Technical Appendix 8.3 Borrow Pit Assessment

Glentarken Wind Farm

SSE Renewables

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Basis of Report

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1.0 Introduction

SLR Consulting Ltd (SLR) was commissioned by SSE Renewables Services Ltd ('the agent) on behalf of SSE Generation Ltd (the 'Applicant'), to undertake a BP Assessment (BPA) for the proposed Glentarken Wind Farm (the Proposed Development). The Applicant is proposing to submit a Section 36 application to construct and operate an up to 12-turbine wind farm (up to 180 m tip height), energy storage and associated infrastructure with generation capacity of greater than 50 MW. The Proposed Development is detailed on **Figure 8.3.1** with the Borrow Pit (BP) search areas shown as BP1- BP6.

There has been substantial works undertaken to date at the Proposed Development to inform the proposed BPs, including site reconnaissance visits and several phases of peat probing which are detailed within **Technical Appendix (TA) 8.1: Peat Landslide and Hazard Risk Assessment (PLHRA) and TA 8.2: Peat Management Plan (PMP).**

The principal objective of this report is to provide an initial assessment of the aggregate requirements for the Proposed Development and identify potential BPs suitable for providing this aggregate.

The six proposed BP search areas reviewed within this report were selected because of their morphology, accessibility from proposed tracks, orientation and the expected proximity to suitable rock close to the surface. The proposed BPs are in areas where peat coverage is anticipated to be minimal and where bedrock may outcrop, and potential aggregate reserves are expected to occur near the surface.

The work has been undertaken by a team of Geotechnical Engineers and Geologists, with over 10 years' experience in undertaking peat assessments. The team was led by a Chartered Hydrogeologist with 30 years' consultancy experience and specialising in the assessment of soils, geology and water for renewable power projects in Scotland.

2.0 Geological Setting

This assessment has been completed through a largely desk-based review of soil and geological maps and OS contour data with site reconnaissance undertaken by a geologist and geotechnical engineer, to cross-check the geological desk-based review.

2.1.1 Superficial Geology

Based on information provided by the British Geological Survey (BGS) online viewer[1] there is an absence of mapped superficial material across the main area of the Proposed Development to the north of Glen Tarken. Glacial till is mapped to the north and south or the Proposed Development. Till and Morainic Deposits are mapped along the main access track up to BP4, BP05 and BP06. Alluvium and River Terrace Deposits are mapped beyond the western boundary of the Proposed Development near Glen Beich.

Figure 8.3.2 shows the superficial geology mapping and the Proposed Development.

2.1.2 Bedrock Geology

Based on the available BGS online data[1] the Proposed Development is underlain by a number of different bedrock formations as detailed below:

- Pitlochry Schist Formation - Psammite and Semipelite; mapped along the southern parts of the main access up to and beyond BP3.
- Loch Tay Limestone Formation – Metalimestone; only mapped along the western boundary and not under any proposed infrastructure.
- Southern Highland Group – Semipelite; mapped under most of the western half of the Proposed Development.
- North Britain Siluro-Devonian Calc-Alkaline Dyke Suite – Felsite; mapped within the east of the Proposed Development.
- Dalradian Supergroup - Metagabbro and Metamicrogabbro; also mapped with the east of the Proposed Development.

Several igneous intrusions of the Central Scotland Late Carboniferous Tholeiitic Dyke Swarm - Quartz-Microgabbro and North Britain Siluro-Devonian Calc-Alkaline Dyke Suite – Microgranite are noted along the western boundary of the Proposed Development. Another larger intrusion of Central Scotland Late Carboniferous Tholeiitic Dyke Swarm - Basalt is noted in the East from T6 to T3.

One major fault is inferred south to north along the western boundary of the Proposed Development.

Figures 8.3.3a and 8.3.3b shows the bedrock geology mapping and the Proposed Development.

2.2 Mining and Quarrying

Information from The Coal Authority Online Viewer[2] indicates that the Proposed Development is not within a coal mining reporting area.

BGS Online data[1] indicate there are three historical pits, named Creag Dhubh and Meall Reamhar located south of the Proposed Development. They are likely to be associated with

[1] BGS Online Viewer, available at: https://mapapps2.bgs.ac.uk/geoindex/home.html?

[2] The Coal Authority, The Coal Authority Map Viewer, available online at: https://datamine-cauk.hub.arcgis.com/

the construction of the existing access tracks at and within the area of the Proposed Development.

2.3 Hydrogeology

Information from Scotland's Environment Online Map Viewer[3] indicate that the bedrock units underlying the Proposed Development are generally impermeable and without groundwater except at shallow depth. Some groundwater flow may occur in shallow cracks and joints open to weathering with rare springs yielding low volumes of water.

2.4 Hydrology

The Proposed Development is located within the surface water catchment of the River Earn and Loch Earn (ID: 100251) specifically the west and northwest of the Proposed Development is located within the sub-catchment of the Beich Burn (ID: 6822) while the east and southeast is located within the sub-catchment of the Tarken Burn (ID: 6820).

2.5 Aerial Photography

From review of aerial photography, bedrock outcrops are abundant across the Proposed Development. This was confirmed during site walkovers where bedrock outcrops were frequently encountered. Bedrock was often seen on the tops of ridges and flatter tops, mostly bedrock at or near surface.

[3] Scotland's Environment, Scotland's Environment Map, available online at: https://map.environment.gov.scot/sewebmap/

3.0 BP Assessment

This section of the report provides an assessment of the six potential BP search area locations with an evaluation of their potential to meet the Proposed Development's aggregate requirements.

The assessment has been completed through a desk-based review of geological maps and memoirs and is supported by several site visits from SLR geologists and a geotechnical engineer. Potential BP locations were inspected visually with a view to assess ground conditions and help determine the BP's suitability for use during construction of the Proposed Development.

In exploring the six potential BPBP search area locations, as defined in **Figures 8.3.4a and 8.3.4b**, consideration has been given to the practical aspects of each BP. The main aspects to consider are as follows:

- ease of access;
- rock type;
- overburden thickness;
- topography;
- current and historical uses;
- proximity to construction activities;
- visual impact; and
- impact on environmentally sensitive areas.

Steeper topography is preferable for quarrying, where peat and soils coverage will be limited. Careful consideration was given to landscape and visual impacts, and other considerations included proximity to watercourses and places of archaeological interest. The proposed BPs are in areas where the peat cover is typically thinner or vacant and aggregate reserves are expected to occur near the surface.

3.1 Aggregate Requirements

The proposed turbine (T) locations and their subsequent maintenance would require the construction of a purpose-built network of access tracks. These tracks would be single track with occasional passing places, un-metalled and would be constructed to the turbine suppliers' specifications conforming to the Specification for Highway Works (SHW)[4].

The indicative volumes of aggregate required for site infrastructure are summarised in Table A and based on the materials calculator provided in **Annex A**.

The aggregate requirements below have been calculated based on estimate of aggregate volumes required.

[4] Highways Agency, Manual of Contract Documents for Highway Works Volume 1 Specification for Highway Works, Series 600 Earthworks, Published February 2017.

Table A: Aggregate Requirement Summary

Infrastructure Element	Volume of Aggregate Required (m^3)
Excavated Track	47,240
Floating Track	19,209
Upgraded Track	3,402
Track Percentage Uplift for Localised Widening	3,493
Turbine Bases - formation only	3,719
Fill above Turbine Bases	38,052
Total WTG Concrete Foundation Aggregate	5,256
Permanent Hardstandings	34,680
Temporary Hardstandings	42,696
Substation Platform (Inc Temp, Perm and BESS)	31,250
Main Construction Compound	8,000
Access Track Construction Compound	2,000
Laydown Area (x2)	12,000
Batching Plant	8,000
Total	**258,997**

It has been estimated that approximately 258,997m^3 of suitable quality rock would be required to construct the Proposed Development. This includes SHW[4] classes 6F2, 6N/6P and concrete aggregate. If rock quality is not suitable for each of these engineered materials then there may be a requirement for imported materials.

No account has been taken in the calculations for the fortuitous 'winning' of rock during the construction phase for example during infrastructure excavations. If such rock was available, the amount extracted from the BPBPs could be reduced.

3.2 BP Assessment

This section of the report provides an assessment of the six BP search areas together with an evaluation of their potential to meet the Proposed Development's aggregate requirements. The BP design within each search area is detailed within **Figures 8.3.4 a and 8.3.4 b**.

All BPs could be extended or reduced in size depending on review of aggregate requirements and/or ground investigation data.

The geology encountered within the Proposed Development is supported by BGS geological maps for the Proposed Development. Dimensions of the BPs, volume of superficial material to be removed and volumes of site won rock for each BP have been estimated based on cross-sections developed through a digital terrain model. These are required to be confirmed by future intrusive ground investigation works.

The calculations provided in this report assume a worst-case scenario and where no other rock or materials would be found on site during construction. In the event that such rock was available the amount extracted from the BPs could be reduced.

3.2.1 BP 1

BP 1 is located to the east of the Proposed Development adjacent to T3 at the approximate National Grid Reference (NGR) 267353, 729369.

Photo 1: BP1 facing east (06/08/2024)

Table B: BP 1

BP 1	
Superficial Geology	Not mapped
Bedrock Geology	1. Dalradian Supergroup - Metagabbro and Metamicrogabbro 2. Central Scotland Late Carboniferous Tholeiitic Dyke Swarm - Basalt
Inferred Design Parameters	Overall slope angle 45° Maximum face height 15m
Gradient	Slope increasing steeply towards the south-east
Details of Extraction	Combination of drilling and blasting
Estimated Excavation Area	9,080 m^2
Estimated Excavation Volume	37,700 m^3

3.2.2 BP 2

BP 2 is located in the centre of the Proposed Development adjacent to T4 at the approximate National Grid Reference (NGR) 266446, 729544.

Photo 2: BP2 facing north-west (06/08/2024)

Table C: BP 2

BP 2	
Superficial Geology	Not mapped
Bedrock Geology	1. North Britain Siluro-devonian Calc-alkaline Dyke Suite – Felsite 2. Dalradian Supergroup - Metagabbro and Metamicrogabbro
Inferred Design Parameters	Overall slope angle 45° Maximum face height 15m
Gradient	Slope increasing steeply towards the west
Details of Extraction	Combination of drilling and blasting
Estimated Excavation Area	28,125 m^2
Estimated Excavation Volume	119,400 m^3

3.2.3 BP 3

BP 3 is located in the west of the Proposed Development west of Creag Dubh at the approximate National Grid Reference (NGR) 264209, 728703.

Photo 3: BP3 facing north-east (06/08/2024)

Table D: BP 3

BP 3	
Superficial Geology	Not mapped
Bedrock Geology	Southern Highland Group - Semipelite
Inferred Design Parameters	Overall slope angle 45° Maximum face height 15m
Gradient	Slope increasing steeply towards the east
Details of Extraction	Combination of drilling and blasting
Estimated Excavation Area	8,240 m^2
Estimated Excavation Volume	35,600 m^3

3.2.4 BP 4

BP 4 is located in the west of the Proposed Development along the main access track at the approximate National Grid Reference (NGR) 262838, 726964.

Photo 4: BP4 facing south (06/08/2024)

Table E: BP 4

BP 4	
Superficial Geology	Till and Morainic Deposits – Diamicton, Sand and Gravel
Bedrock Geology	Pitlochry Schist Formation - Psammite and Semipelite
Inferred Design Parameters	Overall slope angle 45° Maximum face height 15m
Gradient	Slope increasing steeply towards the east
Details of Extraction	Combination of drilling and blasting
Estimated Excavation Area	6,905 m^2
Estimated Excavation Volume	24,200 m^3

3.2.5 BP 5

BP 5 is located in the west of the Proposed Development along the main access track at the approximate National Gird Reference (NGR) 262526, 726259.

Photo 5: BP5 facing south (06/08/2024)

Table F: BP 5

BP 5	
Superficial Geology	Till and Morainic Deposits – Diamicton, Sand and Gravel
Bedrock Geology	Pitlochry Schist Formation - Psammite and Semipelite
Inferred Design Parameters	Overall slope angle 45° Maximum face height 15m
Gradient	Slope increasing steeply towards the east
Details of Extraction	Combination of drilling and blasting
Estimated Excavation Area	7,100 m^2
Estimated Excavation Volume	35,000 m^3

3.2.6 BP 6

BP 6 is located in the west of the Proposed Development along the main access track at the approximate National Grid Reference (NGR) 262201, 725416.

Photo 6: BP6 facing south (06/08/2024)

Table G: BP 6

BP 6	
Superficial Geology	Till and Morainic Deposits – Diamicton, Sand and Gravel
Bedrock Geology	Pitlochry Schist Formation - Psammite and Semipelite
Inferred Design Parameters	Overall slope angle 45° Maximum face height 15m
Gradient	Slope increasing steeply towards the east
Details of Extraction	Combination of drilling and blasting
Estimated Excavation Area	9,780 m^2
Estimated Excavation Volume	51,200 m^3

4.0 Proposed BP Design

The indicative BP volumes are presented in Table B to Table G. The design of the BPs anticipates extracting a net stone volume suitable for the requirements of the Proposed Development, excluding imported top surface dressing which would require importing. This target capacity has been determined based on the estimated requirements for construction materials together with additional allowances for overburden material. It is envisaged that overburden/soils together with processed materials would be carefully stored adjacent to the excavation void for eventual use in the restoration process.

4.1 Marking Out and Overburden Stripping

The permitted extents of the BP would be marked out with pegs, and overburden, including topsoil, subsoil and weathered rock horizons, would be stripped from within this delineated area.

The overburden and weathered rock horizons would be stripped using a combination of crawler tractor dozers and backtrackers with the material loaded by loading shovels. The overburden (including surface vegetation turves) would be carefully stripped and stored as a series of separate turves, topsoil, subsoil and weathered rock storage mounds to be used for reinstatement purposes.

4.2 Excavations within Rock

Once overburden and weathered rock horizons have been stripped, and stored, a suitably qualified geotechnical engineer/blasting engineer would assess the nature of the underlying solid rock strata. The engineer would provide advice on suitable extraction techniques including; extraction method, bench and cut face design parameters, and blasting design (if required).

If blasting is required, blasting would be undertaken in accordance with the Quarries Regulations 1999[5] and Annex D PAN 50[6].

A combination of digging, ripping and blasting would be utilised to excavate rock (subject to the nature of the material encountered, depth of weathering and level of fracturing) which would be processed using a mobile crushing and screening plant, which would be sited within the base of the working BP.

4.3 Stockpiling of Materials

The initial overburden strip would be stored within temporary screening mounds around the perimeter of the BP. The screening mounds would be at least 1.5m in height.

The remaining unsuitable materials (weathered/unsuitable rock horizons) would be stockpiled within the base of the working BP. The stockpiles would have a maximum height of 5m, with maximum side-slope gradients of 1(Vertical (V)) in 2.5(Horizontal (H)) and be in full compliance with the Quarries Regulations 1999[5] and Quarries National Joint Advisory Committee (QNJAC) Guidelines[7]. This material would be used as part of the restoration profiling on the cut faces.

[5] Health and Safety Executive (2014), Health and Safety at Quarries, Quarries Regulations 1999, Approved Code of Practice and Guidance (Second Edition).
[6] Scottish Government (2000), PAN 50 Annex D: Controlling the Environmental Effects of Surface Mineral Works.
[7] Quarries National Joint Advisory Committee (2020), Available at: http://qnjac.co.uk/what-is-qnjac/. Last accessed April 2020.

4.4 Access Tracks/Haulage Routes

The proposed access to the BP(s) would involve constructing access tracks from the main wind farm access track. The access tracks would include suitable roadside drainage ditches, with soakaways located, where appropriate.

The tracks (haulage routes) within the BP would have a gradient of no steeper than 1(V) in 10(H).

4.5 Water Management/Drainage

The BP(s) would feature a perimeter surface drain, which would aim to prevent water in-flow into the BP. The water collected within the surface drains would be discharged either into the surrounding vegetation, or into suitably located settlement lagoons.

Where necessary, surface settlement lagoons would be constructed within the BP. These would be constructed with the aim of containing any surface water collection within the excavation voids, and from collection of water from the perimeter surface drains. The lagoons would be contained within a bunded area at the base of the BP, with suitable pumping systems installed allowing water to be pumped to soakaways as required.

4.6 Restoration

Upon completion of extraction at the BP(s), surface profile restoration would be undertaken using the stockpiled overburden materials and other suitable materials excavated on-site (including peat) subject to review by the Environmental Clerk of Works (EnvCoW).

General fill material would be sourced from the stockpiles located within the BP void. These would comprise of materials with unsuitable engineering properties for the Proposed Development construction such as weathered rock and unsuitable/poor quality rock horizons, and unsuitable materials arising from the crusher/blasting operations. This material would be utilised to provide the basis of the restoration profile.

The fill materials would be used as general fill to soften the benched profile of the excavations and provide a gentler sloping gradient than near vertical working face slope designs. The fill materials would also be used to provide a suitable gradient on the BP floor to prevent ponding.

The stripped soils, and subsoil horizons which would be stored within perimeter screening mounds would be utilised as the surface dressing layer in which to provide a suitable medium for seeding and planting as appropriate.

The restoration of the BP sites would not involve importing any material onto the Proposed Development. Only materials arising from the excavations would be utilised as part of the restoration scheme. The base of the BP would re-use existing stockpiled materials/soils generated from the site excavations to create a habitat on the floor of the BP, which would be a maximum of 2 m thick across the floor area and if suitable, some of these soils could be used to ‘dress’ shallower side slopes but not on the steeper faces.

An EnvCoW would be in place, to monitor the restoration and aftercare of the BPs.

4.7 Best Practice Guidance Documents

A number of general pollution prevention measures would be employed to minimise the risks to ground and surface waters during the creation and use of the BPs. Extraction operations would be carried out in accordance with relevant SEPA Guidance for Pollution Prevention[8]

8 SEPA (2019), Guidance for Pollution Prevention (GPPs). Available at https://www.netregs.org.uk/environmental-topics/pollution-prevention-guidelines-ppgs-and-replacement-series/guidance-for-pollution-prevention-gpps-full-list/

and other codes of best practice, to ensure that both ground and surface waters are not contaminated. These would include relevant codes of best practice relevant to the site, including:

- European Commission (EC) Water Framework Directive (2000/60/EC);
- Planning Advice Note (PAN) 50, Controlling the Environmental Effects of Surface Mineral Workings Scottish Government (2000);
- Good Practice on Controlling the Effects of Surface Mineral Working on the Water Environment, Department of the Communities and Local Government and Mineral Industry Research Organisation (2008);
- The Water Environment (Controlled Activities) (Scotland) Regulations 2011;
- Guidance for Pollution Prevention (GPPs) (various dates and references), SEPA; and
- Environmental Good Practice on Site C692, CIRIA (2010).

5.0 Conclusion

In summary, six BP search areas have been assessed as being capable of supplying all the aggregate required for the Proposed Development. The locations and methods of working would be managed to cause minimal impact to the ground conditions and water environment. The BP design and recommended methods of operation are in line with the Quarries Regulations, Approved Code of Practice, 1999 (as amended)[9] to provide a safe working environment and minimise risk of instability.

An approximate volume of excavated materials has been calculated for each of the proposed BP locations within the BP search areas, these volumes are based on initial calculations based on assumptions for the Proposed Development. These calculations would be verified by detailed intrusive investigation at the proposed locations, post-consent. Calculations do not take into consideration the 'winning' of materials along the route. Each of the proposed BPs selected could be increased or decreased in size, depending on the aggregate requirements or following an assessment of the suitability of aggregate materials following detailed ground investigation.

The quality of rock anticipated on-site is inferred from a visual assessment of rock outcrops and published information. An intrusive ground investigation, sampling and material laboratory testing will be required to confirm ground condition and suitability.

Prior to the construction of the Proposed Development, design and best practices, and any required mitigation measures, would be set out in full within a Construction Environmental Management Plan (CEMP) and would be secured by an appropriately worded pre-development condition of consent. An Outline CEMP is provided in **TA 2.1 (EIAR Volume 4).**

[9] Health and Safety Executive (2014), Health and Safety at Quarries, Quarries Regulations 1999, Approved Code of Practice and Guidance (Second Edition).

Figures

Technical Appendix 8.3 Borrow Pit Assessment

Glentarken Wind Farm

SSE Renewables

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Annex A Aggregate Assessment

Technical Appendix 8.3 Borrow Pit Assessment

Glentarken Wind Farm

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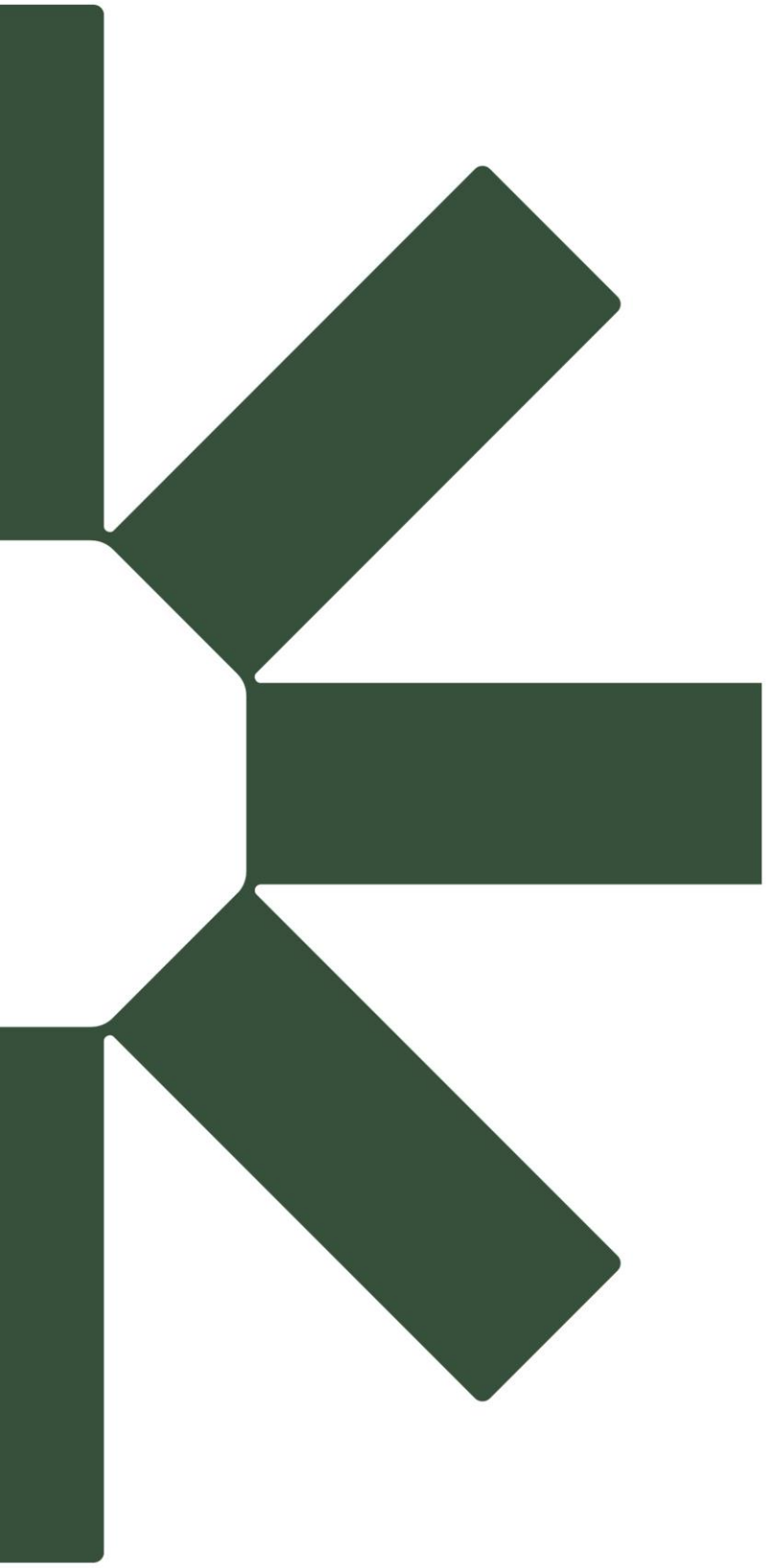
SLR Project No.: 405.065137.00001

Infrastructure	Length (m)	Width (m)	Embankment (m)	Total Width (m)	Area (m2)	Aggregate Thickness (m)	Number	Aggregate Volume (m^3)	Notes:
Excavated Track	11810	7	1	8	94480	0.5	1	47240	Assumes 7m wide track with embankment
Floating Track	2792	7	1.6	8.6	24011	0.8	1	19209	Assumes 7m wide track with embankment
Upgraded Track	972	6	1	7	6804	0.5	1	3402	Assumes 6m wide upgrade with embankment
Track Percentage Uplift for Localised Widening					6265			3493	5% Track Uplift for Localised Widening
Turbine Bases - formation only					620	0.5	12	3719	Assumes 28.1m diameter
Fill above Turbine Bases					1140	3.55	12	38052	Less volume of bases 12*876m^3 = 10,512m^3
WTG Concrete Foundation Aggregate							12	5256	Assumes proportion of aggregate is 0.5 of 1m^3. Volume of 1no. foundation = 876m^3
Permanent Hardstandings					2890	1	12	34680	
Temporary Hardstandings					3558	1	12	42696	
Substation					31250	1	1	31250	
Main Construction Compound					10000	0.8	1	8000	
Access Track Construction Compound					2500	0.8	1	2000	
Laydown Area					15000	0.8	1	12000	
Batching Plant					10000	0.8	1	8000	
Total Requirement								**258997**	All volumes measurements in m^3, based on turbine requirements and information provided by SSE

Potential Volume of Rock to be sourced on site	
BP1	37700
BP2	119400
BP3	35600
BP4	24200
BP5	35000
BP6	51200
Total Volume from Site (m^3)	303100
Surplus Volume (m^3)	44103
plus 10% contingency (m^3)	48514



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