GREEN GEN TOWY USK

Consultation March 2024

Addendum Phase One Grid Connection Strategy

GREEN GEN CYMRU

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Contents

Introduction

1. Green GEN Cymru has undertaken an appraisal of grid connection options to determine the most appropriate solution to connect our proposed South Wales Energy Parks to the National Electricity Transmission System (NETS). The scope of this is outlined in the Updated Phase One Grid Connection Strategy and includes the general location of the proposed connection substation, as well as the potential connection route from the Energy Parks to the substation.

2. This document explains the assessment and decision-making process which has led to the selection of the preferred option for the connection of the South Wales Energy Parks to the NETS.

3. Our initial review considered and assessed 11 potential connection options within three broad geographical zones, which included connections into both new and existing substations in England and Wales. These options were reviewed against how each performed on technical, environmental and cost grounds against the identified need to develop an efficient, co-ordinated, and economic system.

4. Following feedback received regarding the options appraisal work undertaken to date and reported in the Grid Connection Strategy Report (GCSR) first published in March 2023, we have now undertaken some further analysis to consider how connection options would perform if a connection was sought to be made from the Eastern Cluster and the Western Cluster to multiple, and potentially separate, grid connection points on the NETS.

5. To date, Green GEN Cymru has focused on the performance of connection options based on the requirement to deliver a connection from the Eastern Cluster and Western Cluster to a single grid connection point. For each connection option, this meant that the total indicative distance associated with that connection option was the result of an aggregation of the distance from the central point of the Western Cluster and the central point of the Eastern Cluster to a single grid connection point. Consultees have subsequently asked us to consider how the connection options would perform if the distances were instead calculated on the basis of an individual connection between each connection option and (1) the Easter Cluster and (2) the Western Cluster. Implicitly, consultees were therefore also asking us to consider the potential merit of separate grid connection points for each cluster.

6. The further analysis which we have undertaken has proven to be a useful way of testing our proposals to date and our findings are set out in this addendum. This work has led us to conclude that the connection option which we have taken forward for further development and appraisal to date, continues to be the preferred option. Furthermore, for the reasons explained in the addendum, we remain of the view that a combined connection from the Eastern Cluster and the Western Cluster to a single grid connection point is the right solution for the project.

7. Our appraisal has considered potential environmental impacts that the connection of the South Wales Energy Parks could have, so far as known at this stage of development, and the measures that may be implemented to avoid, or mitigate such impacts.

Purpose of the Addendum

8. This addendum has been produced to document the further analysis that we have undertaken in response to the feedback we have received from stakeholders during the first round of consultation on the Green GEN Towy Usk project. It is designed to provide transparency as regards the performance of different connection options and to ensure that stakeholders are informed of the rationale behind the strategic approach being taken to the delivery of grid connections for the South Wales Energy Parks.

9. The focus of this document is on the infrastructure required to connect the South Wales Energy Parks managed by Bute Energy. These energy parks have been organised into two groups: an Eastern Cluster and a Western Cluster. We have considered the infrastructure needed for their connection.

10. This addendum to the GCSR is now being published as part of this version of the GCSR and should be read alongside the main report. This aims to build upon the version of the GCSR first shared with stakeholders in March 2023 during the Towy Usk public consultation, which was subsequently updated in January 2024 to coincide with the Towy Teifi public consultation. This addendum has been informed from feedback received from consultees during public consultation and in response to the Towy Usk Environmental Impact Assessment (EIA) Scoping process which was conducted by PEDW between 17th October 2023 to 16th February 2024.

11. One theme arising from the feedback received related to the way in which the 11 identified connection options for the 132kV connections were assessed, in particular the grouping together of the Eastern and Western Clusters when calculating and assessing the point to point distances of each connection route and the underlying assumption that both connections would be served by a single point of connection. Furthermore, the feedback received suggested that the range of options initially evaluated could be broadened in scope. We have responded to this feedback by carrying out some further analysis, the results of which are set out in this Addendum in order to enable consultees to understand how the different options perform where the potential for multiple points of connection between the Eastern and Western Clusters to the National Transmission System are concerned, as opposed to the single point of connection which informed the original GCSR.

12. The further analysis we have undertaken is considered to be a useful way of testing our proposals to date and has reinforced our view that a combined connection from the Eastern Cluster and the Western Cluster to a single grid connection point in Carmarthenshire is the right solution.

13. Further information regarding the results of our additional analysis and the conclusions we have reached can be found in this addendum to the GCSR. This document should be read in conjunction with the main report of the GCSR.

Feedback Received

Summary of Feedback

14. This addendum summarises and addresses the feedback received from stakeholders regarding the options presented in the Grid Connection Strategy Report (GCSR). The matters raised within feedback have focused upon two key themes.

15. Firstly, a theme of the feedback received related to the way in which connection options had been appraised, with some stakeholders asking for the Eastern and Western Clusters to be appraised separately instead of being analysed on a combined basis.

16. Secondly, the possibility of alternative connections across the border into the West Midlands of England (which we have determined as an existing substation at Bishops Wood) was also raised. The addendum now considers this site, assessing its viability as part of the broader network planning strategy.

The Grid Connection Options

Methodology

17. Our initial appraisals identified and compared the feasible options to provide the connections from our South Wales Energy Parks in the Eastern Cluster and the Western Cluster to a single point of connection to the national grid. The methodology applied in this addendum will consider the feasibility of connecting each cluster to the national grid via individuals points of connection from the Eastern Cluster and the Western Cluster respectively. The addendum will do this using the same 11 grid connection options considered in the main report, in addition to Bishops Wood, appraising how each performs in terms of providing a connection between the Eastern Cluster, on the one hand, and the Western Cluster on the other. The addendum will firstly set out grid connection options from the Eastern Cluster, followed by grid connection options from the Western Cluster.

18. To support the evaluation, an assessment framework was put in place. This enabled us to compare the long list of identified feasible options in a consistent and fair manner.

19. Under Section 9(2) of the Electricity Act 1989, Green GEN Cymru, would be required to 'develop and maintain an efficient, co-ordinated and economical system of electricity'. Schedule 9 of the Electricity Act 1989 would impose a statutory duty on Green GEN Cymru to take account of the following factors in formulating proposals for the installation of overhead lines:

'(a) the desirability of preserving natural beauty, of conserving flora, fauna and geological or physiographical features of special interest and of protecting sites, buildings, and objects of architectural, historic, or archaeological interest; and,

(b) to do what it reasonably can to mitigate any effects which the proposals would have on the natural beauty of the countryside or any such flora, fauna, features, sites, buildings or objects.'

20. The addendum will follow broadly the same methodology for assessing the feasibility of the proposed grid connection options with the options being assessed according to the following key factors: Environmental; Technical; and Cost. As this is an addendum to the report, we have not included the environmental analysis here to avoid duplication, however this remains a critical factor in decision making. The environmental considerations are contained within the main report and this addendum should be read in combination with it.

21. We have reviewed the latest available cost information, as can be seen in Table 3 below, and carried out further assessment of likely costings based on best available industry practice. The respective costings of each of OHL and UGC technologies will likely change and, potentially, both may increase throughout the lifetime of the project. We will regularly review the best available and up to date cost information as the projects develop further. This is considered sufficient at this stage, to allow us to develop an estimate for each option, and for this to inform a comparison of relative costs. Table 1 presents the unit costs that informed our assessment and comparison of options. The consideration of technology options and choice is contained within the main GCSR, along with further commentary on developments in undergrounding technologies.

Cost category	Estimated unit cost
132kV Double circuit OHL	£1m/km
132kV Double circuit underground cable	£6.8m/km
Extension of existing substation	£10m
Development of new substation	£25m

Table 1 – Indicative unit costs

Initial Grid Connections Review

22. Figure 4 shows the location of the South Wales Energy Parks and the NETS infrastructure in this area. Substations are represented by the named squares shown along the transmission circuit routes. In addition, Figure 4 shows the location of key sensitive areas such as National Park, National Landscapes, and other designations.

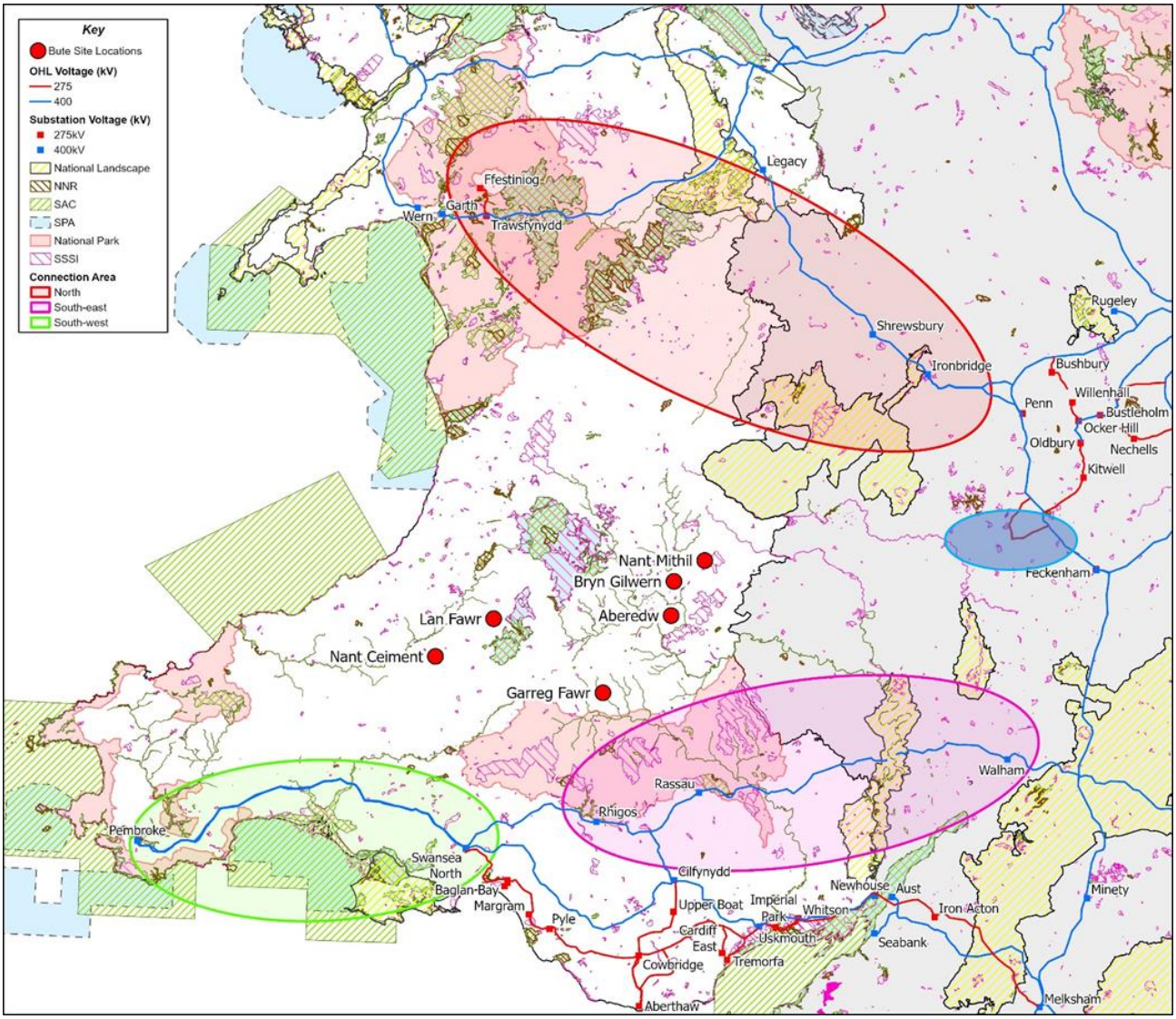

Figure 1 – Bute Energy's proposed South Wales Energy Parks, existing Transmission Network infrastructure and nationally designated areas.

Eastern Cluster

Options within the North Zone

Option 1 - Trawsfynydd (Existing Substation)

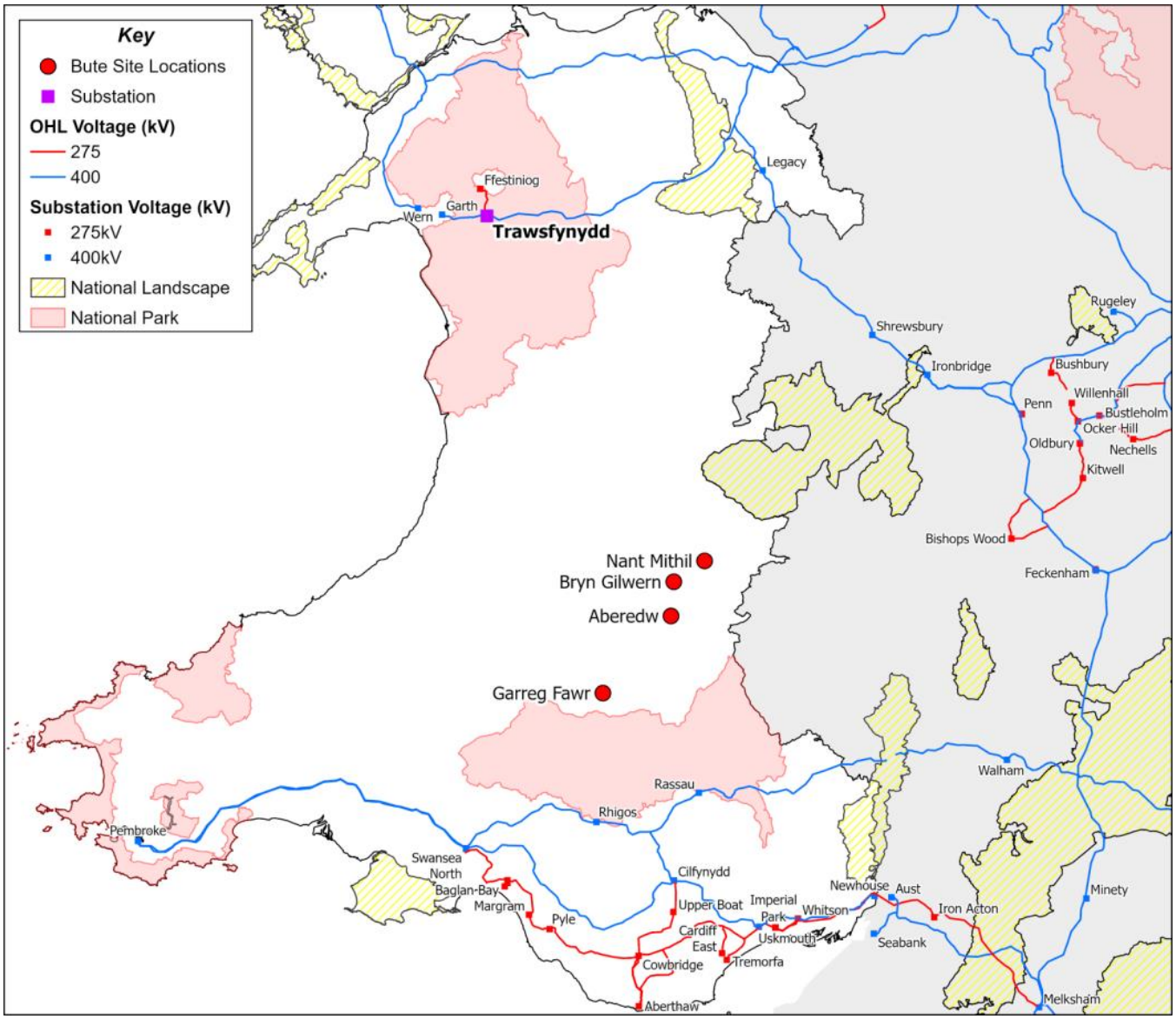

Figure 2 - Option 1 - Trawsfynydd (Existing Substation)

Technical Requirements

23. A direct point to point connection from the Eastern Cluster of Energy Parks to the Trawsfynydd substation would require approximately 85 km of OHL. From a technical perspective, this length could lead to significantly higher electrical losses compared to other options located closer to the Eastern Cluster. In addition to the increased length of the line, an extension to the existing Trawsfynydd substation (within the National Park) would be required for this connection option.

Cost Assumptions

24. Based on the anticipated point to point connection distance from the Eastern Cluster to the Trawsfynydd substation and the assumed mitigation required for undergrounding in the Eryri National Park, the following high level cost assumption has been applied to this option.

Substation	Direct point-to-point distance	Mitigations required	Indicative cost estimate
Trawsfynydd	c.85km	Undergrounding (approximately 25km) and substation extension	c. £240m

Option 2 - Shrewsbury (Existing Substation)

25. Due to both Shrewsbury and Ironbridge 400kV substations being geographically proximate, these connection options are discussed together below under the heading ‘Option 3 - Ironbridge (Existing Substation)’.

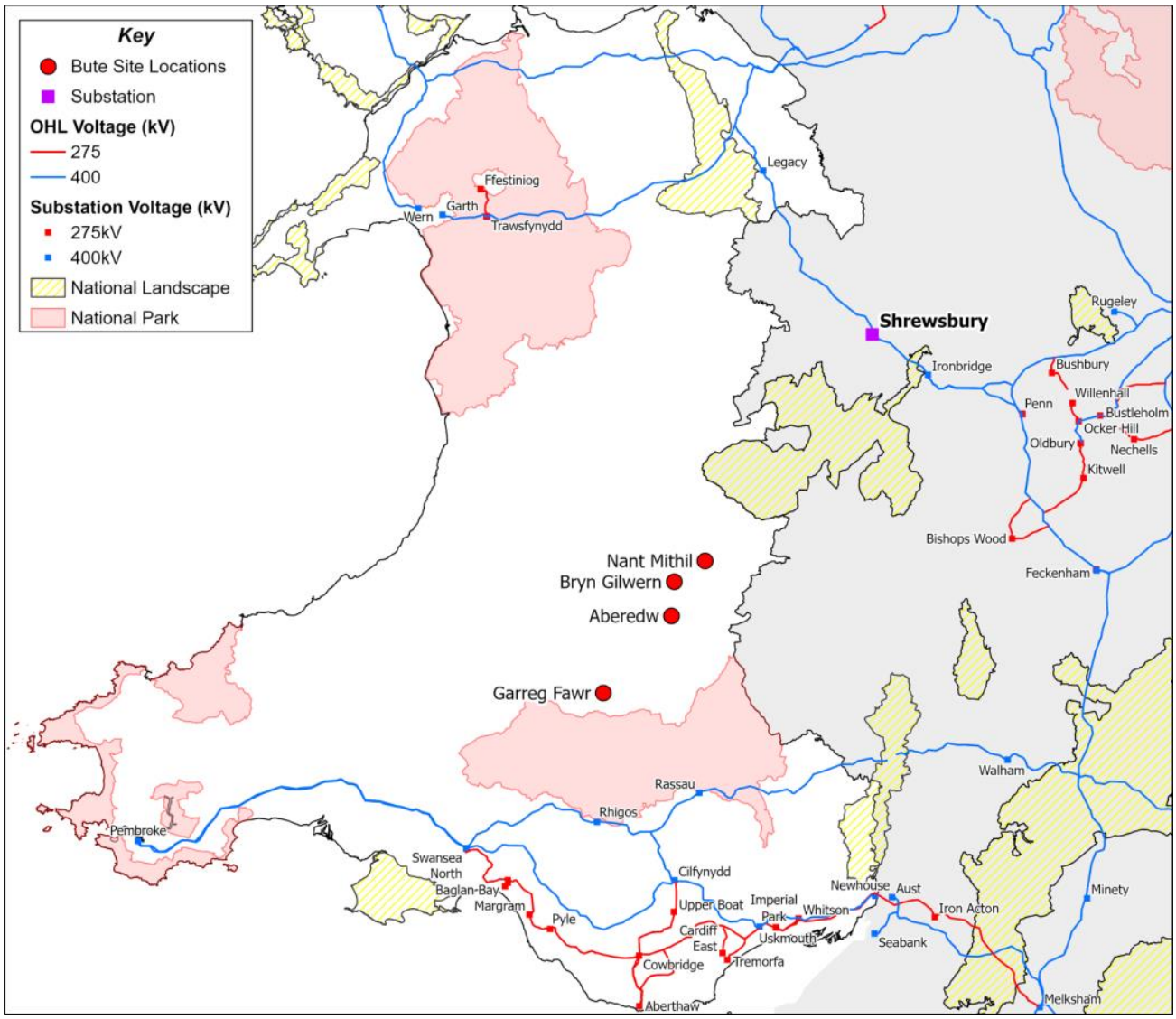

Figure 3 - Option 2 - Shrewsbury (Existing Substation)

Option 3 - Ironbridge (Existing Substation)

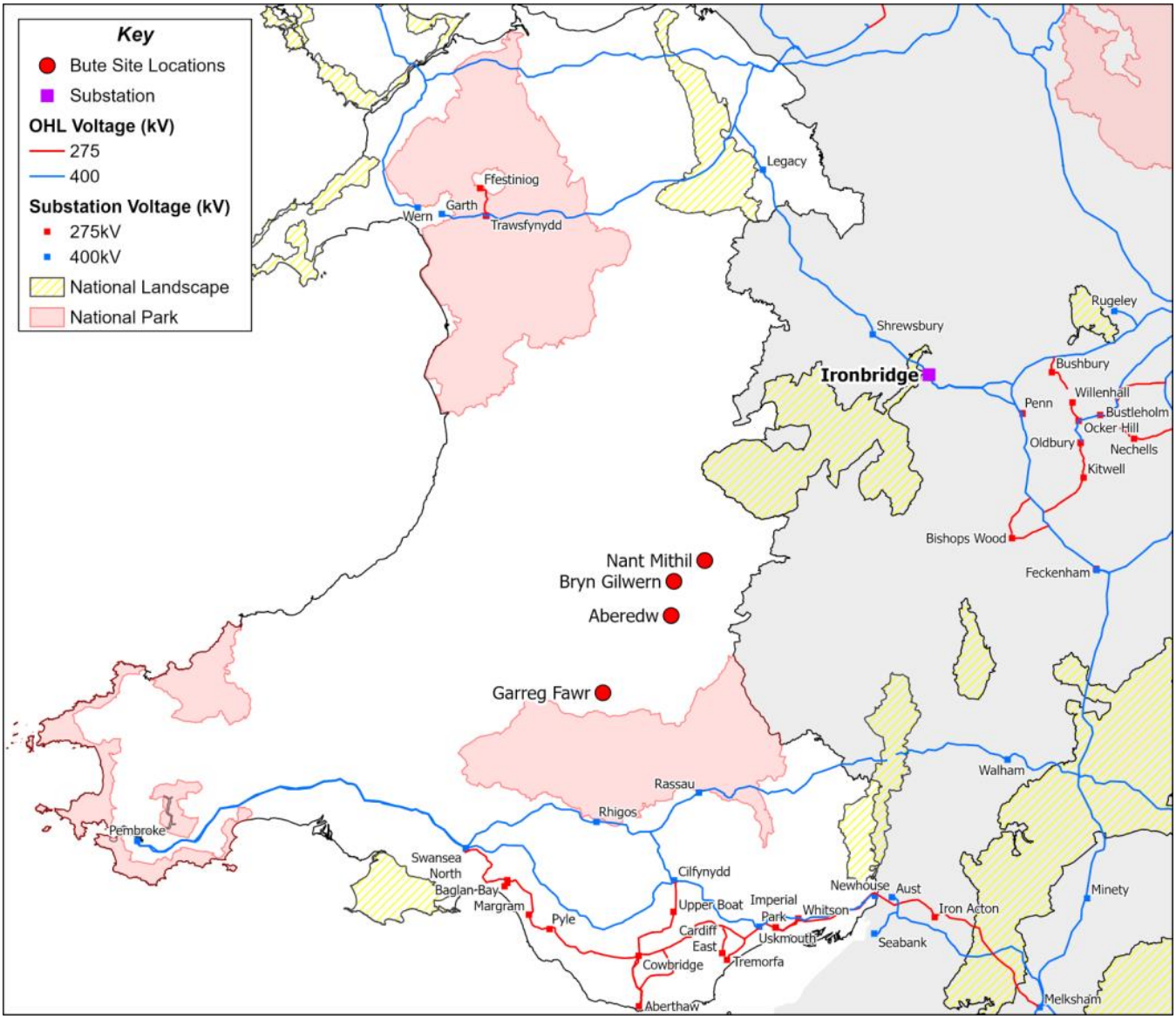

Figure 4 - Option 3 - Ironbridge (Existing Substation)

Technical Requirements

26. A direct point to point connection from the Eastern Cluster of Energy Parks to either the Shrewsbury or Ironbridge substations would be 75km and 80km respectively. An extension to the existing Shrewsbury or Ironbridge substations would be required for these connection options.

Cost Assumptions

27. Based on the anticipated point to point connection distance from the Eastern Cluster of Energy Parks to the Shrewsbury or Ironbridge substations and the assumed mitigation required for routeing around the Shropshire Hills National Landscape, the following high level cost assumption has been applied to these options.

Substation	Direct point-to-point distance	Mitigations required	Indicative cost estimate
Shrewsbury	c. 75km	OHL routeing diversion (c. 5km) and substation extension	c. £90m
Ironbridge	c. 80km	OHL routeing diversion (c. 15km) and substation extension	c. £105m

Option 4 - Lower Frankton (New substation)

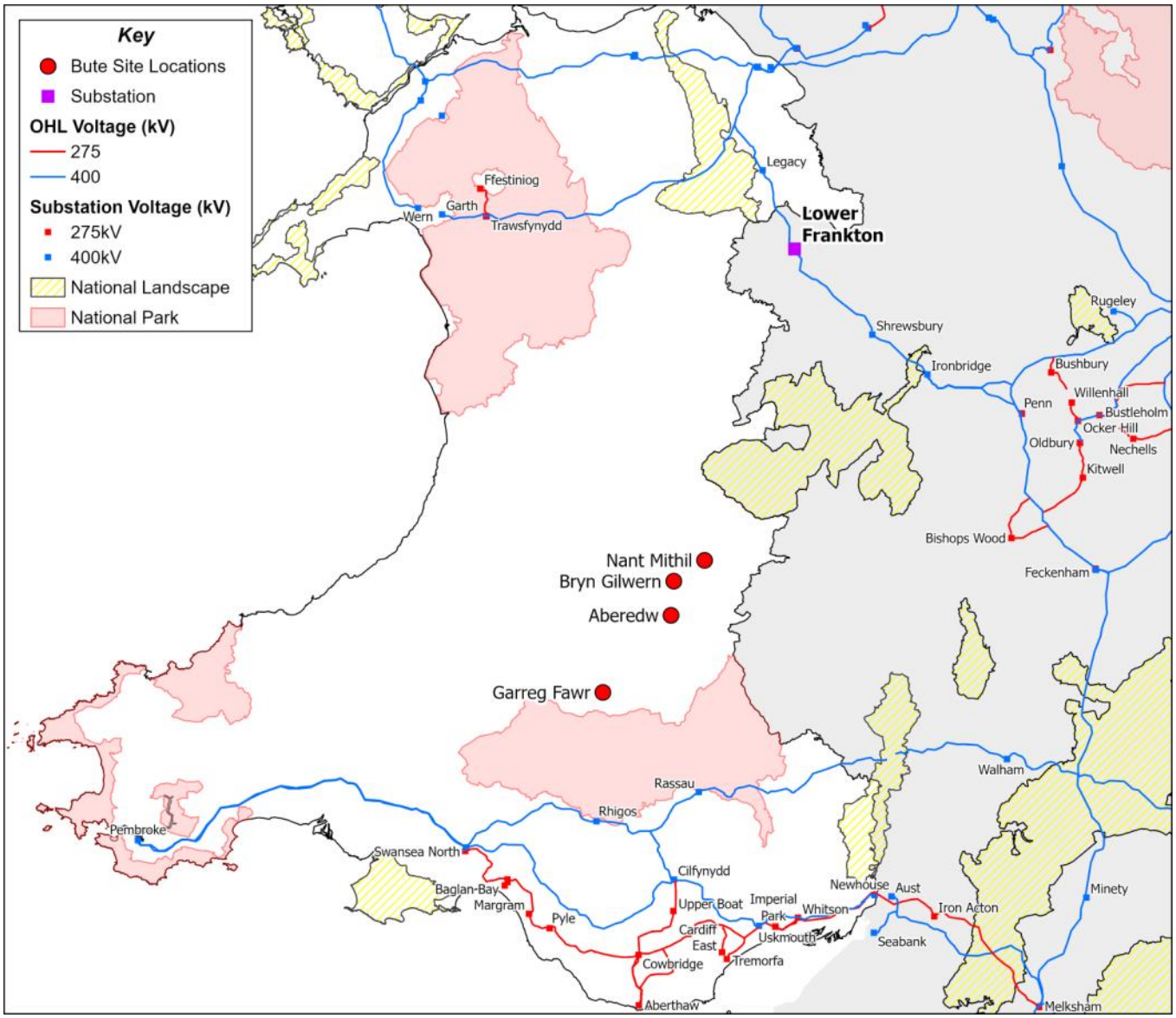

Figure 5 - Option 4 - Lower Frankton (New substation)

Technical Requirements

28. A direct point to point connection from the Eastern Cluster of Energy Parks to a new substation at Lower Frankton would be approximately 85 km in length.

Cost Assumptions

29. Based on the anticipated point to point connection distance from the Eastern Cluster of Energy Parks to a new potential substation at Lower Frankton, including the potential for OHL routeing around sensitive designations and the development of a new substation, the following high level cost assumption has been applied to this option.

Substation	Direct point-to-point distance	Mitigations required	Indicative cost estimate
Lower Frankton	c. 85 km	OHL routeing diversion (c.5 km) and new substation	c. £115m

Options within in the South-East Zone

Option 5 - Walham (Existing Substation)

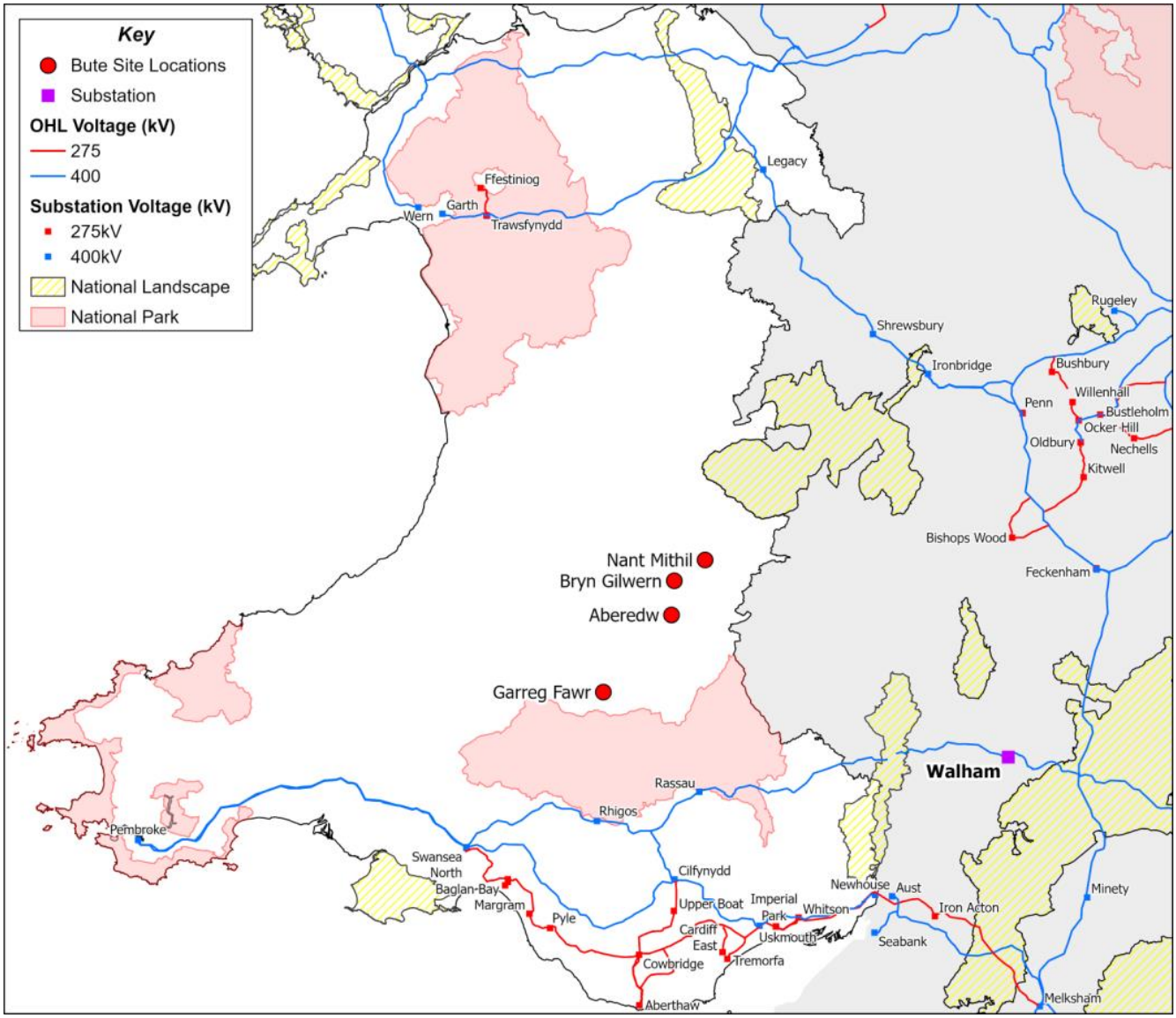

Figure 6 - Option 5 - Walham (Existing Substation)

Technical Requirements

30. A direct point to point connection from the Eastern Cluster of Energy Parks to the Walham substation would require approximately 85 km of infrastructure. An extension to the existing Walham substation would be required for this connection option.

Cost Assumptions

31. Based on the anticipated point to point connection distance from the Eastern Cluster of Energy Parks to the Walham substation, including the potential OHL routeing around sensitive designations, the following high level cost assumption has been applied to this option.

Substation	Direct point-to-point distance	Mitigations required	Indicative cost estimate
Walham	c. 85 km	OHL routeing diversions (c. 10 km) and substation extension	c. £105m

Option 6 - Rhigos (Existing Substation)

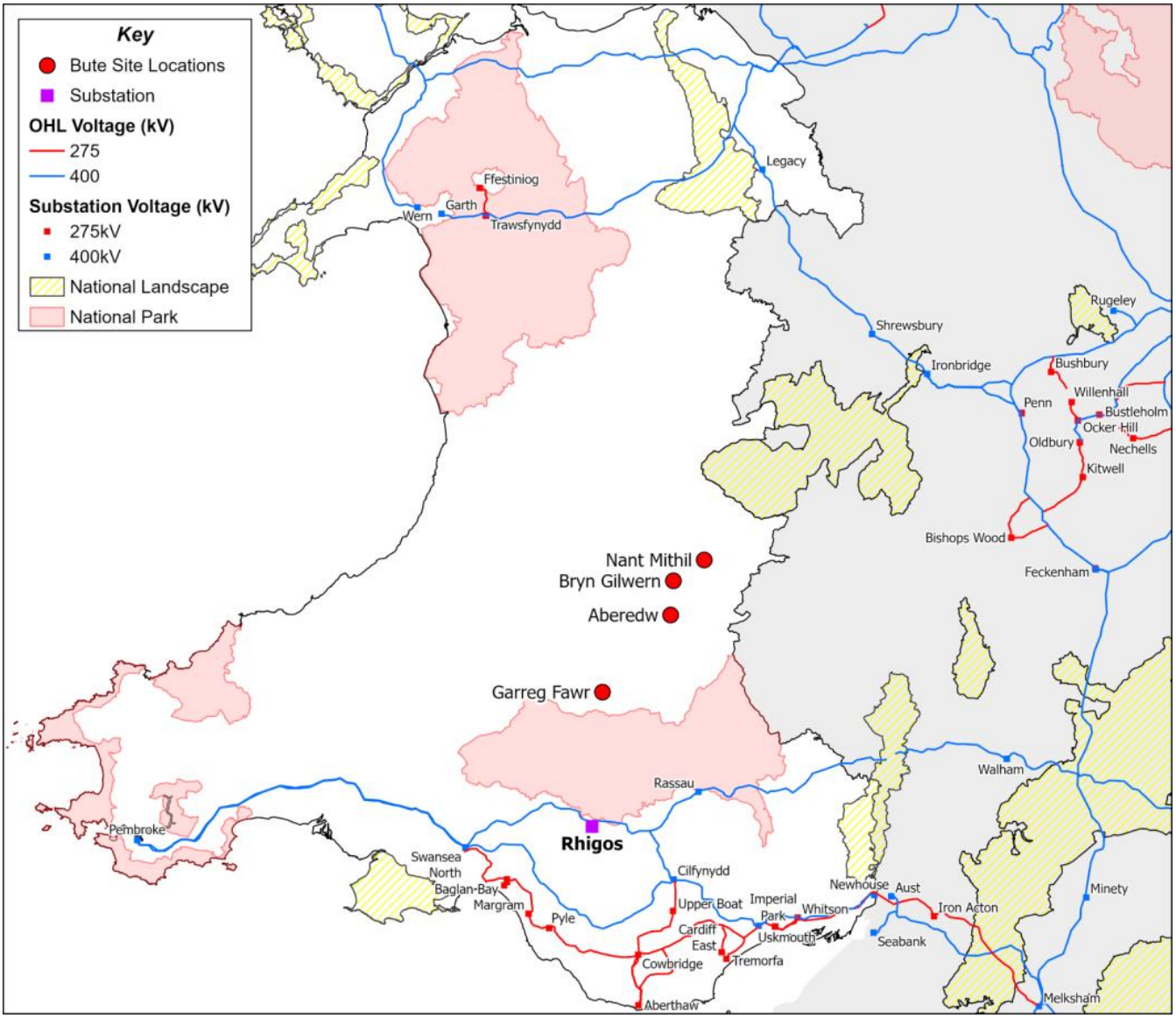

Figure 7 - Option 6 - Rhigos (Existing Substation)

32. Due to both Rhigos and Rassau 400kV substations being geographically proximate, these connection options are discussed together below.

Option 7 - Rassau (Existing Substation)

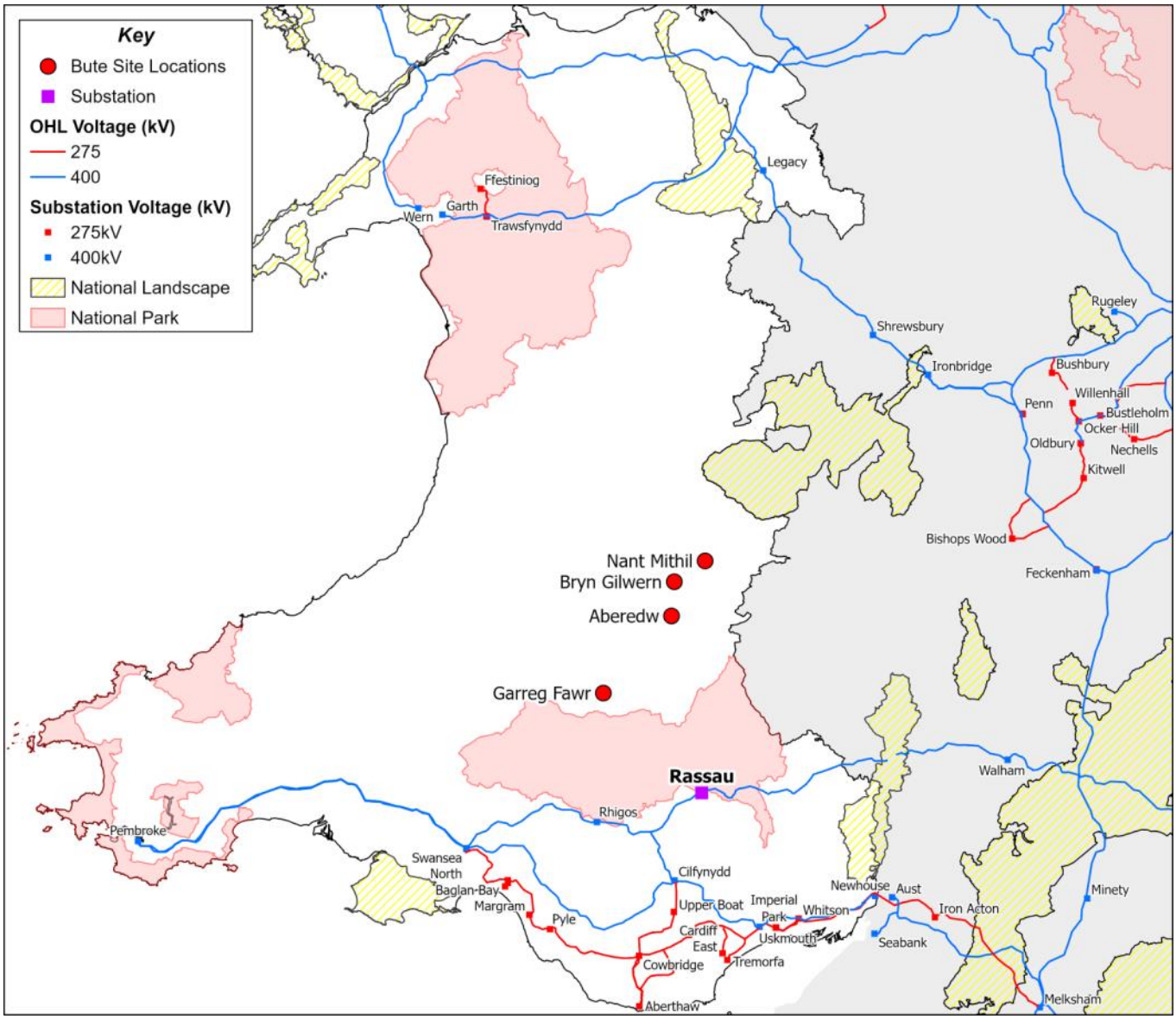

Figure 8 - Option 7 - Rassau (Existing Substation)

Technical Requirements

33. A direct point to point connection from the Eastern Cluster to Rhigos and Rassau substations would require a route of approximately 40 km in length respectively.

34. When considering a direct point to point distance only, this is a comparatively shorter distance compared to other options considered within the North and south eastern zones. An extension to the existing Rhigos or Rassau substations would be required for these connection options.

Cost Assumptions

35. Based on the anticipated point to point connection distance from the Eastern Cluster of Energy Parks to the Rhigos and Rassau substations, including the potential for a significant routeing diversion around

the Bannau Brycheiniog National Park to avoid direct impacts on this designation, the following high level cost assumption has been applied to this option.

Substation	Direct point-to-point distance	Mitigations required	Indicative cost estimate
Rhigos	c. 40 km	OHL routeing diversion (c.65km) and substation extension	c. £115m
Rassau	c. 40 km	OHL routeing diversion (c.65km) and substation extension	c. £115m

Option 8 - Abergavenny (New Substation)

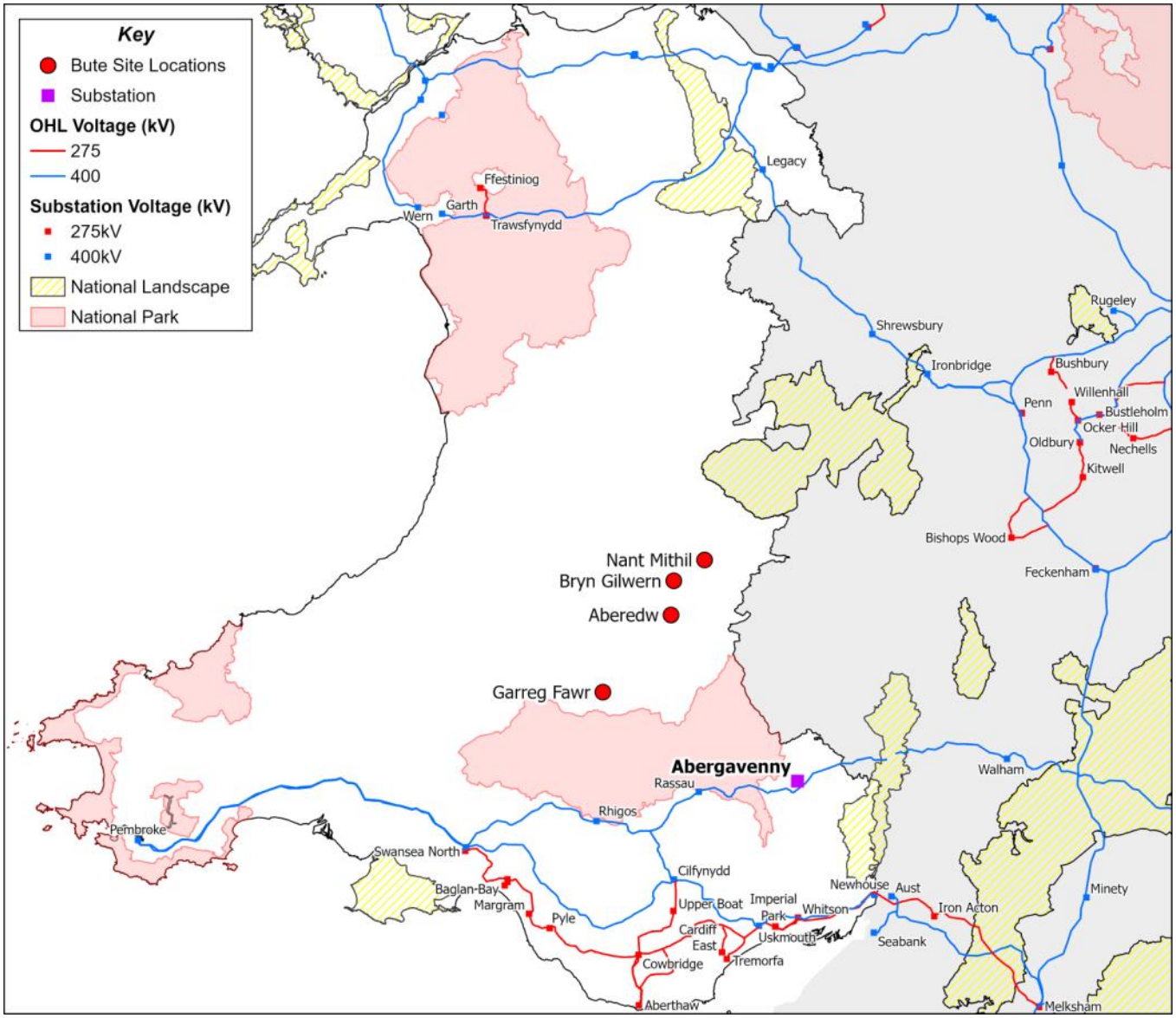

Figure 9 - Option 8 - Abergavenny (New Substation)

Technical Requirements

36. A direct point to point connection from the Eastern Cluster of Energy Parks to a new Abergavenny substation would be approximately 50 km in length.

Cost Assumptions

37. Based on the anticipated point to point connection distance from the Eastern Cluster of Energy Parks to a new substation in the vicinity of Abergavenny, including the potential OHL routeing around sensitive designations and development of a new substation, the following high level cost assumption has been applied to this option.

Substation	Direct point-to-point distance	Mitigations required	Indicative cost estimate
Abergavenny	c. 50 km	OHL routeing diversion (c.10km) and new substation	c. £85m

Options within the South-West Zone

Option 9 - Swansea North (Existing Substation)

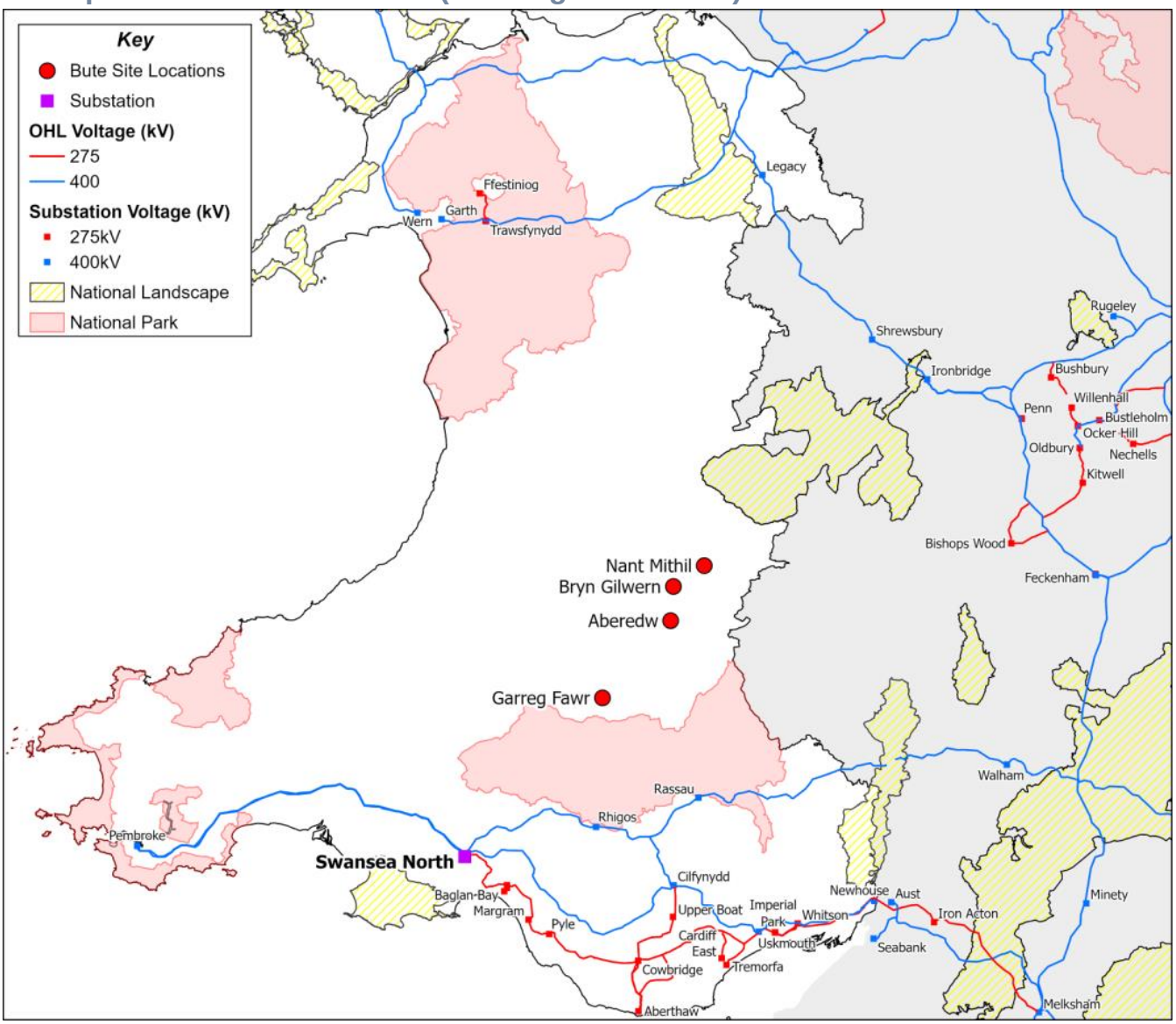

Figure 10 - Option 9 - Swansea North (Existing Substation)

Technical Requirements

38. A direct point to point connection from the Eastern Cluster of Energy Parks to the Swansea North substation would require a connection length of approximately 65 km. An extension to the existing Swansea North substation would be required for this connection option.

Cost Assumptions

39. Based on the anticipated point to point connection distance from the Eastern Cluster of Energy Parks to the Swansea North substation, including the potential for OHL routeing around sensitive receptors and undergrounding or special crossings of existing infrastructure, the following high level cost assumption has been applied to this option.

Substation	Direct point-to-point distance	Mitigations required	Indicative cost estimate
Swansea North	c. 65km	OHL routeing diversion (c. 15km), potential special crossings or undergrounding (c.5km) and substation extension	c. £124m

Option 10 - Pembroke (Existing Substation)

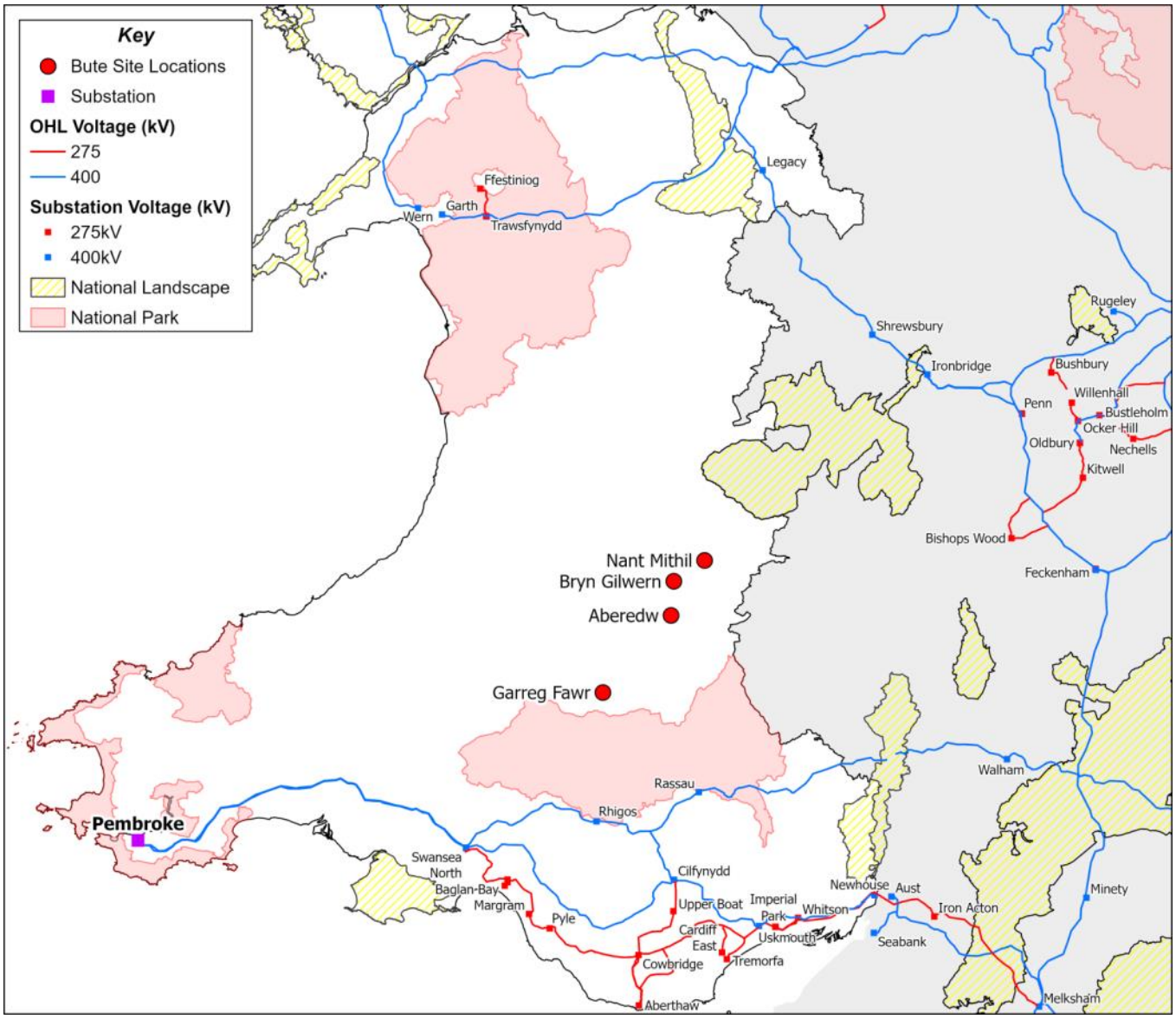

Figure 11 - Option 10 - Pembroke (Existing Substation)

Technical Requirements

40. A direct point to point connection from the Eastern Cluster of Energy Parks to the substation at Pembroke would require a connection length of approximately 120 km.

41. There would accordingly be a significant distance between the Eastern Cluster of Energy Parks and this substation. From a technical perspective, this could lead to higher electrical losses compared to other options located closer to the Energy Parks. An extension to the existing Pembroke substation would be required for this connection option.

Cost Assumptions

42. Based on the anticipated point to point connection distance from the Eastern Cluster of Energy Parks to the Pembroke substation, including the potential for OHL routeing around sensitive designations, the following high level cost assumption has been applied to this option.

Substation	Direct point-to-point distance	Mitigations required	Indicative cost estimate
Pembroke	c120 km	OHL routeing diversion (c.5km) and substation extension	c. £135m

Option 11 - Carmarthen (New Substation)

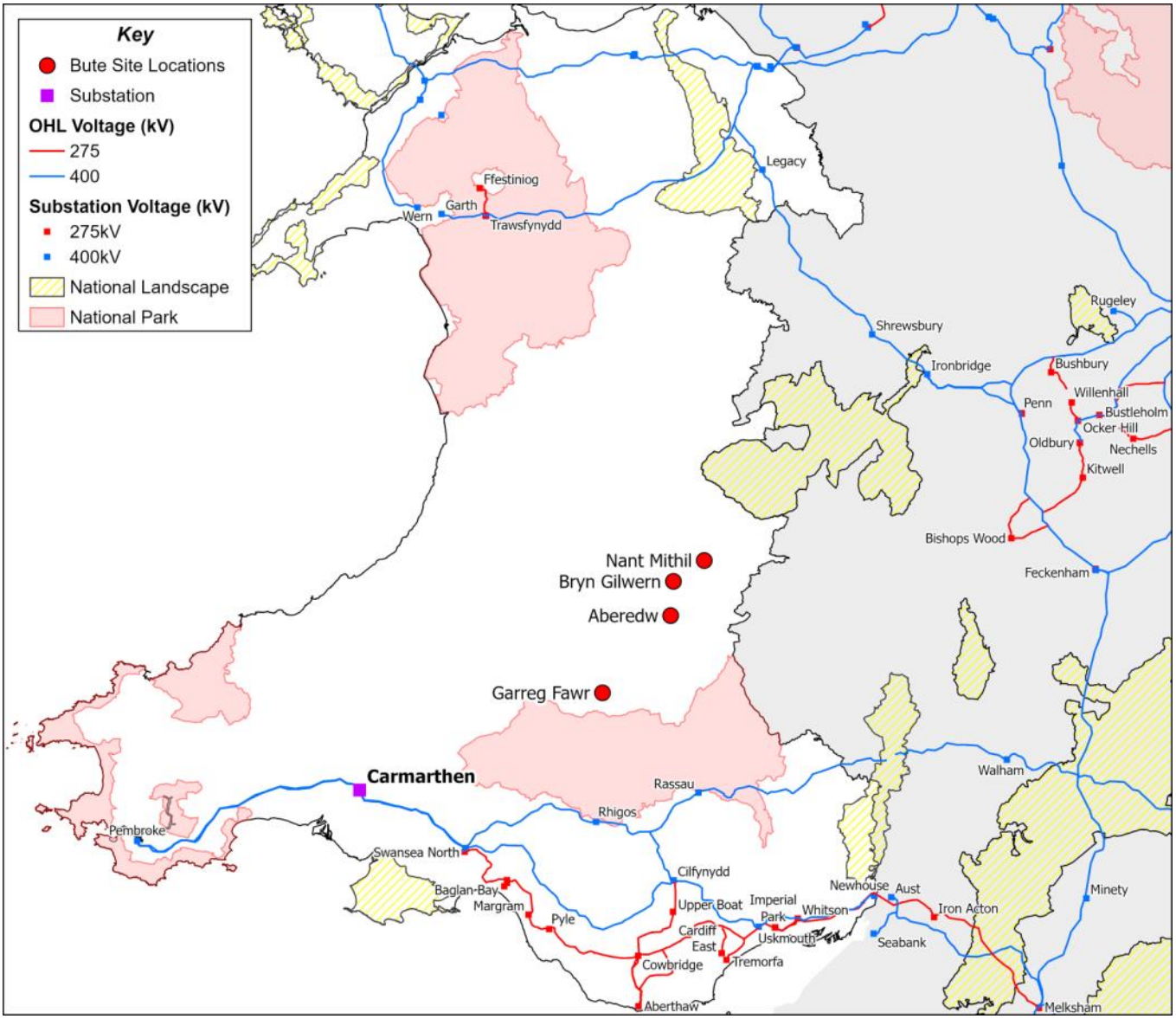

Figure 12 - Option 11 - Carmarthen (New Substation)

Technical Requirements

43. A direct point to point connection from the Eastern Cluster of Energy Parks to a new substation at Carmarthen would require a connection length of approximately 70 km.

Cost Assumptions

44. Based on the anticipated point to point connection distance from the Eastern Cluster of Energy Parks to a new substation in the vicinity of Carmarthen, including the potential for OHL routeing around sensitive designations and development of a new substation, the following high level cost assumption has been applied to this option.

Substation	Direct point-to-point distance	Mitigations required	Indicative cost estimate

Carmarthen	c. 70 km	OHL routeing diversion (c.5 km), new substation	c. £100m

Western Cluster

Options within the North Zone

Option 1 - Trawsfynydd (Existing Substation)

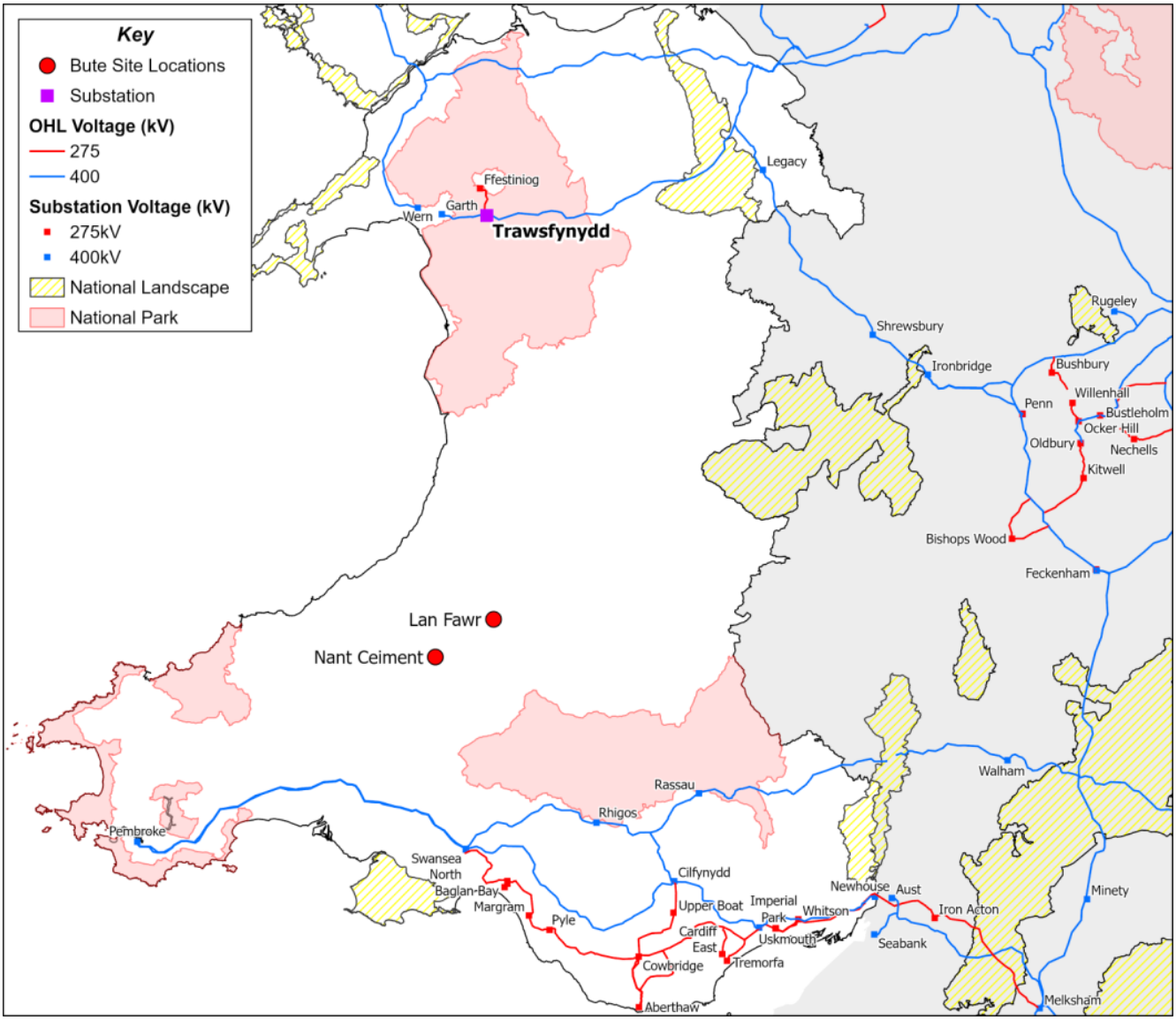

Figure 13 - Option 1 - Trawsfynydd (Existing Substation)

Technical Requirements

45. A point-to-point connection from the Western Cluster of Energy Parks would require approximately 85km of OHL. From a technical perspective, this connection length could lead to significantly higher electrical losses compared to other options located closer to the Western Cluster of Energy Parks. In addition to the increased length of the line, an extension to the existing Trawsfynydd substation (within the National Park) would be required for this connection option.

Cost Assumptions

46. Based on the anticipated point to point connection distance from the Western Cluster of Energy Parks to the Trawsfynydd substation and the assumed mitigation required for undergrounding in the Eryri National Park, the following high level cost assumption has been applied to this option.

Substation	Direct point-to-point distance	Mitigations required	Indicative cost estimate
Trawsfynydd	c.85km	Undergrounding (approximately 25km) and substation extension	c. £240m

Option 2 - Shrewsbury (Existing Substation)

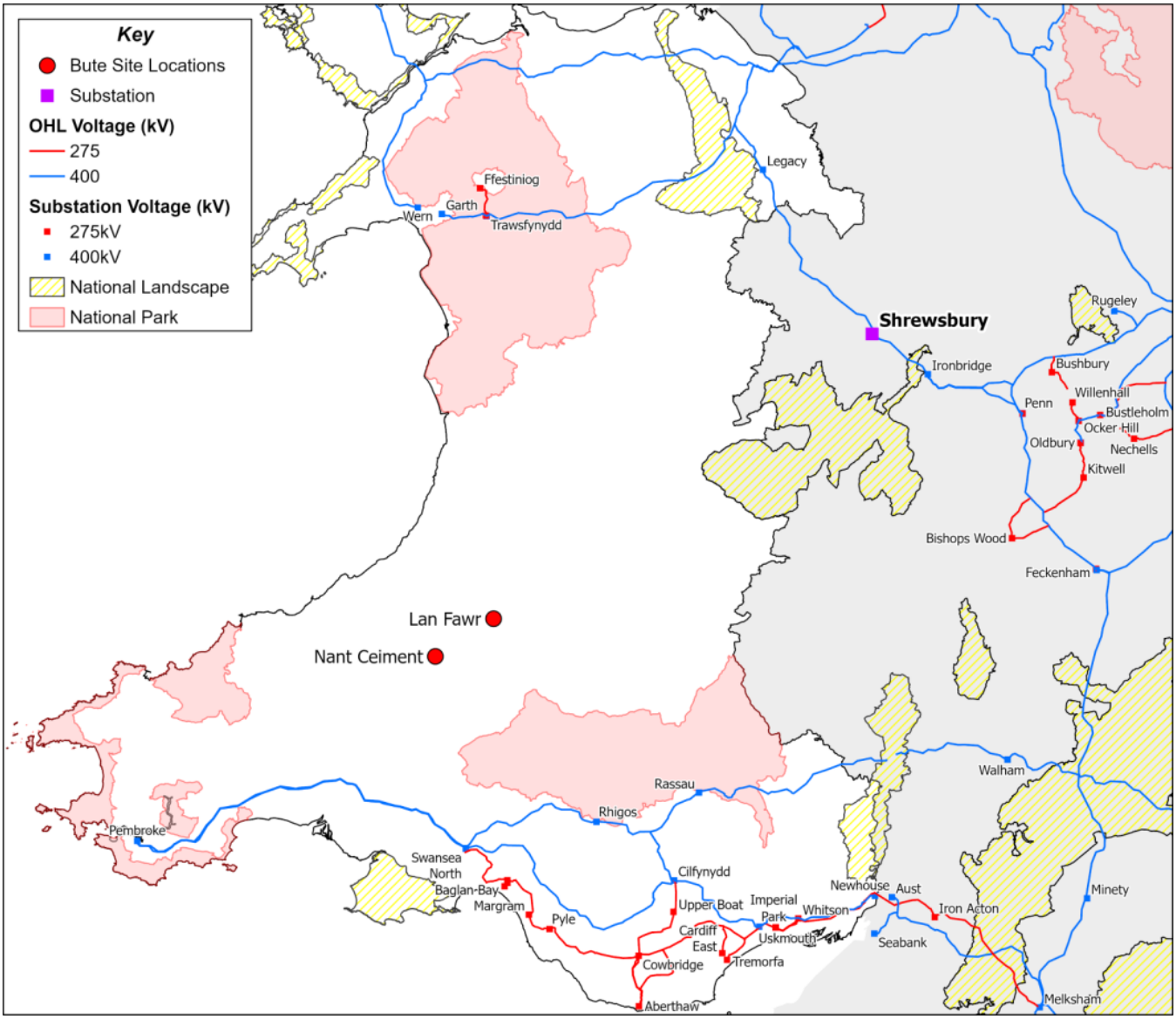

Figure 14 - Option 2 - Shrewsbury (Existing Substation)

47. Due to both Shrewsbury and Ironbridge 400kV substations being geographically proximate, these connection options are discussed together below.

Option 3 - Ironbridge (Existing Substation)

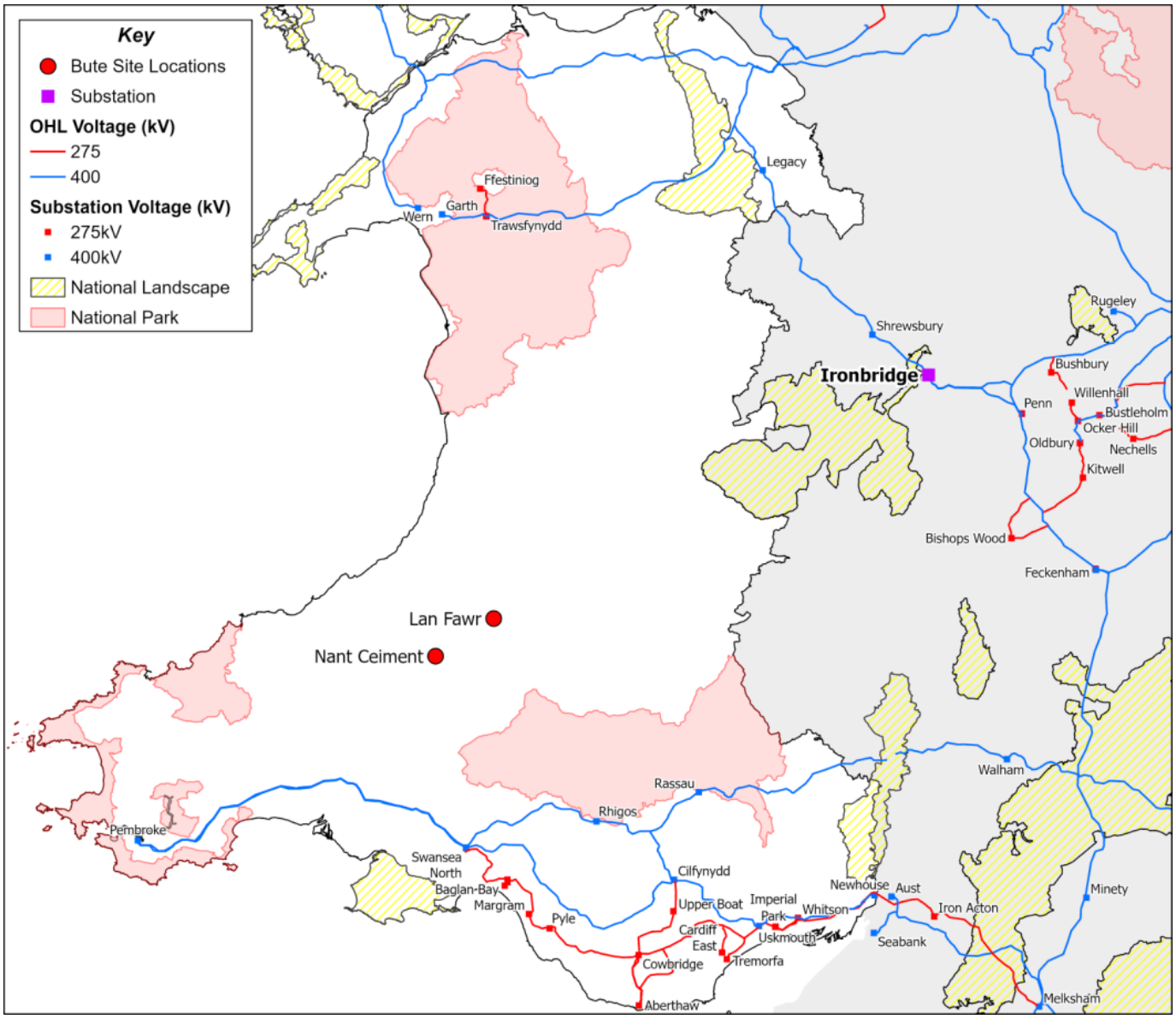

Figure 15 - Option 3 - Ironbridge (Existing Substation)

Technical Requirements

48. A direct connection from the Western Cluster of Energy Parks would be approximately 100 km, in the case of Shrewsbury, and 110 km, in the case of Ironbridge. There would accordingly be a significant distance between the proposed Western Cluster of Energy Parks and these substations. From a technical perspective, this could lead to higher electrical losses compared to other options located closer to the Energy Parks.

49. An extension to the existing Shrewsbury or Ironbridge substations would be required for these connection options.

Cost Assumptions

50. Based on the anticipated point to point connection distance from the Western Cluster of Energy Parks to the Shrewsbury or Ironbridge substations and the assumed mitigation required for routeing around the Shropshire Hills National Landscape, the following high level cost assumption has been applied to these options.

Substation	Direct point-to-point distance	Mitigations required	Indicative cost estimate
Shrewsbury	c. 100 km	OHL routeing diversion (c. 5km) and substation extension	c. £120m
Ironbridge	c. 110 km	OHL routeing diversion (c. 45km) and substation extension	c. £165m

Option 4 - Lower Frankton (New substation)

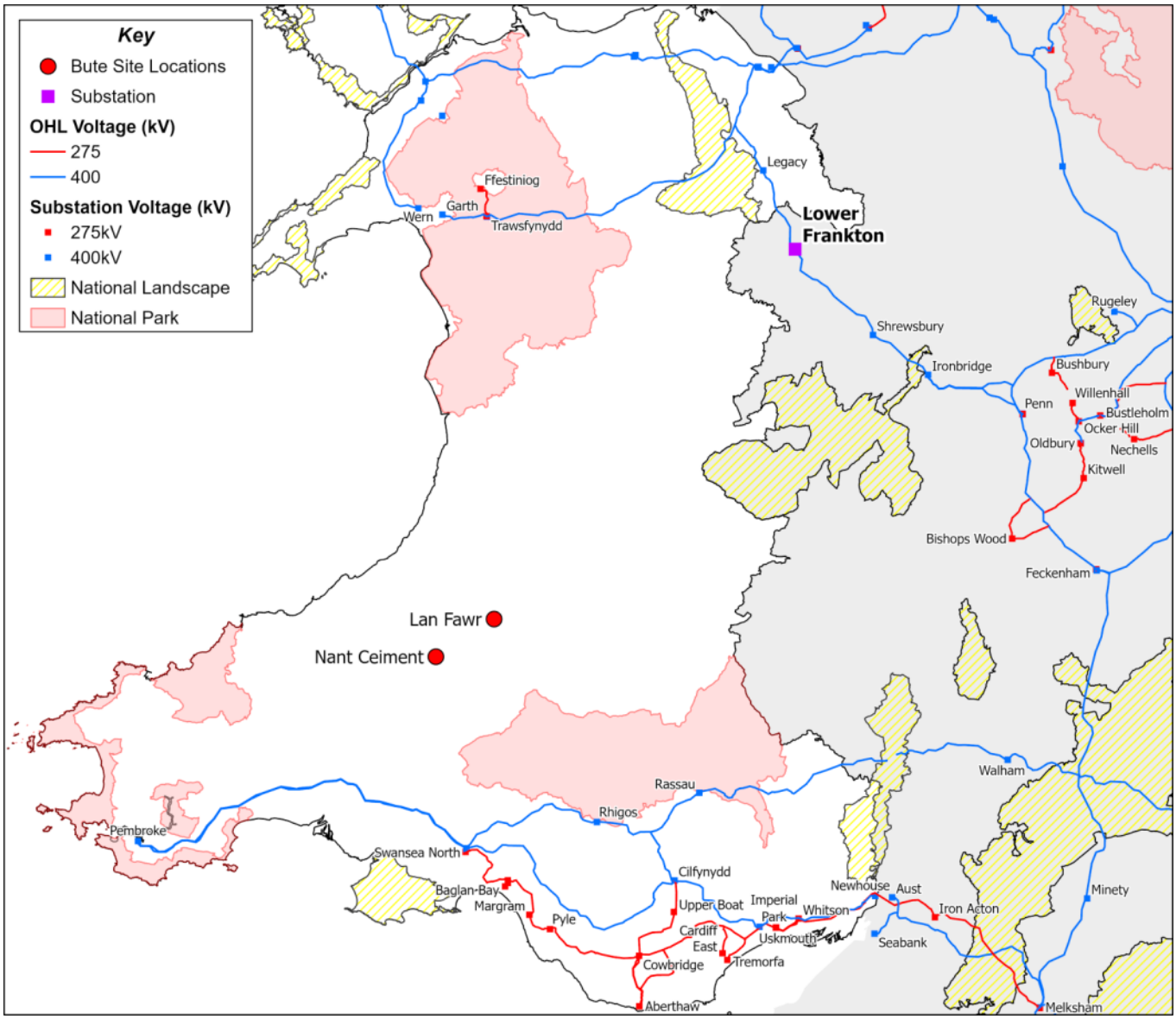

Figure 16 - Option 4 - Lower Frankton (New substation)

Technical Requirements

51. A direct route from the Western Cluster of Energy Parks would be approximately 95 km. There would therefore be a significant distance between the proposed South Wales Energy Parks and this substation. From a technical perspective, this could lead to higher electrical losses compared to other options located closer to the Energy Parks.

Cost Assumptions

52. Based on the anticipated point to point connection distance from the Western Cluster of Energy Parks to a new potential substation at Lower Frankton, including the potential for OHL routeing around sensitive designations and the development of a new substation, the following high level cost assumption has been applied to this option.

Substation	Direct point-to-point distance	Mitigations required	Indicative cost estimate
Lower Frankton	c. 95 km	New substation	c. £120m

Options within in the South-East Zone

Option 5 - Walham (Existing Substation)

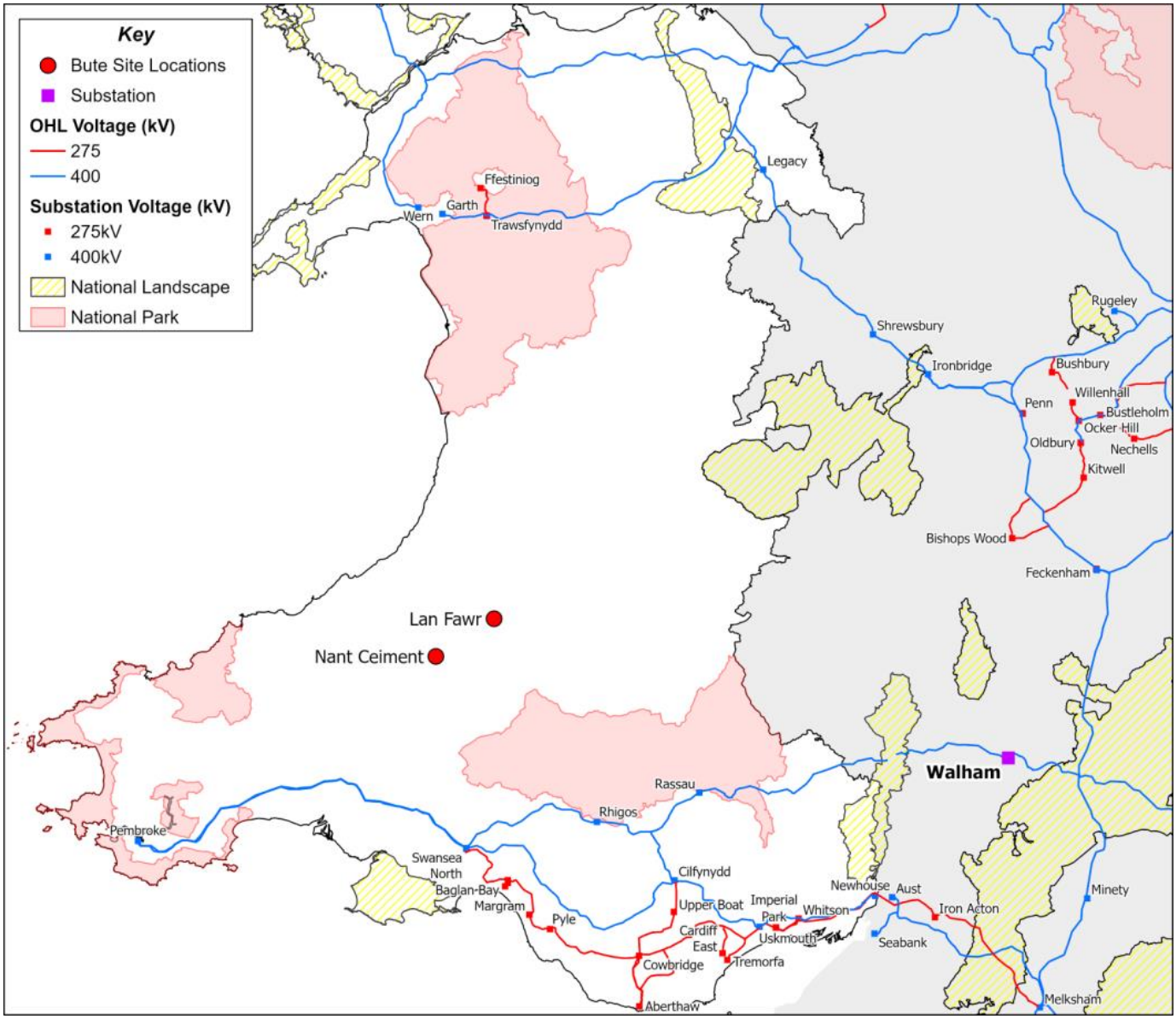

Figure 17 - Option 5 - Walham (Existing Substation)

Technical Requirements

53. A direct connection from the Western Cluster would be approximately 120 km in length. There would therefore be a significant distance between the proposed Western Cluster of Energy Parks and this substation. From a technical perspective, this could lead to higher electrical losses compared to other options located closer to the Western Cluster and would also increase the amount of land affected by the pylons and grid route. An extension to the existing Walham substation would be required for this connection option.

Cost Assumptions

54. Based on the anticipated point to point connection distance from the Western Cluster of Energy Parks to the Walham substation, including the potential OHL routeing around sensitive designations, the following high level cost assumption has been applied to this option.

Substation	Direct point-to-point distance	Mitigations required	Indicative cost estimate
Walham	c. 120 km	OHL routeing diversions (c. 30 km) and substation extension	c. £160m

Option 6 - Rhigos (Existing Substation)

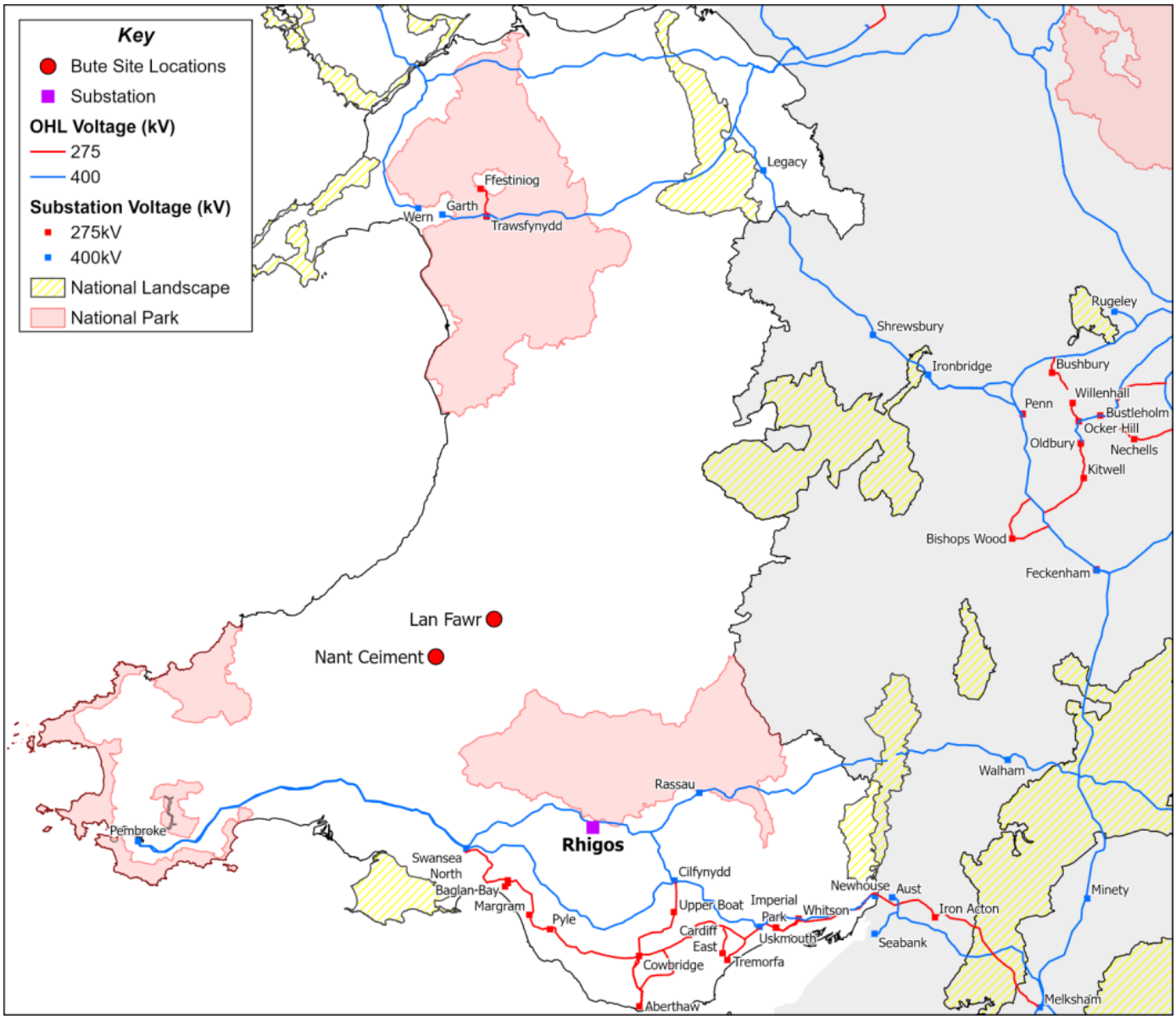

Figure 18 - Option 6 - Rhigos (Existing Substation)

55. Due to both Rhigos and Rassau 400kV substations being geographically proximate, these connection options are discussed together below.

Option 7 - Rassau (Existing Substation)

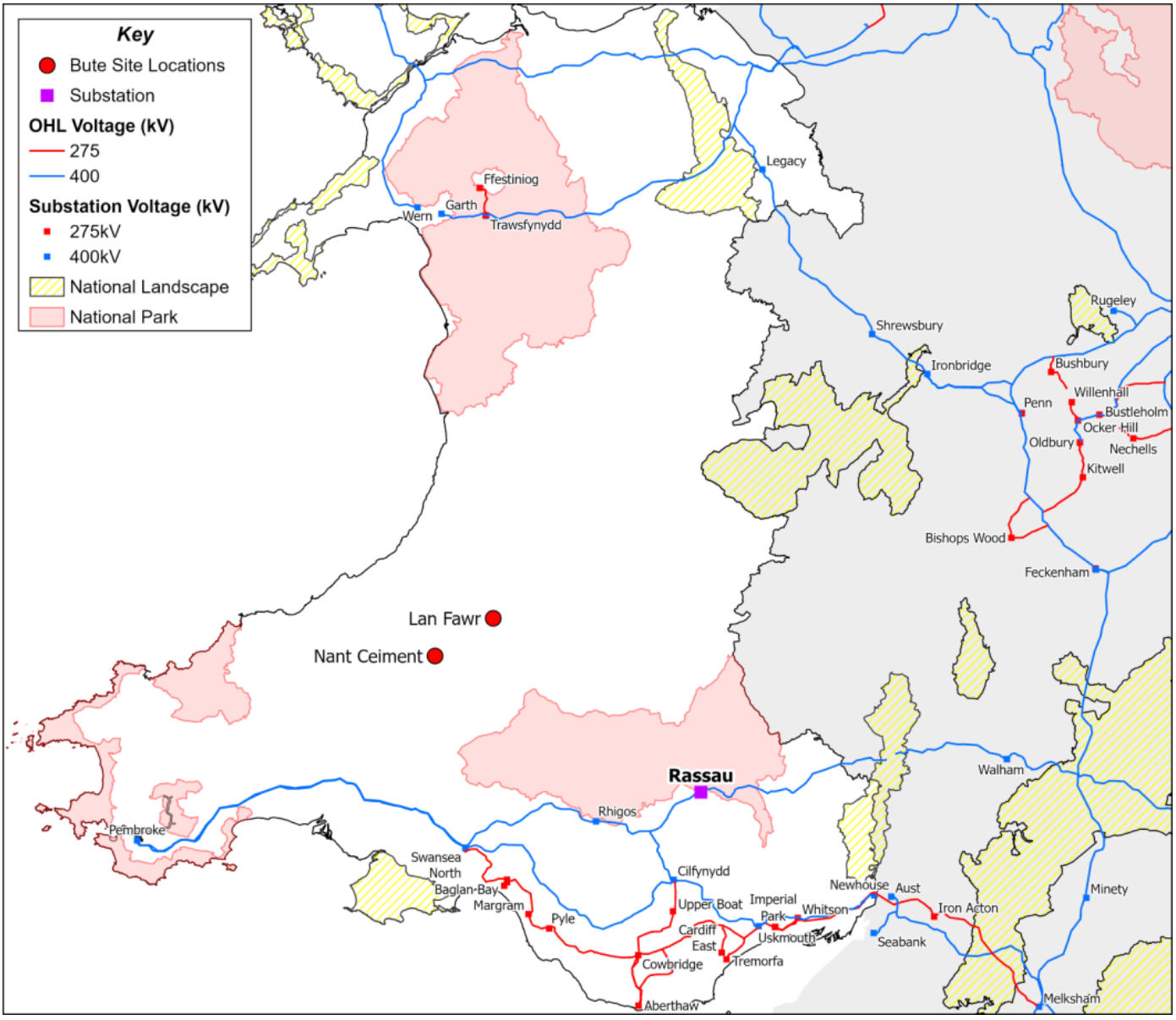

Figure 19 - Option 7 - Rassau (Existing Substation)

Technical Requirements

56. A direct point to point connection from the Western Cluster to Rhigos and Rassau substations would require a route of approximately 60km in length respectively.

57. When considering a direct point to point distance only, this is a comparatively shorter distance compared to other options considered within the North and south eastern zones. An extension to the existing Rhigos or Rassau substations would be required for these connection options.

Cost Assumptions

58. Based on the anticipated point to point connection distance from the Western Cluster of Energy Parks to the Rhigos and Rassau substations, including the potential for a significant routeing diversion around

the Bannau Brycheiniog National Park to avoid direct impacts on this designation, the following high level cost assumption has been applied to this option.

Substation	Direct point-to-point distance	Mitigations required	Indicative cost estimate
Rhigos	c. 60 km	OHL routeing diversion (c.30km) and substation extension	c. £100m
Rassau	c. 60 km	OHL routeing diversion (c.30km) and substation extension	c. £100m

Option 8 - Abergavenny (New Substation)

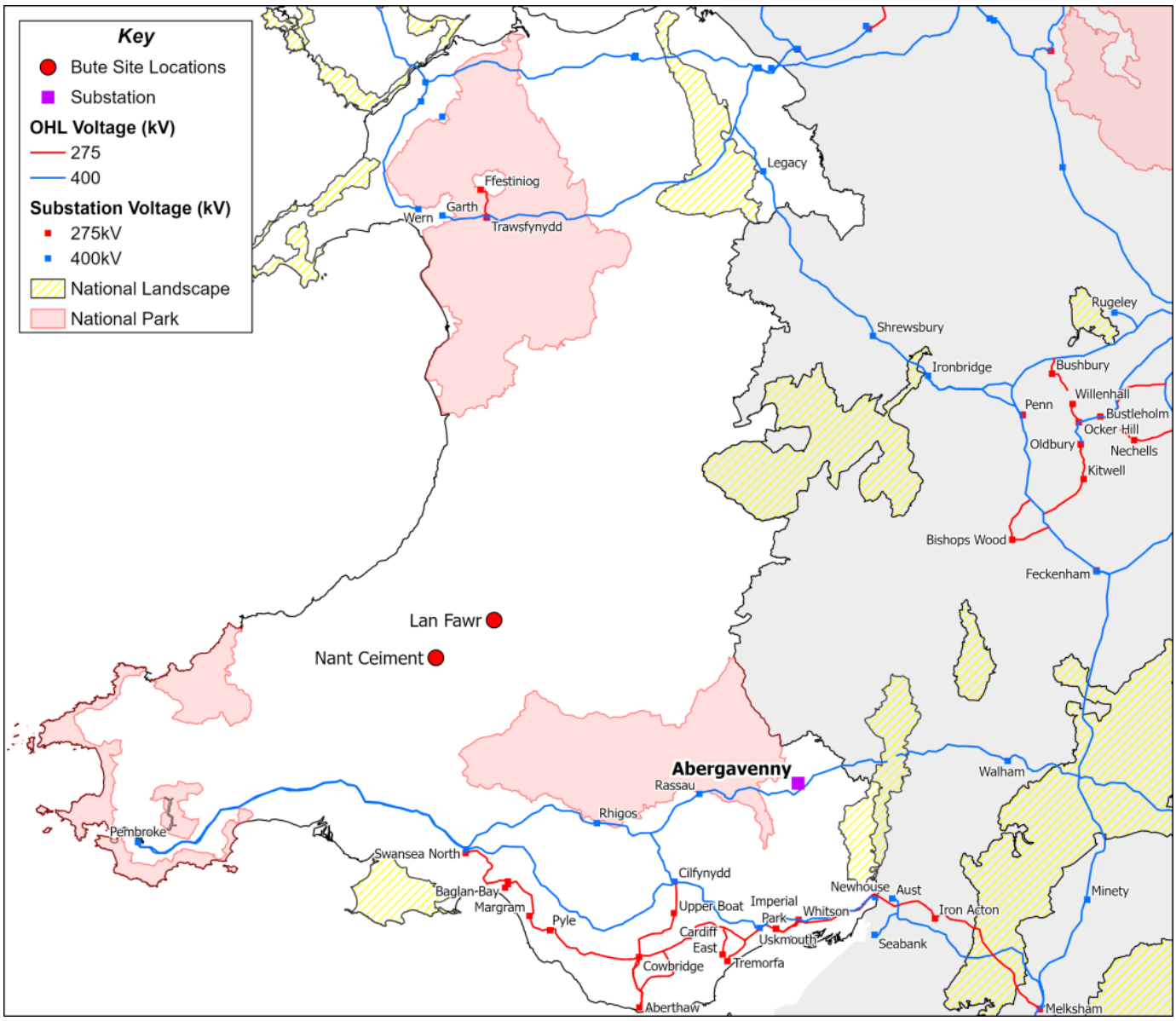

Figure 20 - Option 8 - Abergavenny (New Substation)

Technical Requirements

59. A connection from the Western Cluster of Energy Parks would require a connection of approximately 75 km.

Cost Assumptions

60. Based on the anticipated point to point connection distance from the Western Cluster of Energy Parks to a new substation in the vicinity of Abergavenny, including the potential OHL routeing around sensitive designations and development of a new substation, the following high level cost assumption has been applied to this option.

Substation	Direct point-to-point distance	Mitigations required	Indicative cost estimate
Abergavenny	c. 75 km	OHL routeing diversion (c.35km) and new substation	c. £135m

Options within the South-West Zone

Option 9 - Swansea North (Existing Substation)

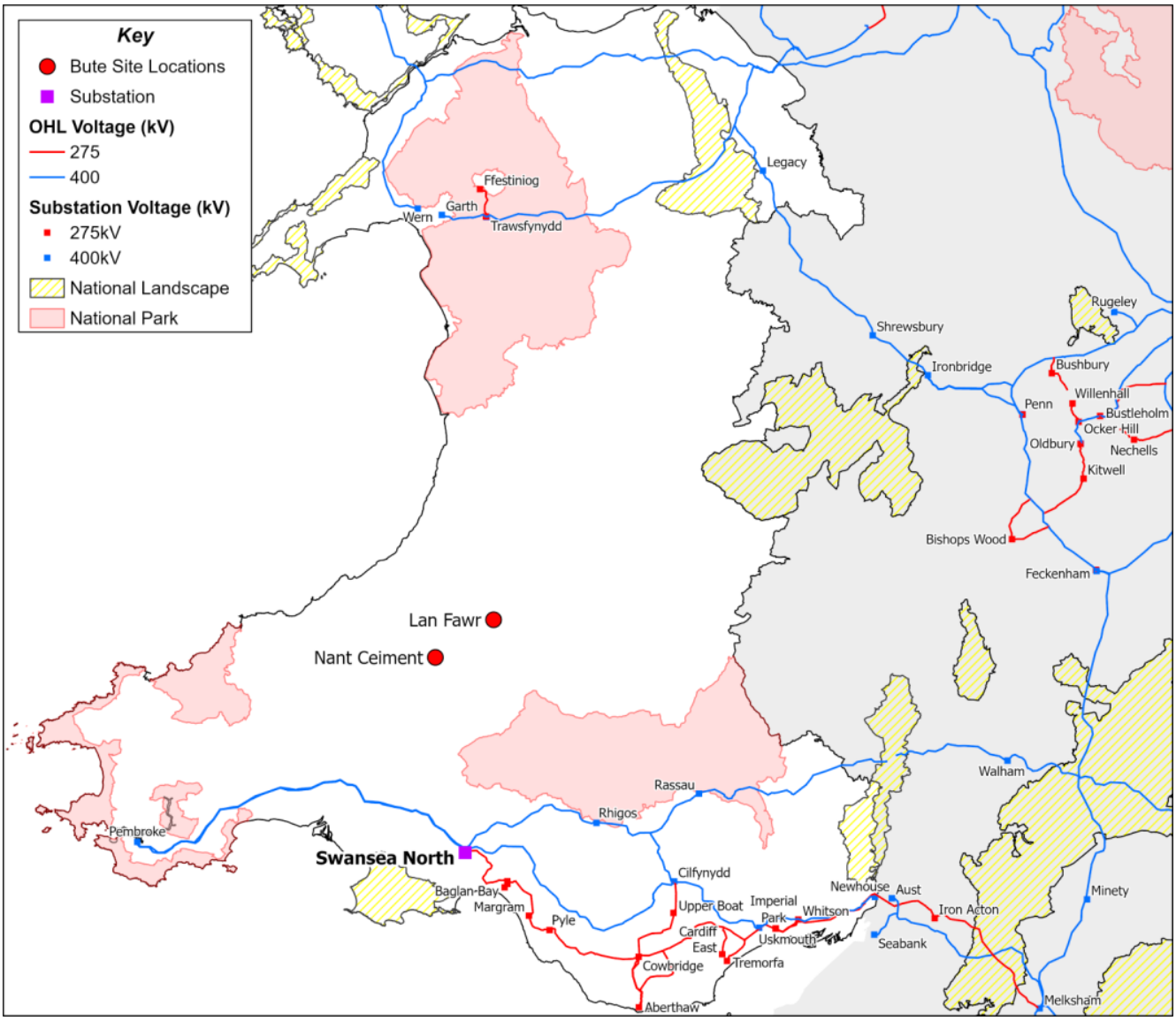

Figure 21 - Option 9 - Swansea North (Existing Substation)

Technical Requirements

61. A direct point to point connection from the Western Cluster of Energy Parks to the Swansea North substation would require a connection length of approximately 55 km. An extension to the existing Swansea North substation would be required for this connection option.

Cost Assumptions

62. Based on the anticipated point to point connection distance from the Western Cluster of Energy Parks to the Swansea North substation, including the potential for OHL routeing around sensitive receptors and undergrounding or special crossings of existing infrastructure, the following high level cost assumption has been applied to this option.

Substation	Direct point-to-point distance	Mitigations required	Indicative cost estimate
Swansea North	c. 55km	OHL routeing diversion (c. 5km), potential special crossings or undergrounding (c.5km) and substation extension	c. £100m

Option 10 - Pembroke (Existing Substation)

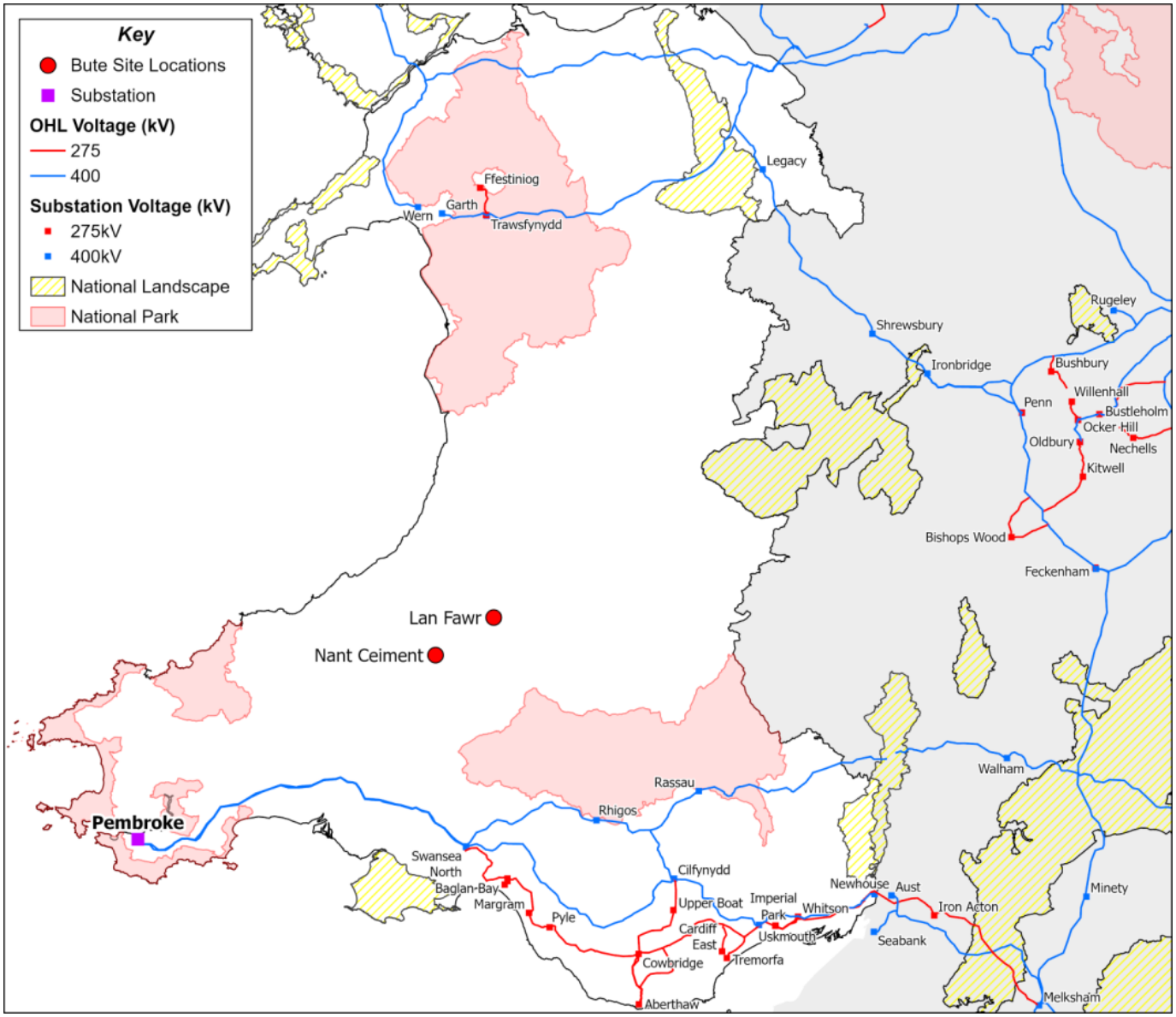

Figure 22 - Option 10 - Pembroke (Existing Substation)

Technical Requirements

63. A direct point to point connection from the Western Cluster of Energy Parks to the substation at Pembroke would require a connection length of approximately 90km. From a technical perspective, this could lead to higher electrical losses compared to other options located closer to the Western Cluster. An extension to the existing Pembroke substation would be required for this connection option.

Cost Assumptions

64. Based on the anticipated point to point connection distance from the Western Cluster of Energy Parks to the Pembroke substation, including the potential for OHL routeing around sensitive designations, the following high level cost assumption has been applied to this option.

Substation	Direct point-to-point distance	Mitigations required	Indicative cost estimate
Pembroke	c 90km	OHL routeing diversion (c.5km) and substation extension	c. £105m

Option 11 - Carmarthen (New Substation)

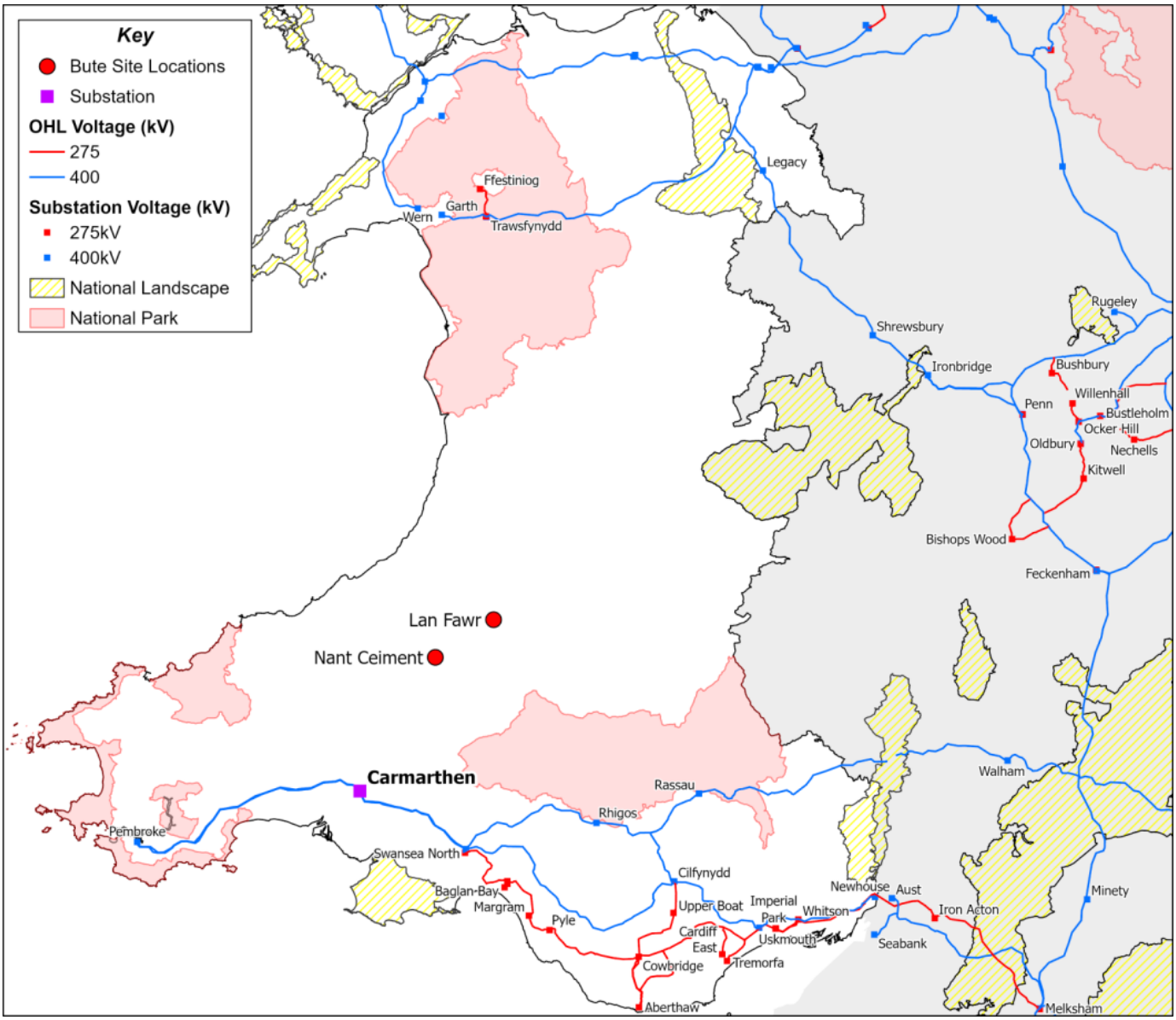

Figure 23 - Option 11 - Carmarthen (New Substation)

Technical Requirements

65. A direct point to point connection from the Western Cluster of Energy Parks to a new substation at Carmarthen would require a connection length of approximately 45km.

Cost Assumptions

66. Based on the anticipated point to point connection distance from the Western Cluster of Energy Parks to a new substation in the vicinity of Carmarthen, including the potential for OHL routeing around sensitive designations and development of a new substation, the following high level cost assumption has been applied to this option.

Substation	Direct point-to-point distance	Mitigations required	Indicative cost estimate
Carmarthen	c. 45 km	New substation	c. £70m

Alternative Connection Option

67. In addition to the options which Green GEN Cymru originally considered, this addendum also includes an additional option at Bishops Wood in response to consultee feedback. Here we have first presented the combined analysis of the Eastern and Western Clusters going to a single point of connection into Bishops Wood, as is the same in the main report of the GCSR. This is then followed up by sperate cluster analysis using the same methodology as this addendum.

Combined Eastern and Western Clusters

Option 12 – Bishops Wood (Existing Substation)

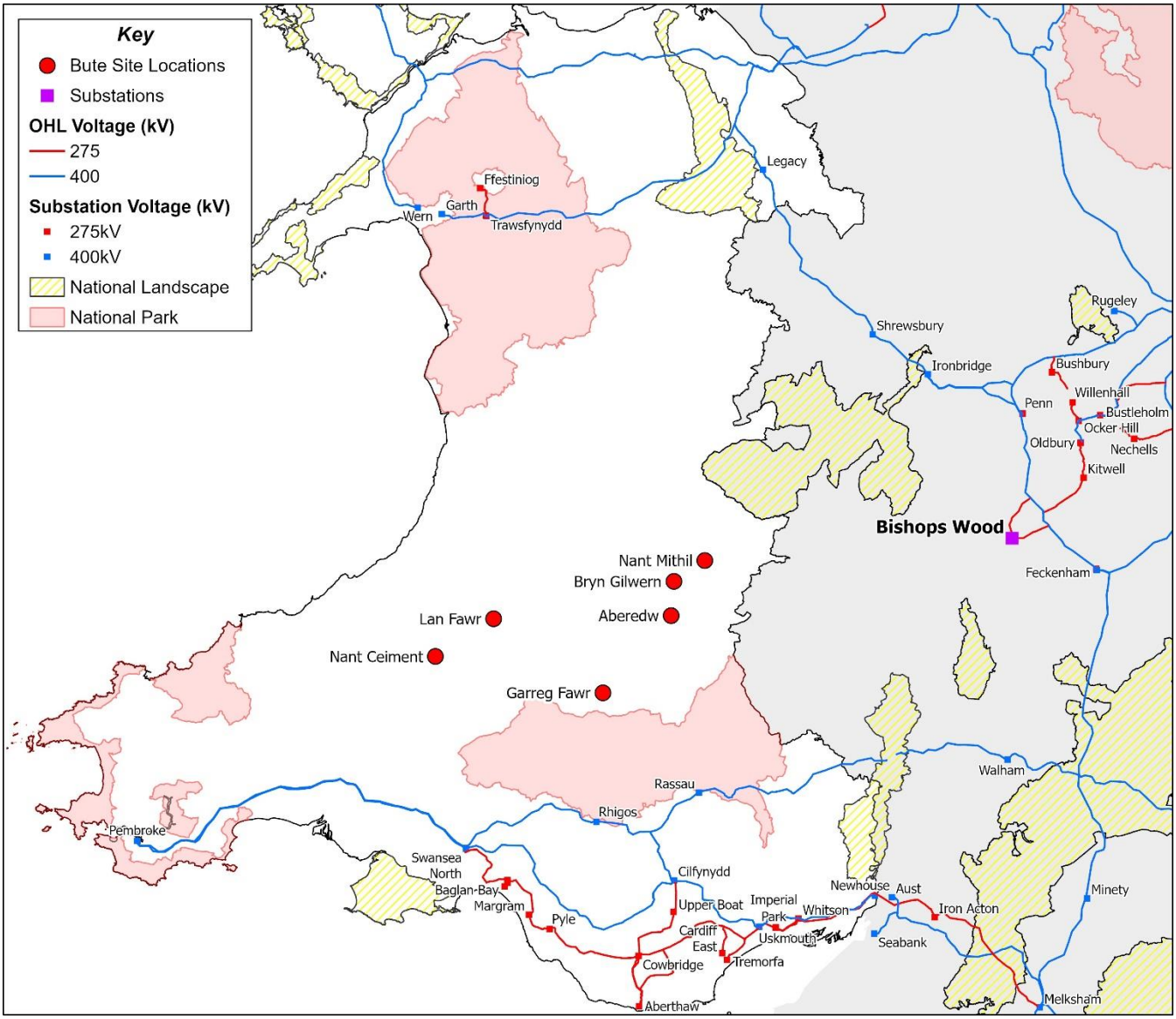

Figure 24 - Option 12 - Bishops Wood (Existing Substation)

68. This option considers the possibility of connecting both the Energy Parks into the existing 275kV substation at Bishops Wood located in Wychavon District in Worcestershire. It is approximately 4 km

south of the town of Stourport on Severn and to the east of the Eastern Cluster of the South Wales Energy Parks.

Technical Requirements

69. A direct point to point connection from the Eastern Cluster of Energy Parks to the Bishops Wood substation would require a connection length of approximately 80km. A direct connection from the Western Cluster to the Carmarthen substation would be approximately 120 km.

Environmental Considerations

70. A direct point to point connection route from the Energy Parks would need to be carefully routed due to the prominence of SSSI that surround the Eastern Clusters EPs such as Llandeilo, Rhulen and Llanbedr Hills SSSI and Glascwm and Gladestry Hills SSSI. However, a benefit here is that there would be no interaction with a National Park. It will have to cross the River Lugg SSSI near Leominster and also cross the River Teme SSSI about 10km west of Bishops Wood substation. There will also need to be other diversions throughout the route as pockets of SSSIs can be found throughout the Welsh Marches and Worcestershire.

71. The immediate vicinity of the substation is congested with existing OHL infrastructure as well as having to cross the River Severn. Therefore, there is the potential that a new connection into the substation would likely have to employ special crossing techniques or undergrounding to avoid these pieces of key infrastructure.

72. It is also considered that there could be routeing challenges in any approach to the Bishops Wood substation due to the presence of built development in the area around the settlements of Stourport on Severn and Astley Cross. A route in this location could lead to routeing pinch points, and the potential for undergrounding in some locations to facilitate crossings of sensitive infrastructure.

73. Any route from the Energy Parks would need to be carefully routed and considered to reduce potential impacts on a number of additional key designations, including (but not limited to):

- Radnor Forest SSSI
- River Lugg SSSI
- River Teme SSSI
- Hanley Dingle SSSI
- River Tywi SSSI and SAC
- River Wye SSSI and SAC
- River USK SSSI and SAC
- Elenydd SSSI and SPA
- Llandeilo, Rhulen and Llanbedr Hills SSSI
- Glascwm and Gladestry Hills SSSI
- Maelienydd SSSI
- Cwm Doethie - Mynydd Mallaen SSSI
- Elenydd Malaen – SPA
- Caeau Mynydd Mawr SAC

Cost Assumptions

74. Based on the anticipated point to point connection distance from the Energy Parks to Bishops Wood, including the potential for OHL routeing around sensitive receptors and undergrounding or special crossings of existing infrastructure, the following high level cost assumption has been applied to this option.

Substation	Direct point-to-point distance	Mitigations required	Indicative cost estimate
Bishops Wood (Combined Clusters)	c. 200km	OHL routeing diversion (c.10 km), extension to existing substation.	c. £220m

Eastern Cluster

Option 12 – Bishops Wood (Existing Substation)

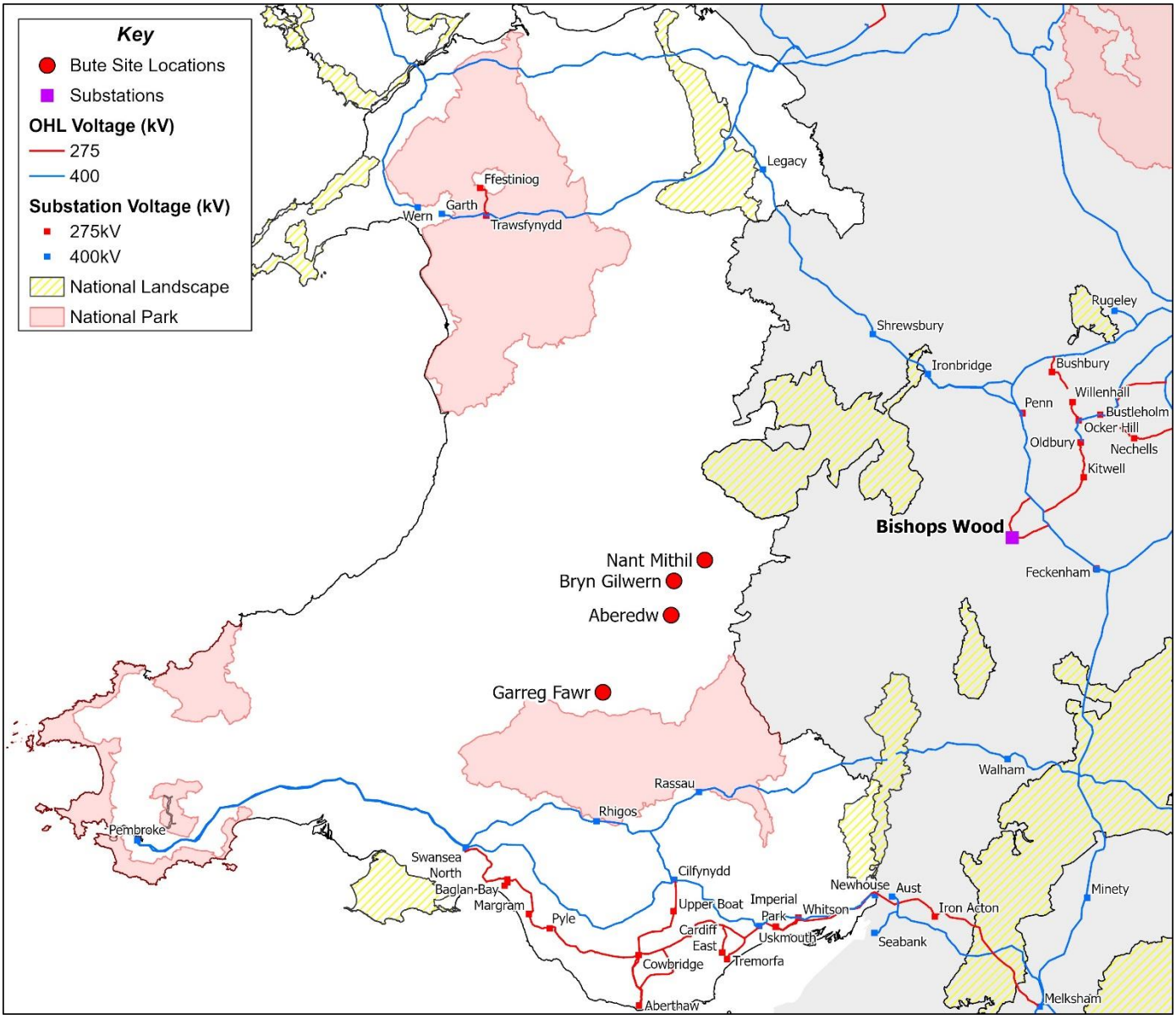

Figure 25 - Option 12 - Bishops Wood (Existing Substation)

75. This option considers the possibility of connecting the Eastern Cluster into the existing 275kV substation at Bishops Wood located in Wychavon District in Worcestershire. It is approximately 4 km south of the town of Stourport on Severn and to the east of the Eastern Cluster of the South Wales Energy Parks.

Technical Requirements

76. A direct point to point connection from the Eastern Cluster of Energy Parks to the Bishops Wood substation would require a connection length of approximately 80km.

Cost Assumptions

77. Based on the anticipated point to point connection distance from the Eastern Cluster to Bishops Wood, including the potential for OHL routeing around sensitive receptors and undergrounding or special crossings of existing infrastructure, the following high level cost assumption has been applied to this option.

Substation	Direct point-to-point distance	Mitigations required	Indicative cost estimate
Bishops Wood	c. 80km	OHL routeing diversion (c.5 km), extension to existing substation.	c. £95m

Western Cluster

Option 12 –Bishops Wood (Existing Substation)

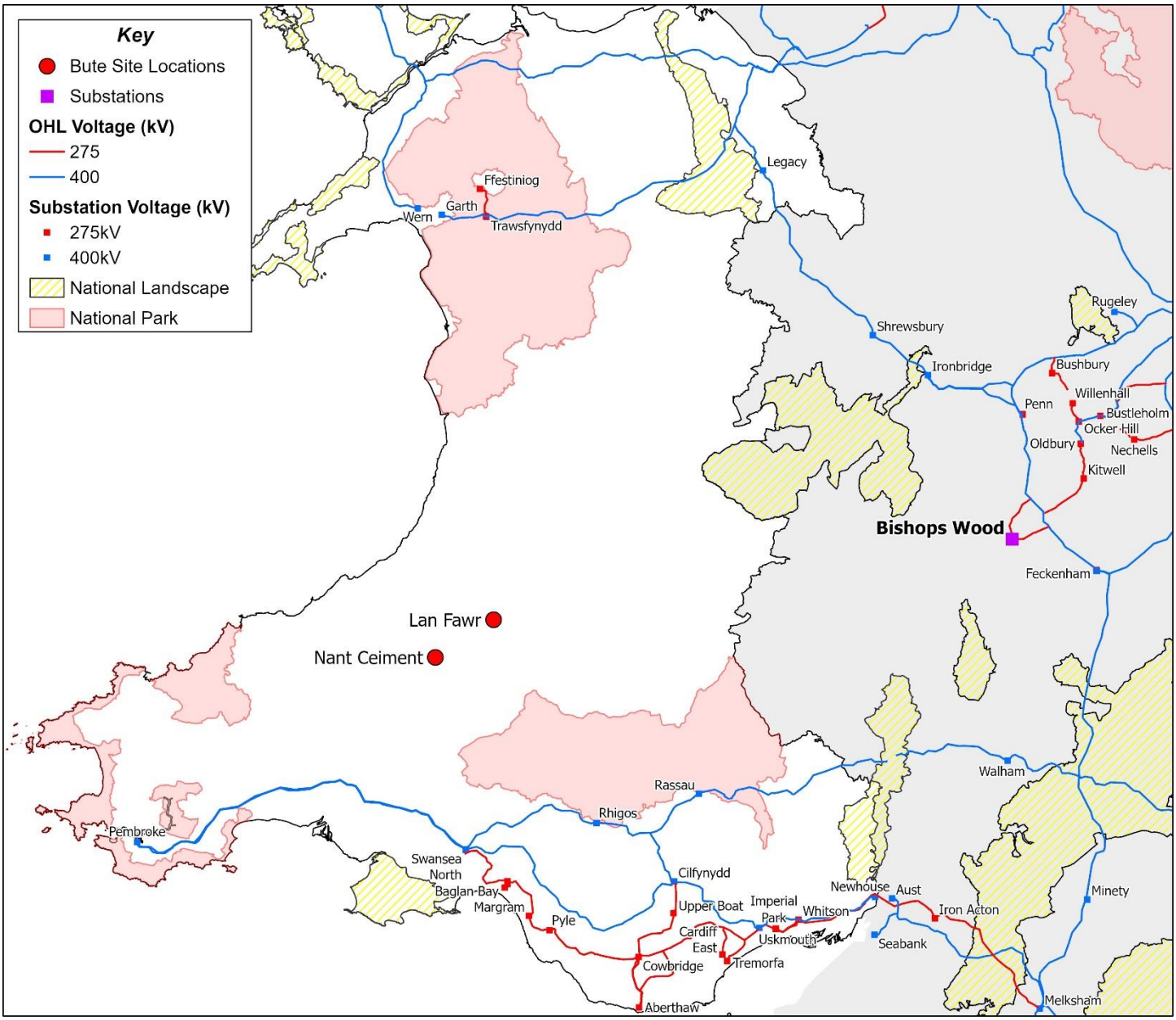

Figure 26 - Option 12 - Bishops Wood (Existing Substation)

78. This option considers the possibility of connecting the Western Cluster into the existing 275kV substation at Bishops Wood located in Wychavon District in Worcestershire. It is approximately 4 km south of the town of Stourport on Severn and to the east of the Eastern Cluster of the South Wales Energy Parks.

Technical Requirements

79. A direct connection from the Western Cluster to the Carmarthen substation would be approximately 120 km.

Cost Assumptions

80. Based on the anticipated point to point connection distance from the Western Cluster, through the Eastern Cluster to Bishops Wood including the potential for OHL routeing around sensitive receptors and undergrounding or special crossings of existing infrastructure, the following high level cost assumption has been applied to this option.

Substation	Direct point-to-point distance	Mitigations required	Indicative cost estimate
Bishops Wood	c. 120km	OHL routeing diversion (c.5 km), extension to existing substation.	c. £135m

Summary and Preferred Option

Summary of All Options

81. For ease of reference, the table below presents all the options per cluster with a description and the total distance and indicative cost of them. The total distances are the point to point measurements in addition to any diversion we have assumed to be needed.

Table 2 - Summary of Eastern Cluster Options

Option	Description	Total Distance	Indicative cost estimate
1 Trawsfynydd	Existing Substation with undergrounding needed (approximately 25km) and a substation extension	c.85 km	£240m
2 Shrewsbury	Existing Substation with an OHL routeing diversion (c. 5km) and substation extension	c. 80 km	£90m
3 Ironbridge	Existing Substation with an OHL routeing diversion (c. 15km) and substation extension.	c. 95 km	£105m
4 Lower Frankton	New Substation with an OHL routeing diversion (c.5 km)	c. 90 km	£115m
5 Walham	Existing Substation with an OHL routeing diversions (c. 10 km) and substation extension	c. 95 km	£105m
6 Rhigos	Existing Substation with an OHL routeing diversion (c.65km) and substation extension	c. 105 km	£115m
7 Rassau	Existing Substation with an OHL routeing diversion (c.65km) and substation extension	c. 105 km	£115m
8 Abergavenny	New Substation with an OHL routeing diversion (c.10km)	c. 60 km	£85m
9 Swansea North	Existing Substation with an OHL routeing diversion (c. 15km), potential special crossings or undergrounding (c.5km) and substation extension	c. 80km	£124m
10 Pembroke	Existing Substation with an OHL routeing diversion (c.5km) and substation extension	c. 125 km	£135m
11 Carmarthen	New Substation with an OHL routeing diversion (c.5 km)	c. 75 km	£100m
12 Bishops Wood	Existing substation with an OHL routeing diversion (c.5 km) and substation extension.	c. 85km	£95m

Table 3 - Summary of Western Cluster Options

Option	Description	Total Distance	Indicative cost estimate
1 Trawsfyndd	Existing Substation with undergrounding needed (approximately 25km) and a substation extension	c.85 km	£240m
2 Shrewsbury	Existing Substation with an OHL routeing diversion (c. 5km) and substation extension	c. 105 km	£115m
3 Ironbridge	Existing Substation with an OHL routeing diversion (c. 45km) and substation extension.	c. 155 km	£165m
4 Lower Frankton	New Substation	c. 95 km	£120m
5 Walham	Existing Substation with an OHL routeing diversion (c. 30 km) and substation extension	c. 150 km	£160m
6 Rhigos	Existing Substation with an OHL routeing diversion (c.30km) and substation extension	c. 90 km	£100m
7 Rassau	Existing Substation with an OHL routeing diversion (c.30km) and substation extension	c. 90 km	£100m
8 Abergavenny	New Substation with an OHL routeing diversion (c.35km)	c. 110 km	£135m
9 Swansea North	Existing Substation, potential special crossings or undergrounding (c.5km) and substation extension	c. 55km	£99m
10 Pembroke	Existing Substation with an OHL routeing diversion (c.5km) and substation extension	c. 95 km	£105m
11 Carmarthen	New Substation	c. 45 km	£70m
12 Bishops Wood	Existing Substation with an OHL routeing diversion (c.5km) and substation extension	c.125 km	£135m

Table 4 - Bishops Wood Combined Cluster

Option	Description	Total Distance	Indicative cost estimate
12 Bishops Wood (Combined Clusters)	OHL routeing diversion (c.10 km), extension to existing substation.	c. 210km	c. £220m

Summary of options within the North Zone

Eastern Cluster

82. All of the connection options within the North Zone from the Eastern Cluster measure from 75km to 85km point to point. Whilst it is acknowledged that a northern route from the Eastern Cluster of Energy Parks could provide the benefit of potentially linking in with other Energy Parks that Bute Energy has connection agreements for (as outlined in the Green GEN Phase 2 Grid Connection Strategy), the amount of energy generated from these parks would necessitate an additional connection and could not be accommodated on the proposed connections from the Eastern Cluster of Energy Parks described in this document.

83. The main constraints with these sets of options are the significant interactions with designated areas, such as the Eryri National Park and the Shropshire Hills National Landscape. These interactions could lead to increased environmental impacts and the associated planning and consenting risks, as well as additional costs associated with avoidance and the compensatory measures that would be required.

84. When considering the options in the North Zone in isolation, the most logical point to connect to within this zone would be Shrewsbury, with the shortest point to point distance, an existing substation and a mitigatable effect on designated areas. All of the connection options in the North Zone would however lead to longer connection lengths at a higher cost when compared to alternatives considered and are therefore not considered to be preferable.

Western Cluster

85. All of the connection options within the North Zone from the Western Cluster measure from 85km to 110km point to point. As mentioned above the main constraints with these sets of options are the significant interactions with designated areas, such as the Eryri National Park and the Shropshire Hills National Landscape.

86. When considering the options in the North Zone in isolation, the most logical point to connect to within this zone would be either Shrewsbury or Lower Frankton, with a comparable cost comparison and total combined distances. All of the connection options in the North Zone would however lead to longer connection lengths at a higher cost when compared to alternatives considered and are therefore not considered to be preferable.

Summary of options within the South East Zone

Eastern Cluster

87. The connection options within the South East Zone would offer a wide variety of point-to-point route lengths. The shortest direct point-to-point total length would be a connection to the Rhigos or Rassau substations, whilst the longest distance would be a connection to Walham substation.

88. As with the connection options considered in the North Zone, a new connection from the Eastern Cluster to Walham substation would be longer in distance than other available options. Longer routes would lead to additional interaction with environmental receptors, cost, increased disruption, and higher electrical losses.

89. Whist a direct route would offer shorter and more direct connection routes than other possible solutions, connections to either Rhigos or Rassau substations were not considered to perform strongly given the availability of other routes with lesser impacts on National Parks. If these options were to be progressed, we would expect that a significant portion of the route would be undergrounded or a significant diversion around the National Park would be required.

90. In addition to the significant financial costs associated with undergrounding, such a long length of UGC would also lead to substantial disruption within the Bannau Brycheiniog National Park, impacting on local communities, visitors to the National Park, as well as the environment and its scenic beauty. For these reasons, routes to Rhigos or Rassau should be discounted.

91. The proposal for a new Abergavenny substation was considered as an alternative to avoid directly routeing the new connection through the Bannau Brycheiniog National Park. The length and cost of Abergavenny is the lowest out of all the 12 options studied for the Eastern Cluster. However, there are no current proposals from NGET to develop a substation in this location and therefore an option to connect into a new substation at Abergavenny is considered to be a major constraint to the deliverability of the connection for the energy parks within anticipated timescales for their construction and operation. In addition, a connection to a new Abergavenny substation could lead to notable interactions with the setting of the National Park. This would be expected to necessitate a route diversion.

Western Cluster

92. The connection options within the South East Zone would offer a wide variety of point-to-point route lengths. The shortest direct point-to-point total length would be a connection from to the Rhigos or Rassau substations, whilst the longest distance would be a connection to Walham substation.

93. A connection to Walham would also need to pass through, or be diverted around, three Nationally designated areas; the Bannau Brycheiniog National Park, the Malvern Hills National Landscape, and the Wye Valley National Landscape. These interactions could lead to increased environmental impacts and the associated planning and consenting risks, as well as additional costs associated with mitigation measures that are likely to be required. In view of these factors, a possible new connection between the South Wales Energy Parks and Walham should be discounted.

94. The proposal for a new Abergavenny substation was considered as an alternative to avoid directly routeing the new connection through the Bannau Brycheiniog National Park. Whilst routeing around the National Park would give rise to fewer impacts than routing directly through it, a connection to a new Abergavenny substation could lead to notable interactions with the setting of the National Park. This would be expected to necessitate a significant route diversion, particularly when considering a connection from the Western Cluster of Energy Parks and is therefore not considered to be the preferred point of connection from this cluster.

Summary of options in the South West Zone

Eastern Cluster

95. Two of the three considered connection options within the South West Zone offer comparatively short direct point-to-point route lengths: these are Swansea North and Carmarthen (80km and 75km

respectively). In contrast a new connection to the Pembroke Substation would result in a significantly longer route.

96. Longer routes would lead to interaction with more environmental receptors, additional cost, increased disruption, and higher electrical losses. The significant length of the route required to the Pembroke substation was therefore considered to perform poorly as compared to other shorter options in the South West Zone. This, in addition to the fact that any route would be likely to pass in the vicinity of an option to connect in the Carmarthen area, means that an option to Pembroke is not preferred.

97. When compared to other options considered within the South East Zone, a new connection into the Swansea North substation would be capable of avoiding significant interactions with the Bannau Brycheiniog National Park. Some undergrounding and special crossings could be required within the vicinity of the existing substation at Swansea North due to the presence of other existing infrastructure. Any potential undergrounding or special crossings that would be needed at Swansea North would lead to a notable cost increase. It is also considered that a route to Swansea North could be challenging to progress due to the existing built environment in the area.

98. The Swansea North substation would offer a far shorter point-to-point circuit route, compared to the Pembroke substation, which is unlikely to require significant route diversions or extensions when compared to other options that have been discounted. Short routes minimise disruption and electrical losses. The potential need for undergrounding and special crossings of existing infrastructure in the area would however lead to additional costs for this connection option.

99. As with the Swansea North option, the connection into a new Carmarthen substation is not considered likely to lead to significant interactions with the Bannau Brycheiniog National Park. A new substation would be required; however this is currently in development by National Grid which factors into the consideration of the deliverability of this option.

Western Cluster

100. The shortest route from the Western Cluster of Energy Parks is the proposed new substation at Carmarthen. Due to the significant additional distance when compared with alternatives, a connection to Pembroke from the Western Cluster of Energy Parks is not considered preferred.

101. As with the Swansea North option, the connection into a new Carmarthen substation is not considered likely to lead to significant interactions with the Bannau Brycheiniog National Park, however a new substation would be required. Notwithstanding, the proposal for a new Carmarthen substation would represent the lowest overall connection length required from the Western Cluster of Energy Parks and would be the lowest cost option overall. This would therefore offer the most economical and efficient solution, whilst also having the lowest potential impact on communities and key designated areas out of the options that have been considered.

Preferred Option

102. The decision to pursue a combined solution for both the Eastern and Western clusters, is supported by an evaluation of environmental, technical, and strategic factors relating to the deliverability and availability of the options within the required timescales for the anticipated operation of the energy parks. The work initially undertaken to adopt a coordinated approach to the connection of the South Wales Energy Parks has facilitated agreements with National Grid for these connections to be accommodated within the new substation near Carmarthen. The proposal to deliver this substation to enable connections for the Bute Energy Parks, alongside other customers, is being promoted by National Grid and the deliverability of that proposal weighs heavily on the decision to progress with this as the preferred option.

103. The analysis has illustrated that there is a clear case for connecting into a new substation at Carmarthen from the Western Cluster over all other connection options. The connection to an assumed new substation on the NETS near Abergavenny for the Eastern Cluster would be shorter and have a potential lower cost when compared with a point of connection at Carmarthenshire, however the development of a new substation in this location is not currently proposed and therefore it's deliverability is considered significantly less certain than the proposed connection point near Carmarthen.

104. Carmarthen also represents a reasonable option for providing a connection to the Eastern Cluster, particularly when compared with the options to connect into existing substations.

105. The deliverability and availability of a substation at Carmarthen, which is proposed to become operational during the later part of the decade, presents a timely opportunity to connect the renewable energy proposed to be generated at the Energy Parks and aligns with Wales's ambitious net-zero obligations. This combined with the fact there are no current proposals by National Grid to erect a new substation at Abergavenny, clearly shows that the Carmarthen substation is preferable.

106. Moreover, the other third-party developments that are proposed to connect to the new substation in Carmarthen would support a joined-up approach to development in the region. This coordinated effort is expected to streamline processes, reduce environmental impact, and foster a more sustainable model of development. In contrast, the absence of proposals for new substation infrastructure at Abergavenny, coupled with the environmental detriment of constructing additional substations, underscores the advantages of a single, consolidated connection near Carmarthen. This strategic move not only capitalises on existing infrastructure developments but also amplifies the project's contribution to the national and local government climate emergency responses. This will position the project as a pivotal player in the transition to sustainable energy.

107. Ultimately, the pursuit of a combined solution for both clusters, with a connection to Carmarthen, we believe is the most deliverable and achieves a favourable strategic approach. In addition, this approach ensures the project's alignment with broader national objectives and obligations regarding climate change. As the project moves forward, it is imperative to continue engaging with stakeholders and articulating the strategic considerations that guide these decisions, thereby fostering a collaborative and informed pathway to supporting the net-zero ambitions.