

# Outline Fire Risk Management Plan

## Fairgreen BESS

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Ref	05560-9571670
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### Revision History

Issue	Date	Name	Latest changes
01	25/02/2025	Felix Klenner	Draft for initial consultation
02	18/06/2025	Daniel Rose	Update for planning submission

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# 1 Introduction

This document forms the Fairgreen BESS outline fire risk management plan. The document indicates how the project in the current state of its development addresses fire risk in several ways. It contains key mitigation measures against the risk of fire ignition and propagation within the battery energy storage system (BESS) site.

Fire safety of BESS is governed by regulation and international standards out with the planning system. While this report and its appendices do cover some of those standards, the focus of this report is on the location and design considerations as they are relevant for the planning application.

The local Essex Fire Department are not a statutory consultee for this project, but a draft version of this document was sent to Essex Fire Service for review and feedback. No response has been received from Essex Fire Department. As described in Section 3.2 the Fire Service will continue to be consulted.

Battery technology and associated understanding of fire risk is continually evolving within the industry. As such, this document sets out key principles and mitigation measures based on the current understanding of battery fire risk but does not include a detailed Fire Risk Management Plan. A detailed Fire Risk Management Plan would be developed during detailed design, following battery selection.

## 2 Project Description

### 2.1 General project information

Renewable Energy Systems Ltd (RES) is developing a 150 MW BESS facility near Rayleigh Substation. The BESS will consist of battery storage enclosures (BSEs), power conversion systems (PCSs), transformers, electrical infrastructure, foundations, access track, crane hardstanding, and spares storage containers. The grid connection will be via an onsite 132kV substation.

### 2.2 Battery selection

The proposed battery technology for the development is anticipated to be lithium iron phosphate (LFP). LFP has better thermal stability and enters thermal runaway at higher temperatures compared to some other battery chemistries. This is demonstrated by the UL 9540A test results of RES' preferred battery system which show that, at a unit level following deliberate initiation of thermal runaway:

- No flaming outside the initiating battery rack was observed.
- Surface temperatures of modules within the target battery rack adjacent to the initiating battery rack do not exceed the temperature at which thermally initiated cell venting occurs.
- Wall surface temperature rise does not exceed 97°C above ambient.
- Explosion hazards were not observed during the test.

Data from UL9540A testing can also be used to inform detailed design of the site and safety systems.

Each BSE has an approximate footprint of 6.1 x 2.4m. The exact battery form factor and capacity will be determined during detail design phase and would be documented within the detailed Fire Risk Management Plan.

## 3 Design Factors

### 3.1 RES Internal BESS safety best practice principles

Based on available standards, construction and operation experience, RES has developed internal best practice to manage the safety of battery energy storage systems. A document summary of these principles can be found in Appendix A.

### 3.2 Fire response strategy

It is the intention that the site would be designed not to require emergency response intervention to prevent fire spread or any other significant risks to people or property. Key principles of the NFCC Grid Scale Battery Energy Storage System planning - Guidance for FRS, 2023 (“the NFCC Guidance”) are addressed through the mitigations identified within this report, as these pertain to the fire risk management strategy set out below.

The overarching fire risk management strategy would adopt the following controls:

1. Implement measures that result in a very low risk of fire ignition and an unsuitable environment for sustaining fire.
2. Implement measures that result in a very low risk of fire propagation and spread within a fire source (e.g. BSE).
3. Ensure fire spread between significant elements of the project is not expected, through application of design standards and use of calculations / modelling as necessary.
4. Include adequate provisions to allow the fire service to monitor a fire event, intervening only if there is a failure of the controls above.

Due to the risks associated with lithium-ion fires, transformer fires, and high-power equipment, there are significant safety benefits to minimising fire service intervention and consequential firefighter hazard exposure.

During detailed design, following battery product selection this Outline Fire Risk Management Plan will be developed into a detailed plan, in liaison with the Fire Service and with due consideration of the NFCC Guidance. The detailed Fire Risk Management Plan will include:

- A fire risk appraisal that details how the fire response strategy above will be achieved, including the identification and design of any further mitigations required to achieve the strategy above.
- An emergency response plan.

### 3.3 Mitigation Measures

The following points define the key preliminary design mitigations against the risk of fire ignition and propagation within the BESS site. For a detailed assessment of how the layout meets the recommendations of current NFCC guidance, please refer to Appendix B.

### 3.3.1 Equipment spacing

The site has been developed to include adequate spacing between the battery storage enclosure (BSE) to mitigate against the risk of fire spread in the event of a fire within one BSE. The site layout aligns with applicable NFPA 855 spacing criteria as well as the spacing recommendations outlined in FM Global Property Loss Prevention Datasheet 5-33 (Interim revision January 2024). The layout allows minimum distance of 3m between battery enclosure pairs and any other infrastructure.

### 3.3.2 Protection systems

Each BSE will have a dedicated fire protection system, comprising flammable gas detection and venting, fire detection and alarm, and an automatic fire suppression system. Additionally, key battery health and environment parameters will be continuously monitored with alarms sent to a control centre. Automatic electrical disconnection will be enacted by the battery management system should operational temperature, current or voltage limits be breached. There will be levels of alarms prior to protection limits which warn the operator of proximity to safe operating limits. BSEs will be fitted with deflagration venting and explosion protection appropriate to the hazard.

### 3.3.3 Access to battery storage enclosure

All BSEs will be accessed via external doors only, i.e. no internal corridor to eliminate the risk of people being inside an enclosure during a fire or thermal runaway gas venting incident.

### 3.3.4 Location of BESS facility

The location of the facility has been selected considering the distances from existing nearby premises. There are no residential properties nearby BESS units, with the nearest one more than 200m in distance. A distance of at least 6.1m is achieved between BSEs and the site boundary, in line with NFPA 855 (2023), and there are no existing or planned bushes or trees within 10m of any BSE.

### 3.3.5 Access for emergency services

The primary fire service access route to site will be taken via the primary site entrance to the northeast. A secondary fire service access route will be achievable from the west. The wider strategy for site access is detailed fully in the Fairgreen BESS Transport Statement.

The proposed design provides access into the BESS compound from opposing east and west directions. Compound access options in opposing directions mitigates the risk of smoke and wind direction preventing access to the compound during a BSE fire.

A wind frequency rose sourced from <https://globalwindatlas.info/> website indicates that the prevailing wind direction for the area is from the southwest. Given the relative distances between the proposed BESS compound and the site entrances, as well as the prevailing wind direction, it is assessed as unlikely that both site access points will simultaneously experience obscuration due to adverse conditions at the same time. The wind rose is also shown in Appendix C.

Turning locations for emergency response vehicles are available within the site hardstandings and at the main entrance gates.

The proposed access tracks geometry has been designed to facilitate fire response vehicle access, with a minimum width of 4m, incorporating wider sections at bends. The tracks will be designed and constructed to provide a minimum carrying capacity of 12.5t per axle.

Flood maps for planning shows that flooding is not expected within the BESS compound. The access tracks are subject to flooding in an isolated area. For more detail on the type of flooding and associated flood depths see the Flood Risk Assessment & Surface Water Drainage Strategy. The risk of simultaneous impassable flooding of this track occurring at the same time as a fire event is considered sufficiently low to be tolerated.

### 3.3.6 Water Supply

It is intended that an onsite water supply would not be required to achieve the fire response strategy outlined in 3.2. However, if agreed as necessary in development of the Fire Risk Management Plan, a supply of 1,900 litres per minute for at least 2 hours in line with the NFCC Guidance could be achieved through provision of a piped hydrant or a tank at an accessible location located at minimum of 10m from the nearest battery storage enclosure.

## 4 Operational Factors

As well as mitigations to make the site inherently safer by design and the inclusion of active and passive controls, operational mitigations will be implemented to manage fire risk. This section states the operational factors which will be addressed in the detailed Fire Risk Management Plan.

### 4.1 Emergency Response Plan

The Emergency Response Plan will be developed in line with the detailed Fire Risk Management Plan. It will outline how the operator will respond to incident and accident scenarios on site including clear guidance for first responder organisations.

### 4.2 Hazard Identification and Mitigation Analysis

During detailed design, project and equipment specific hazards will be identified, this will include a Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) assessment. Actions taken to mitigate those hazards will also be identified and residual risks will be communicated as part of the emergency response plan.

### 4.3 Hazardous Material

Any hazardous materials stored at the BESS facility will be fully justified and detailed in the emergency response plan. This will detail the location, description, quantity and appropriate precautions.

### 4.4 Safety Management Structure

The BESS safety management structure is yet to be fully defined but will include a formal top-down management structure that has the authority and responsibility to make decisions in design, procurement, construction and operation that places safety and environmental risk at forefront.

### 4.5 Staff Competence

The detailed Fire Risk Management Plan will ensure that all personnel who have responsibility for safety or activities which could impact the surrounding environment are competent to discharge those responsibilities.



## 5 Conclusion

During the preliminary design, efforts have been made to mitigate fire hazards on site by incorporating specific design factors as described in this Outline Fire Risk Management Plan.

During detailed design and following battery product selection, a detailed Fire Risk Management Plan will be developed. This will include a project specific fire risk appraisal, which will be used to verify and finalise the strategy presented in this document, and an emergency response plan, which will be developed through liaison with the local fire service.



## Appendix A RES BESS safety best practice principles

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# RES BESS safety best practice principles

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Author	Geoff Elston
Date	16/12/2024
Ref	ENG01-9033728

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Revision History

Issue	Date	Name	Latest changes
01	06 December 2024	Geoff Elston	First created
02	12 December 2024	Geoff Elston	Correction to title block date quick part

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# 1 Introduction

This document sets out RES internal best practice for risk mitigation in BESS design.

Based on available standards, construction and operation experience, RES has developed internal best practice to manage the safety of battery energy storage systems.

It is important to be aware of hazards general to the power industry *and* specific to battery energy storage systems.

The key hazards for battery storage projects are:

- Thermal runaway - caused by mechanical or electrical abuse, or internal faults such as lithium plating of cells, resulting in spontaneous internal short circuits.
- High DC fault currents - Short circuit currents from banks of batteries can be in the range of 100kA – 150kA or more.
- Live working - The source of charge of a battery can never be completely isolated.

It is equally important to understand that these inherent hazards can all be controlled through appropriate design and operation procedures and RES is actively collaborating with both BSI/IEC and EPRI in the development of standards and best practice guidance.

## 2 Hazard mitigation analysis, risk mitigation & layers of protection

During detailed design RES projects undergo Hazard Mitigation Analysis (HMA), like Failure Mode and Effects Analysis or HazID, HazOP and LOPA) to identify hazards, and improve design to reduce risk.

### 2.1 Substitution

Lithium-ion batteries have a number of different potential chemical make ups – some of which are listed below:

- NMC – lithium nickel manganese cobalt
- NCA – lithium nickel cobalt aluminium
- LFP – lithium iron phosphate
- LMO – Lithium manganese spinel
- LTO – lithium titanate

Each chemistry has different effects on characteristics of the cell like cost, energy density, cycling life, thermal stability and specific power. NMC and LFP are the most common chemistries for stationary energy storage and while both have intrinsic hazards it is easier to make LFP cells safer as:

- They have greater thermal stability, going into thermal runaway at higher temperatures
- Produce less oxygen during electrolyte breakdown, reducing the risk of combustion

Following the hierarchy of control RES substitutes less thermally stable li-ion chemistries like NMC, for the more thermally stable LFP

### 2.2 Engineering controls

Design methods to address these hazards identified by the HMA can include:

- Protection and control layers through the system, rack and module Battery Management Systems and rack level contactors and fusing.
- Coordination of DC protection between the batteries and PCS including appropriate insulation monitoring and arc-flash assessment
- Ingress Protection rating to match the local installation environment
- Site design to mitigate any external hazards (i.e. vehicle collision, lightning strike, rodent damage)
- NFPA 855 and IEC 62933 safety design standards in conjunction with UL9540A test methods and results should be followed to design storage systems to mitigate effects of fire and explosion.
- Explosion prevention and control (such as active deflagration prevention control or passive deflagration venting), used as an additional measure to mitigate effects of explosive atmospheres in battery containers.

The design of RES' BESS adopt the following layers of protection against failure as standard, to reduce the risk of hazards impacting people and environment:

- Module level monitoring of voltage and temperature via a local battery management system (BMS).
- A secondary BMS at the rack/string level to monitor module operation and allow automatic disconnection of electrical contacts.
- Monitoring of battery storage enclosure environment and/or cell temperature ensuring system stability using RES' proprietary Energy Management System, RESolve.
- A flammable gas detection system capable of warning of an explosive atmosphere present in the system and activating forced ventilation.

In the event these layers of protection fail, fire suppression can reduce the impact of those failures. Design should be informed by Fire Risk Assessment and can include:

- A fire detection system equipped with smoke and heat detectors able to rapidly alert system operators.
- A fire suppression system capable of mitigating fires in the unit not caused by thermal run-away (note: oxygen is not required for thermal run-away to propagate)
- A system to allow application of water in the event of a thermal run-away event to help absorb the heat generated, such as dry type sprinkler systems. Though there are risks associated with fire service intervention in a fire due to the chemicals produced and water may be best used to further reduce the risk of propagation outside of the initiating enclosure.
- Deflagration venting in the form of blast panels to mitigate the effects of an explosion should an explosive atmosphere form.

All of the above conform with NFPA 855 and IEC 62933 safety design standards informed by UL9540A test data to ensure the site is designed appropriately to mitigate effects of fire.

## 2.3 Administrative controls

It is important to have robust operating procedures and to engage with the local emergency services to ensure that they are aware of the hazards, and the protection and control features of the BESS. RES projects development includes:

- Ensuring appropriate signage as per NFPA 855, which includes but is not limited to:
  - Energy storage system identification sign, including type of technology, any special hazards, emergency contact information and suppression system type installed.
  - Location of all electrical power disconnectors.
- Hosting regular site visits by local emergency services to familiarise themselves with the installation.
- A premises information box positioned at a safe distance from the energy storage location and should contain the following information:

- Plans of the site.
  - Description of the site and buildings.
  - Information regarding the use of the site and significant risks.
  - Details of key personnel and emergency contact details.
  - Evacuation strategy within the local area.
  - Construction and layout including emergency access points and isolation systems.
  - Details of fire safety systems, alarms and suppression systems.
- An Emergency Response Plan developed with the local Emergency Responders including clear instruction that Emergency responders should not enter or open containers once alight.

## Appendix B NFCC Recommendations Cross-Referenced to the BESS Layout and Design

Item	NFCC 2022 BESS Guidance Recommendation	Design factors / mitigations	Impact of Draft 2024 NFCC BESS Guidance
1	Access - Minimum of two separate access points to the site	<p>The proposed design provides access into the BESS compound from opposing east and west directions. Compound access options in opposing directions mitigates the risk of smoke and wind direction preventing access to the compound during a BSE fire.</p> <p>A wind frequency rose is presented in Appendix C, indicates that the prevailing wind direction for the area is from the southwest. Given the relative distances between the proposed BESS compound and the site access points, as well as the prevailing wind direction, it is unlikely that both site access points would simultaneously experience obscuration due to adverse conditions at the same time.</p>	No change
2	Roads/hard standing capable of accommodating fire service vehicles in all weather conditions. As such there should be not extreme grades.	The proposed access track and BESS internal compound access corridor geometry have been designed to facilitate fire response vehicle access, with a minimum width of 4m, incorporating wider sections at bends. The tracks will be designed and constructed to provide a minimum carrying capacity of 12.5t per axle.	No change



3	<p>A perimeter road with passing place suitable for service vehicles</p> <p>Access tracks and BESS internal compound corridors must enable unobstructed access to all areas of the facility</p>	<p>The BESS internal compound allows circular routes within the compound and between electrical equipment, allowing access to all BESS units as indicated in Appendix C. There is adequate space within the BESS compound for vehicles to pass.</p> <p>The site meets requirements of Building Regulations Approved Document B Vol 2 allowing all points within BESS compound to be within 45m of a fire appliance when required.</p>	No change
4	<p>Turning circles, passing places etc. size to be advised by FRS depending on fleet</p>	<p>The BESS internal compound corridors allow access to all BESS units (see Appendix C) in two different directions and allow for FRS vehicles to drive in and drive out with minimal reversing.</p> <p>In case that the FRS need to manoeuvre, the layout has allowed several turning points, which achieve the minimum width and bend radius outlined in Building Regulations Approved Document B Vol 2 Table 15.2.</p>	No change
5	<p>Distances from BESS units to occupied buildings and site boundaries.</p>	<p>There are no premises within 25m of BESS units, the nearest residential property is more than 200m from any BESS unit.</p> <p>The site boundary is minimum 30m distance from BESS units.</p>	Guidance increases initial min distance to boundary to 30m - layout remains compliant with the site boundary a minimum of 30m from the BESS units.
6	<p>Access between BESS units - minimum of 6.0m suggested.</p>	<p>The suggested 6.0m separation is based on a 2017 Issue of the FM Global Loss and Prevention Datasheet 5-33 (footnote 9 in the NFCC Guidance). This Datasheet has been revised in July 2023 and again in Jan 2024 and it now details that for containerized LIB-ESS comprised of Lithium iron phosphate (LFP) cells, provide aisle separation of at least 5ft (1.5m) on sides that</p>	Recommended spacing distance of 6.0m removed from guidance. New spacing recommendation is reduced to approx. 1m assuming that the BESS will be fire certified to UL9540A or equivalent. BESS units are not to be vertically stacked.

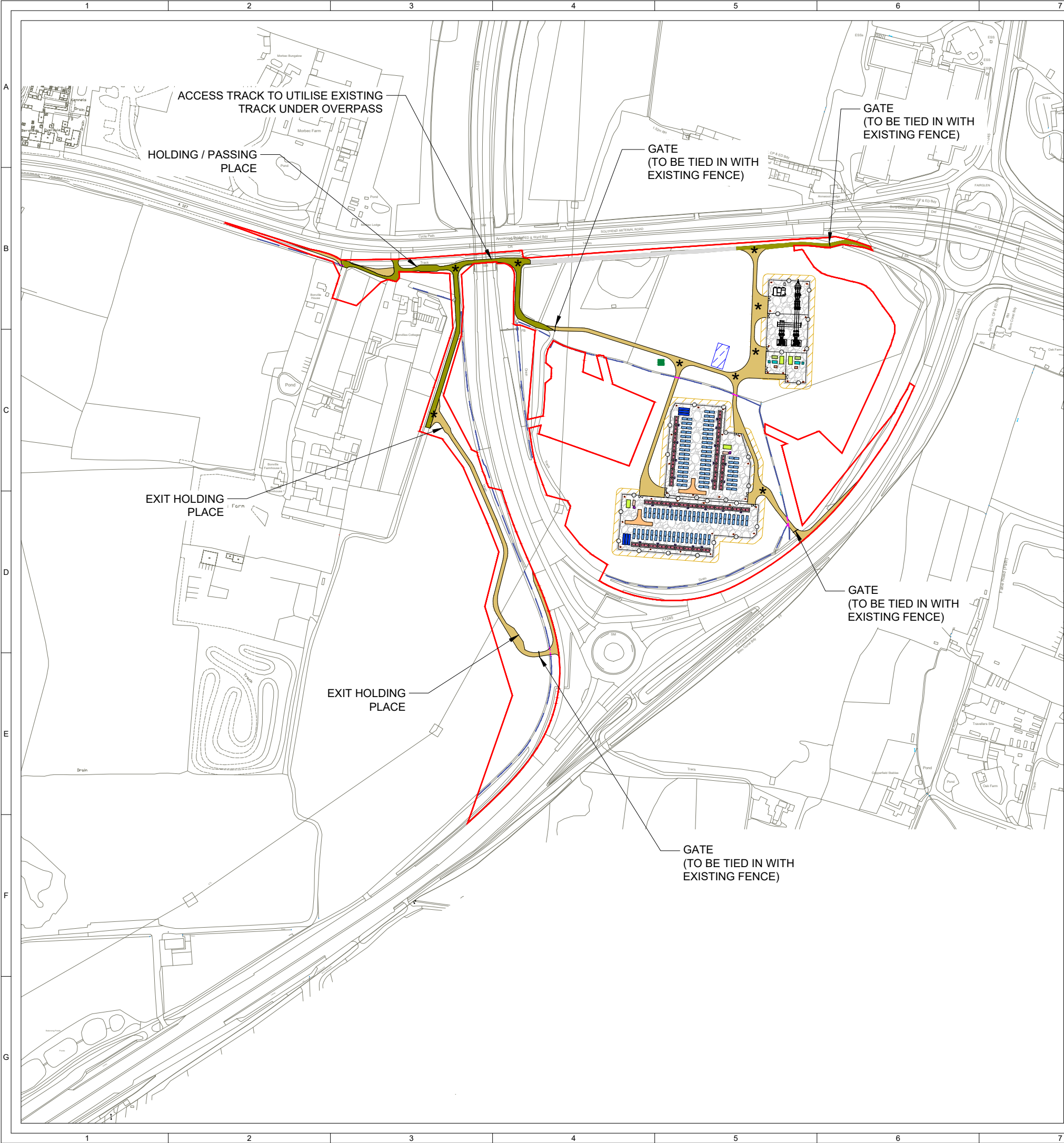
		<p>contain access panels, doors, or deflagration vents.</p> <p>The current site layout has been developed to include adequate spacing between the battery storage enclosure (BSE) (3m when side to side - 0.3m when end to end) to mitigate against the risk of fire spread in the event of a fire within one BSE. The layout allows minimum distance of 3m between battery enclosures and any other infrastructure.</p>	<p><b>Response:</b> Current spacing in excess of new minimum value. The current site layout does not allow for vertical stacked BESS.</p> <p>No impact from change in guidance.</p>
7	Areas within 10m of BESS units to be cleared of combustible vegetation	There is no existing or proposed vegetation within 10m of BESS units.	No change
8	Water supply	<p>It is intended that an onsite water supply would not be required to achieve the fire response strategy outlined in 3.1. However, if agreed as necessary in development of the Fire Risk Management Plan, a supply of 1,900 litres per minute for at least 2 hours in line with the NFCC Guidance could potentially be achieved through an existing water supply located adjacent to the site. While an existing hydrant or a proposed piped hydrant solution is considered a suitable option, further assessment would be needed to confirm if the required water supply could be achieved through this approach. Should the assessment determine that these solutions would not be viable, provision has been made for potential water tank locations, as indicated in Appendix C.</p>	<p>Guidance water supply recommendation has a reduced requirement of 25 l/s (1500 l/m).</p> <p>No impact from change in guidance.</p>



			<table><tr><td>4 Bonville Farm Cottage</td><td>West</td></tr><tr><td>Annwood Lodge</td><td>North</td></tr><tr><td>Oak Farm</td><td>East</td></tr><tr><td>Janda Field</td><td>Southeast</td></tr><tr><td>Copperfield Stables</td><td>Southeast</td></tr><tr><td>Bonvilles Farm</td><td>West</td></tr></table> <p>2. Guidance recommends wind rose to be included showing north and prevailing wind direction.</p> <p><b>Response:</b> A wind rose is shown with the site layout and north direction at Appendix C.</p> <p>No impact from change in guidance</p>	4 Bonville Farm Cottage	West	Annwood Lodge	North	Oak Farm	East	Janda Field	Southeast	Copperfield Stables	Southeast	Bonvilles Farm	West
4 Bonville Farm Cottage	West														
Annwood Lodge	North														
Oak Farm	East														
Janda Field	Southeast														
Copperfield Stables	Southeast														
Bonvilles Farm	West														
11	Environmental Impacts	Should it be agreed that there is a need for use of firefighting water in a manner that risks mobilising combustion contaminants be agreed, the drainage design may be modified to capture and attenuate fire water for later testing and offsite disposal as necessary.	<p>1. Suitable environmental protection measures should be provided. This should include systems for containing and managing water runoff.</p> <p><b>Response:</b> As noted for current guidance, the drainage scheme may optionally be modified to attenuate firefighting runoff.</p> <p>2. Sites located in flood zones should have details of flood protection or mitigation measures. A Flood Risk</p>												

			<p>Assessment &amp; Surface Water Drainage Strategy has been submitted as part of the planning application.</p> <p>Response: The BESS compound does not sit within flood risk areas. Although a small area of flooding has been identified along the access track, the likelihood of a flood event and a fire event occurring simultaneously is very low. No impact from change in guidance.</p>
12	System design, construction, testing and decommissioning	Testing and decommissioning information will only be available at detailed design stage.	No change
13	Deflagration Prevention and venting	Details will be available at detailed design stage, but equipment will be in line with NFPA855 which includes requirements for explosion prevention and venting.	No change

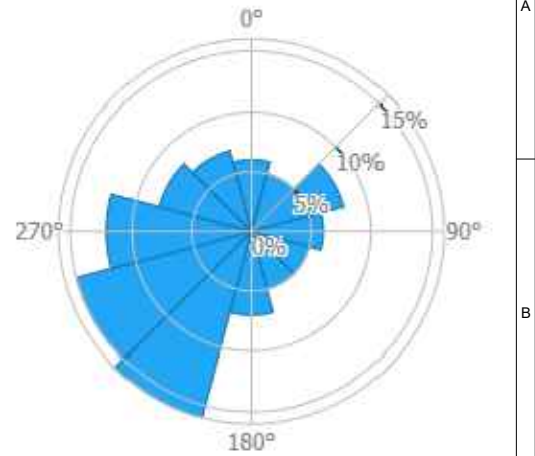
## Appendix C Outline Fire Risk Management Layout



- KEY:
- DEVELOPMENT BOUNDARY (OUTSIDE OF LINE DENOTES BOUNDARY)
  - PALISADE, WELDMESH OR ACOUSTIC FENCE
  - BATTERY STORAGE ENCLOSURE (BSE)
  - POWER CONVERSION SYSTEM (PCS) WITH SINGLE MV SKID AND APRON SLAB
  - BESS SUBSTATION BUILDING
  - AUXILIARY TRANSFORMER
  - LV SWITCHGEAR ROOM
  - AGGREGATION PANEL WITH LV PILLAR
  - PRE-INSERTION RESISTOR
  - CAPACITOR BANK
  - HARMONIC FILTER AND RESISTOR
  - SPARES CONTAINER
  - LIGHTING / CCTV COLUMN
  - ACCESS TRACK
  - EXISTING ACCESS TRACK
  - EXISTING ACCESS TRACK TO BE UPGRADED
  - ALLOWANCE FOR EARTHWORKS (6m)
  - GRAVEL OR ASPHALT FINISH TO SUIT DETAILED EARTHING DESIGN
  - EXISTING DRAINAGE INFRASTRUCTURE
  - WATER CHANNEL CROSSING CULVERT
  - ALLOWANCE FOR FIRE WATER TANK
  - MUSTER POINT
  - POTENTIAL TURNING POINT ON ROAD
  - POTENTIAL VEHICLE TURNING HEAD

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SITE WIND FREQUENCY ROSE



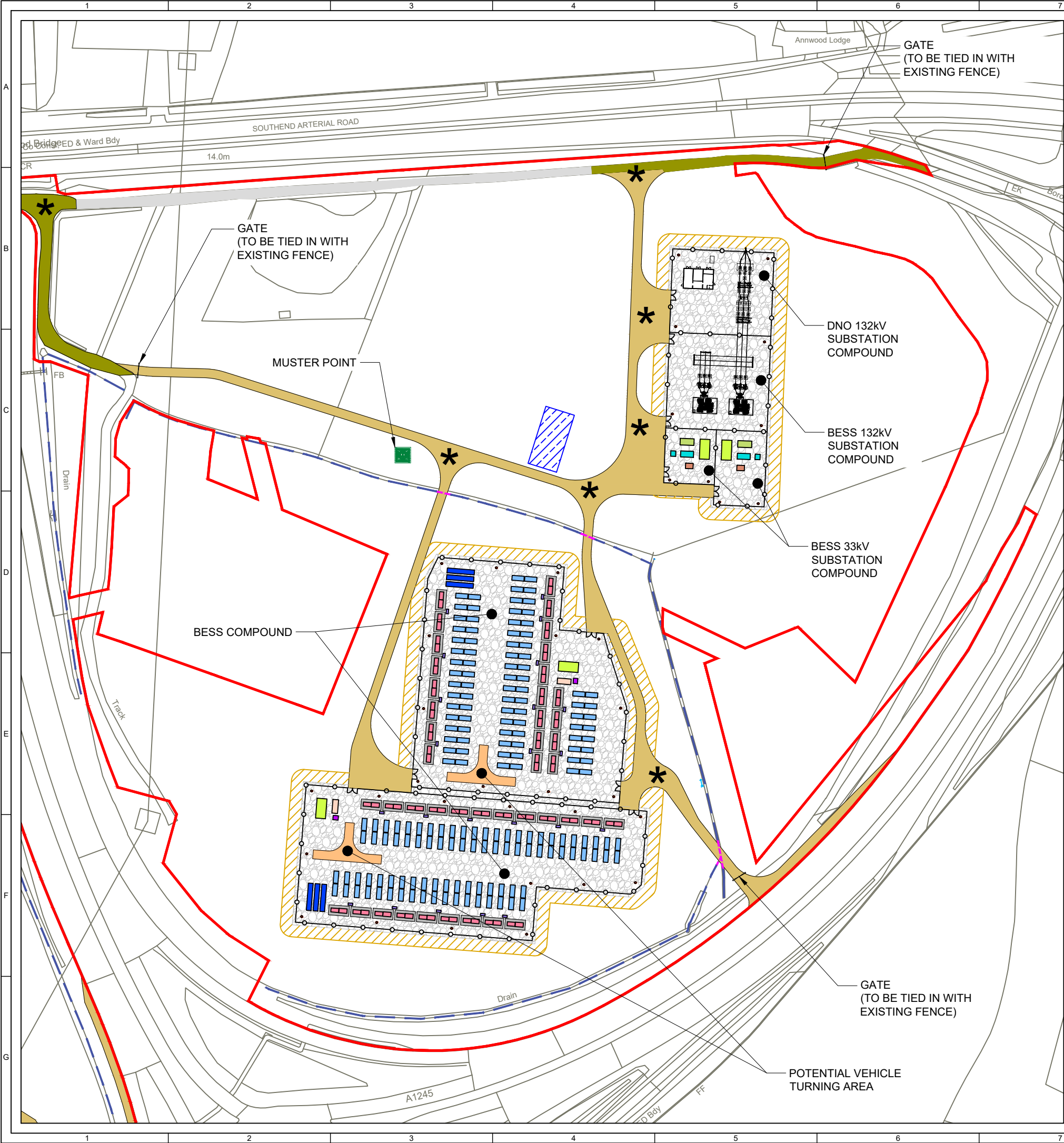
- NOTES:
- DRAWING TO BE READ IN CONJUNCTION WITH REF. [1].
  - EQUIPMENT DETAILS AND CONFIGURATION WITHIN THE ENERGY STORAGE COMPOUND ARE INDICATIVE AND SUBJECT TO DETAILED DESIGN.
  - THIS DRAWING DEFINES OUTLINE FIRE RISK MANAGEMENT INFORMATION FOR THE SITE AND SHALL BE DEVELOPED AS APPROPRIATE ALONGSIDE THE PROJECT DETAILED FIRE RISK MANAGEMENT PLAN.

- REFERENCES:
- [1] INFRASTRUCTURE LAYOUT - 05560-RES-LAY-DR-PT-001

OVERALL  
SHEET 1 OF 2

1	BM	WM	CH	2025-06-13	FIRST ISSUE
ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
PURPOSE				COORDINATES	
PLANNING				OSGB 1936	
SCALE		1:5,000		@A3	DATUM
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PROJECT TITLE					
FAIRGREEN STORAGE					
DRAWING TITLE					
OUTLINE FIRE RISK MANAGEMENT LAYOUT					
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- KEY:
- DEVELOPMENT BOUNDARY (OUTSIDE OF LINE DENOTES BOUNDARY)
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  - LV SWITCHGEAR ROOM
  - AGGREGATION PANEL WITH LV PILLAR
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SITE WIND FREQUENCY ROSE

NOTES:

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REFERENCES:

[1] INFRASTRUCTURE LAYOUT - 05560-RES-LAY-DR-PT-001

**BESS SITE**  
SHEET 2 OF 2

1	BM	WM	CH	2025-06-13	FIRST ISSUE
ISSUE	DRAWN	CHKD	APPD	DATE	REVISION NOTES
PURPOSE					COORDINATES
PLANNING					OSGB 1936
SCALE					DATUM
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DRAWING TITLE					
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