessment for resolving OHL clearance infringements. The expenditure is driven by the unit cost per OHL clearance resolved rather than the additions and disposals of assets.

Table 12: SHEPD Sites Resolved – CV18 Expenditure for RIIO-ED2

Asset Category	Unit	2024	2025	2026	2027	2028	Total
LV Sites Resolved	£m	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
HV Sites Resolved	£m	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
EHV Sites Resolved	£m	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total	**£m**	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 13: SEPD Sites Resolved – CV18 Expenditure for RIIO-ED2

Asset Category	Unit	2024	2025	2026	2027	2028	Total
LV Sites Resolved	£m	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
HV Sites Resolved	£m	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
EHV Sites Resolved	£m	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
132kV Sites Resolved	£m	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total	**£m**	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

It must be noted that the total cost to address OHL clearance infringements is based on the unit cost per clearance resolved and is not solely attributed to asset intervention, this is due to options 2, 3 and 5 (detailed in Section 6) mitigating the OHL clearance infringements without physically replacing assets in some instances. For example, removal of soil / objects under the OHL has a cost associated with it, however, no asset interventions are required or recorded. Furthermore, the unit cost also reflects the cost of a ground inspection to determine mitigations methods, this cost is accounted for even if the initial clearance concern can be risk assessed out or risk level reduced.

7.8 Deliverability of Proposed Volumes

Between our draft and final Business Plans we have carried out a more detailed deliverability assessment of our overall plan as a package and its component investments. Using our draft Business Plan investment and phasing as a baseline we have followed our deliverability assessment methodology. We have assessed any potential delivery constraints to our plan based on:

- In-house workforce capacity and skills constraints based on our planned recruitment and training profile and planned sourcing mix as well as the efficiencies we have built into our Business Plan (detailed in ***Ensuring Deliverability and a Resilient Workforce (Chapter 16)***)
- Assessment of the specific lead and delivery timelines for the asset classes in our planned schemes
- We have evaluated our sourcing mix where there were known delivery constraints to assess opportunities to alleviate any constraints through outsourcing
- We have engaged our supply chain (detailed in ***Ensuring Deliverability And a Resilient Workforce (Chapter 16)***) to explore how the supply chain could support us to efficiently deliver greater volumes of work and how we could implement a range of alternative contracting strategies to deliver this
- We have also engaged with the supply chain on the delivery of work volumes that sit within Uncertainty Mechanisms to ensure we have plans in place to deliver this work if and when the need arises
- We have assessed the synergies between our planned load, non-load and environmental investments to most efficiently plan the scheduling of work and minimise disruption to consumers
- Based on our assessment of delivery constraints and potential solutions to resolve them, we have revised our investment phasing accordingly to ensure our Business Plan is deliverable, meets our consumers' needs and is most cost efficient for our consumers

8 Conclusion

The purpose of this Engineering Justification Paper (EJP) has been to describe the overarching investment strategy that we intend to take during RIIO-ED2 to improve public safety through mitigating OHL clearances.

The background into the OHL clearances, the options considered to rectify identified OHL clearance infringements and the policies driving our decision making has been provided within this EJP.

As described within Section 6, a holistic approach is taken when selecting the most viable option to improving safety and meeting compliance across the network. This includes identifying the number of clearance infringements to be addressed and detailing all viable solutions to resolve them. In relation to improving safety whilst the options considered are highlighted in bold below:

- **Option 1: No Intervention but subject to Risk Assessment**
- **Option 2: Re-tension OHL span or Re-conductor OHL span**
- **Option 3: Increase pole height or larger insulators**
- **Option 4: Underground OHL or Deviate**
- **Option 5: Remove hazard created by Third Party**

A combination of risk assessments and OHL clearance mitigation cost assessments will be used during RIIO-ED2 to identify on a case-by-case basis the safest and most cost-effective intervention option at each site. The overriding priority is to reduce the risk to public, contractors, industry and our operational staff as far as practicable by prioritising intervention where clearances are within very high and high-risk sites. All low and medium risk sites will be risk assessed and only where necessary will intervention be undertaken. In addition to the assessment of risk, we have also applied an adjustment factor to our LV volumes to reflect the percentage of bare wire conductor on our network to determine the volume that must be addressed.

This investment represents a total spend of **£60.5m** throughout RIIO-ED2 by targeting 13,682 spans in SHEPD and 14,412 spans in SEPD that will improve safety in line with ESQCR compliance.

Appendix 1: Acronym Glossary

Table 14: Acronyms Used within Document

Acronym	Description
BPDT	Business Plan Data Table
CV	Cost & Volumes
CV7b	Asset Replacement non-NARM
CV8	Refurbishment non-NARM
CV18	OH Clearance Cost and Volume Table
DNO	Distribution Network Operator
DPCR5	Distribution Price Control Review 5 (2010-15)
EHV	Extra High Voltage (33kV)
EJP	Engineering Justification Paper
ESQCR	Electricity Safety, Quality and Continuity Regulations 2002
HV	High Voltage
IDP	Investment Decision Pack
LV	Low Voltage
OHL	Overhead Line
RIIO-ED1	Distribution Price Control Review (Electricity Distribution 1) 2015-23
RIIO-ED2	Distribution Price Control Review (Electricity Distribution 2) 2023-28
SEPD	Southern Electric Power Distribution
SHEPD	Scottish Hydro Electric Power Distribution
SSEN	Scottish and Southern Electricity Networks

Appendix 2: Relevant Policy, Standards, and Operational Restrictions

The policies, manuals and standards and operational restrictions which govern the management of clearance infringements are listed below in Table 15.

Table 15: OHL Clearance Relevant Documents

Policy Number	Policy Name / Description
RA-NET-OHL-001	ESQC Regulations Risk Register
PR-PS-311	Procedure for Evaluating and Recording Risk Assessments on Overhead Lines and Substations - ESQC Regulations
TG-PS-826	LV OHL – Ground Clearances Risk Assessment
MA-PS-034	Asset Risk Management Index
WI-NET-OHL-008	Inspection of Overhead Lines Installed on Poles
TG-NET-OHL-006	Risk Assessment Mitigation in High Risk Areas-Design, Installation and Maintenance Instruction
PR-PS-340	Application of Clearances to Overhead Lines at LV to 400kV

Appendix 3: Land Use Codes & Risk Matrices

The following tables represent the land use codes used as per ESQCR and the risks associated with LV Insulated conductor, LV Bare Wire conductor and HV/EHV OHL. The full risk matrix can be found in RA-NET-OHL-001.

Table 16: Land Use Code Description

Land Use Code	Surrounding Land
A	River, Loch, Lake or Pond
B	Schools
C	Dense Housing Estates / Schemes
D	Camping and Caravan Sites
E	Recreation ground / Play area
G	Derelict Site
H	Quarry
J	Industrial / Commercial area
K	Road / footpath / verge adjacent to road / public open space
L	Farm yard
M	Beach
N	Arable Crops
O	Private Garden
P	Airfield
Q	Heathland Moorland
R	Forest
S	Pasture Grazing
T	Wasteland
V	Motorway Crossing
W	Railway Crossing

Table 17: Land Use Code Risk Matrix for LV Insulated Conductor

Land Use Code					Inherent Risk				
A	B	C	D	E	P	E	A	R	M
G	H	J	K	L	2	0	1	3	
M	N	O	P	Q	Likelihood		Consequence		
R	S	T	V	W	3		6		18
A	B	C	D	E	P	E	A	R	L
G	H	J	K	L	1	0	0	0	
M	N	O	P	Q	Likelihood		Consequence		
R	S	T	V	W	5		1		5
A	B	C	D	E	P	E	A	R	L
G	H	J	K	L	2	0	0	1	
M	N	O	P	Q	Likelihood		Consequence		
R	S	T	V	W	1		3		3

Table 18: Land Use Code Risk Matrix for LV Bare Wire Conductor

Land Use Code					Inherent Risk				
A	B	C	D	E	P	E	A	R	VH
G	H	J	K	L	5	0	1	7	
M	N	O	P	Q	Likelihood		Consequence		
R	S	T	V	W	5		13		65
A	B	C	D	E	P	E	A	R	VH
G	H	J	K	L	5	0	1	5	
M	N	O	P	Q	Likelihood		Consequence		
R	S	T	V	W	5		11		55
A	B	C	D	E	P	E	A	R	H
G	H	J	K	L	10	0	0	10	
M	N	O	P	Q	Likelihood		Consequence		
R	S	T	V	W	1		20		20
A	B	C	D	E	P	E	A	R	L
G	H	J	K	L	3	0	0	2	
M	N	O	P	Q	Likelihood		Consequence		
R	S	T	V	W	1		5		5

Table 19: Land Use Code Risk Matrix for HV & EHV OHL Conductor

Land Use Code					**Inherent Risk**				
A	B	C	D	E	P	E	A	R	**VH**
G	H	J	K	L	5	0	1	5	
M	N	O	P	Q	Likelihood		Consequence		
R	S	T	V	W	**5**		**11**		**55**
A	B	C	D	E	P	E	A	R	**H**
G	H	J	K	L	5	0	0	7	
M	N	O	P	Q	Likelihood		Consequence		
R	S	T	V	W	**3**		**12**		**36**
A	B	C	D	E	P	E	A	R	**H**
G	H	J	K	L	5	0	0	7	
M	N	O	P	Q	Likelihood		Consequence		
R	S	T	V	W	**2**		**12**		**24**
A	B	C	D	E	P	E	A	R	**H**
G	H	J	K	L	10	0	0	10	
M	N	O	P	Q	Likelihood		Consequence		
R	S	T	V	W	**1**		**20**		**20**
A	B	C	D	E	P	E	A	R	**M**
G	H	J	K	L	2	0	0	2	
M	N	O	P	Q	Likelihood		Consequence		
R	S	T	V	W	**3**		**4**		**12**
A	B	C	D	E	P	E	A	R	**M**
G	H	J	K	L	3	0	0	3	
M	N	O	P	Q	Likelihood		Consequence		
R	S	T	V	W	**2**		**6**		**12**
A	B	C	D	E	P	E	A	R	**M**
G	H	J	K	L	3	0	0	3	
M	N	O	P	Q	Likelihood		Consequence		
R	S	T	V	W	**2**		**6**		**12**