Liverpool Health & Academic Precinct

Infrastructure Management Plan – Electrical & ICT

IA180300-MW-EE-RPT-0001. | D

03rd March 2020

Health Infrastructure

Client Reference

Project Name

Project No:	IA180300
Document Title:	Infrastructure Management Plan – Electrical & ICT
Document No.:	IA180300-MW-EE-RPT-0001
Revision:	D
Document Status:	Final Issue
Date:	03rd March 2020
Client Name:	Health Infrastructure
Client No:	Client Reference
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File Name:	IA180300

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Document history and status

Revision	Date	Description	Author	Checked	Reviewed	Approved
A	21/01/2020	For Review	FC	JH	FC	CS
B	05/02/2020	Final Review	JH	FC	FC	CS
C	12/02/2020	Final Review	FC	JH	JH	CS
D	03/03/2020	Final Issue	FC	JH	JH	CS

Contents

1. Executive Summary

The Liverpool Health and Academic Precinct development is a large-scale project with an approximate floor area of 60,000m2 for Stage 1 and 2, this will require a substantial additional electrical load to supply the development. As part of the Main Works a new high voltage (HV) ring main will be established from the two metering/switching cubicles owned and operated by Endeavour Energy.

- HV metering/switching cubicle No.1 in the south west corner of the hospital campus in the new landscaped forecourt off Goulburn Street

- HV metering/switching cubicle No.2 in the northern end of the hospital campus close to the intersection of Campbell Street and Forbes Street

These two separate HV metering/switching cubicles will be established for each stage of the development (Stage 1 and Stage 2) (as part of the civil infrastructure works) which will split the western site into two zones north and south. These HV metering/switching cubicles will be the demarcation point between Endeavour Energy owned assets and the Hospitals assets. Liverpool Hospital is a high voltage customer which means they own and maintain all the HV network on the site down stream of each HV metering/switching cubicles. All substations and HV cabling from the HV meter/switching cubicle is owned, operated and maintained by the Hospital.

As part of the Main Works two new Hospital owned substations shall be established, one for each stage.

- Stage 1 Substation consisting of 4x transformers (1500kVA each)

- Stage 2 Substation consisting of 2x transformers (1500kVA each)

A new ring main supply shall reticulate from the southern HV metering point to the Stage 1 Substation and a new ring main supply shall also reticulate from the northern HV metering point to the Stage 2 Substation.

Adjacent to each of the two new substations shall be a new low voltage Main Switch Room which shall reticulate all low voltage sub-mains for each building's electrical supplies (Stage 1 and Stage 2 buildings). Each Main Switch room shall be backed up by stand by diesel generators located at the roof level.

The Telecommunications infrastructure shall consist of a new "Lead In" Service Carrier connections installed for the Stage 2 Campus Distributor No2 which is located on level 6. This will provide for the secondary communications for the supply to the hospital which will support and back up the primary lead in supply already provided under the Infrastructure works contract (which terminates into the new Campus Distributor No1 ("special comms room") on the ground floor of the Clinical Services Building east)

2. Electrical – Infrastructure

The Main works scope has been broken up into two construction Stages 1 and 2. Stage 1 is the building to the south which shall be constructed first and Stage 2 is the expansion of this building to the north.

2.1 Stage 1 Construction

The Endeavour Energy HV metering point and switching cubical No 1 will be located on hospital ground towards the southern end of Goulburn Street within the landscaped forecourt to the hospital (refer to Fig 1 below).

From this HV metering and switching point two HV (11kV) cables will be installed to form an internal hospital owned ring main to the Hospital owned Stage 1 substation which shall be located on Level 4 at roof plant room level. These cables will connect into 2 x separate substation rooms (on level 4) each room shall house 2 x 1500kVA dry type/cast resin 11kV/415volt transformers.

Please note that it is an Endeavour Energy requirement that a maximum of two transformers can be housed in the same room and they are stipulating this to this project even though we are a HV customer and the hospital own and maintain all the internal HV plant and equipment after the HV metering and switching cubical.

Therefore, the total installed capacity of this substation shall be 6000kVA (4 x 1500kVA) at the completion of both Stage 1 and Stage 2 construction. However, this electrical capacity will not be required at the completion of Stage 1 (due to the reduced load relating to the overall mechanical services) and therefore only 3 x 1500kVA transformers will be installed for Stage 1. The forth 1500kVA transformer will be installed during the Stage 2 construction (when the mechanical load increases).

Each transformer will connect directly into a dedicated Main LV Switchboard for the required LV distribution around Stage 1. These LV main switchboards are also located in their own dedicated main switch room on Level 4.

Two standby diesel generators will also be located on Level 4 of Stage 1 in their own dedicated room which will interconnect with the above main switchboards via five automatic transfer switches (ATSs) to provide the required essential power supplies in the event of a power failure from Endeavour Energy.

These standby diesel generator sets will back up the power supply to the following: -

- All ICT Communications rooms within the building which will also be complete with UPS supplies
- Essential mechanical loads
- Fire and Life safety plant and equipment including all lifts
- Lighting and Power loads in accordance the NSW Health Engineering Guidelines

A single bulk fuel storage tank will be sized for the standby diesel generator sets located in Stage 1 as well as those to be installed in the later Stage 2 construction, so there will only be one filling point for the redevelopment. The onsite bulk diesel storage tank will be of sufficient size to provide for all Stage 1 and Stage 2 generator sets to operate at full load for a minimum of 24 hours. This bulk fuel storage tank will be located underground with a suitable fill point at ground level below the landscaped entry area off Goulburn Street.

In addition to the permanent diesel generator, the Stage 1 construction will be complete with a mobile generator connection facility to each main LV switchboard to provide additional security/redundancy to the electrical network in the event of a total diesel generator failure of the fixed permanent system.

Refer to Clause 2.3 for the HV single line diagram.

2.2 Stage 2 Construction

The second Endeavour Energy HV metering and switching cubical No 2 will be located on the hospital grounds at the northern end of the redevelopment close to the intersection of Campbell Street and Forbes Street (refer to Fig 1 below).

From this second HV metering and switching point two HV (11kV) cables will be installed to form an internal hospital owned ring main to the Hospital owned Stage 2 substation which shall be located on Level 1. These cables will connect into 2 x substation room (on level 1) and will house 2 x 1500kVA dry type/cast resin 11kV/415volt transformers.

Therefore, the total installed capacity of this substation shall be 3000kVA (2 x 1500kVA) at the completion of both Stage 2 construction.

Each transformer will connect directly into a dedicated Main LV Switchboard for the required LV distribution around Stage 2. These LV main switchboards are located in their own dedicated main switch room on Level 2 (directly above the footprint of the Level 1 substation).

Two standby diesel generators are also required for Stage 2 and these will be located on Level 6 in their own dedicated room at roof plant room level, which will interconnect with the above main switchboards on level 2 via three automatic transfer switches (ATSs) to provide the required essential power supplies in the event of a power failure from Endeavour Energy.

The single bulk fuel storage tank (previously installed for Stage 2) will be used and connected to supply fuel for these two standby diesel generator sets

In addition to the permanent diesel generator, the Stage 2 construction will be complete with a mobile generator connection facility to each main LV switchboard to provide additional security/redundancy to the electrical network in the event of a total diesel generator failure of the fixed permanent system.

Refer to Clause 2.3 for the HV single line diagram

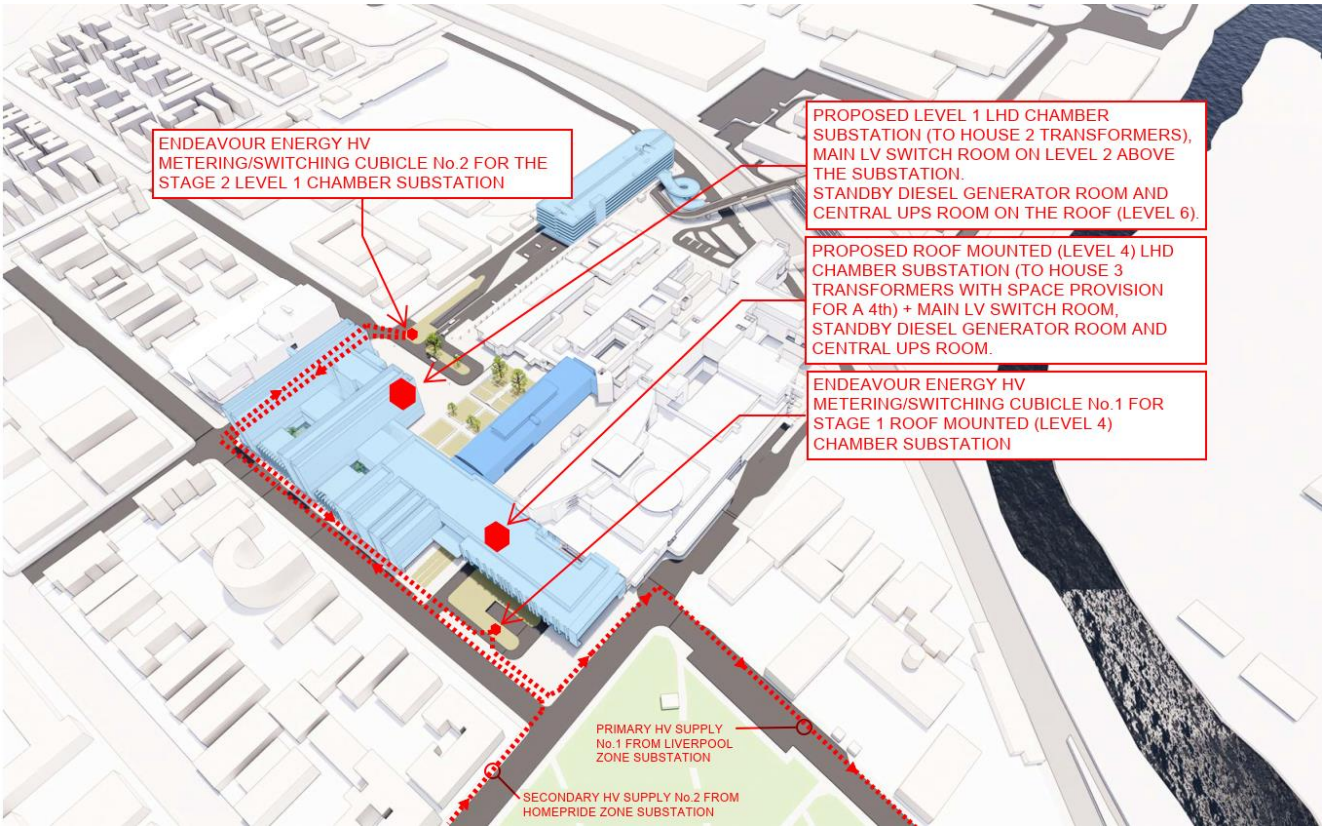

Fig 1 Site Power layout

2.3 HV Single Line Diagram for both Stage 1 and Stage 2

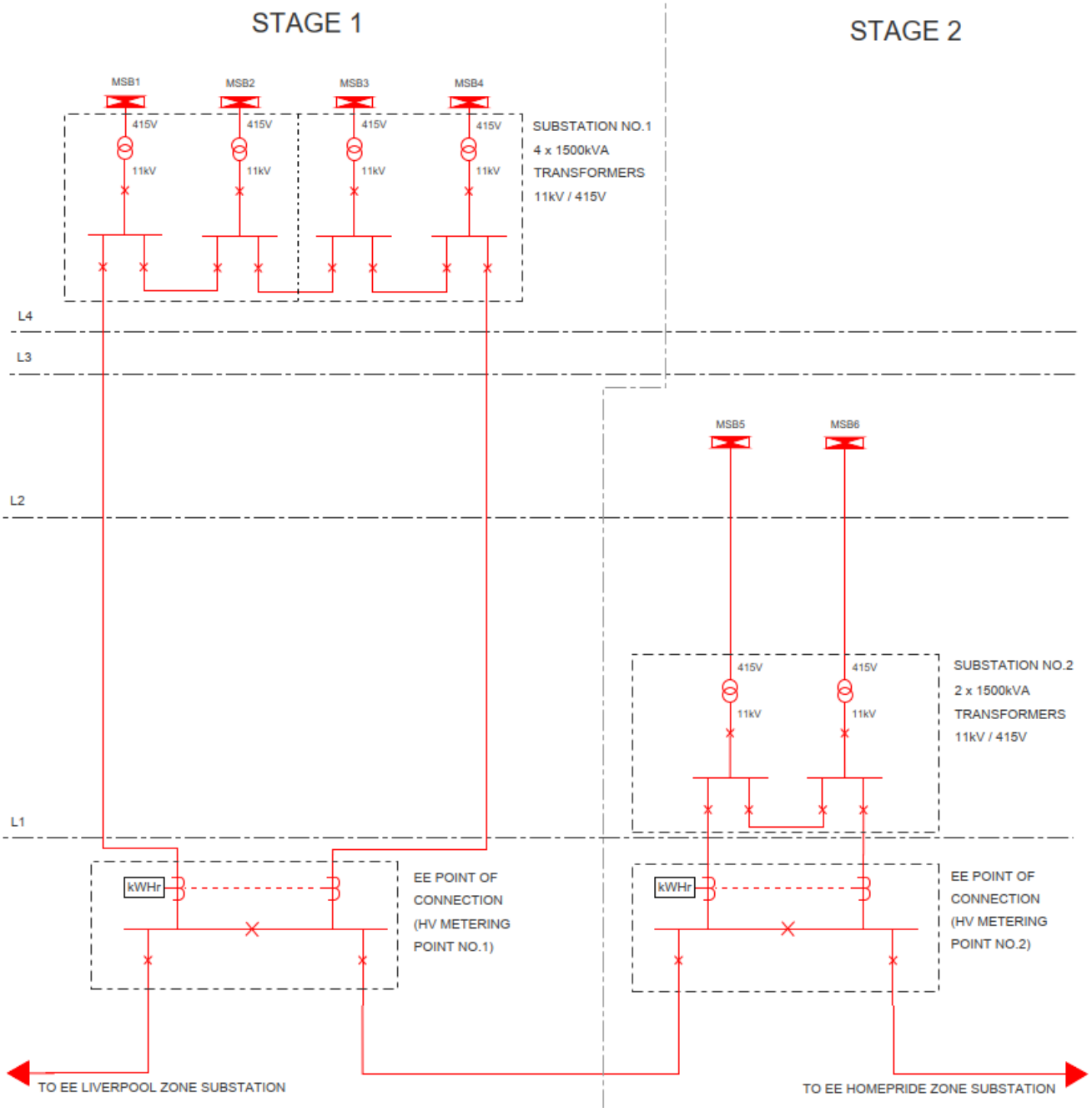

Fig 2 HV single line diagram

2.4 Supply Authority (Endeavour Energy) consultation:

As part of the Civil Infrastructure Works we have coordinated the existing and proposed site electrical loads with Endeavour Energy (EE) to ascertain where the new electrical load will be supplied from. Jacobs HV level 3 team has lodged a "Technical Enquiry" with Endeavour Energy and received advise on the current arrangement to connect two new feeders one from Liverpool Zone substation and the other from Homepride zone substation as shown in the figure below (as provided by Endeavour Energy). Jacobs Level 3 design team are currently working with the Civil infrastructure Works contractor to complete the "Method of supply offer" and acquire the design information package from EE which will then be used to complete the Level 3 Designs for EE approval. This work will all form part of the Civil Infrastructure Works being carried out prior to the Main Works.

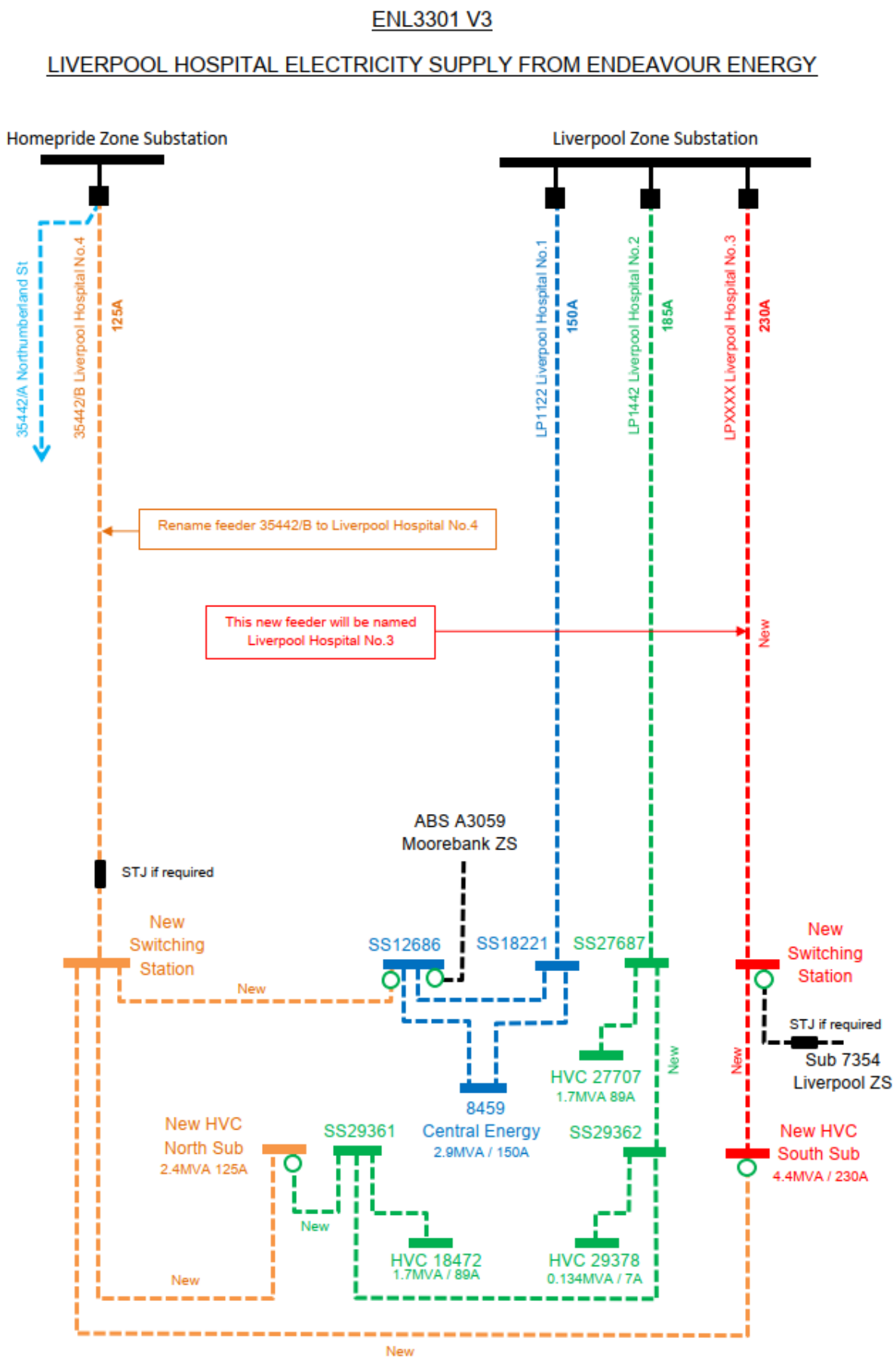

Fig 3 HV external reticulation to the site single line diagram (supplied by Endeavour Energy)

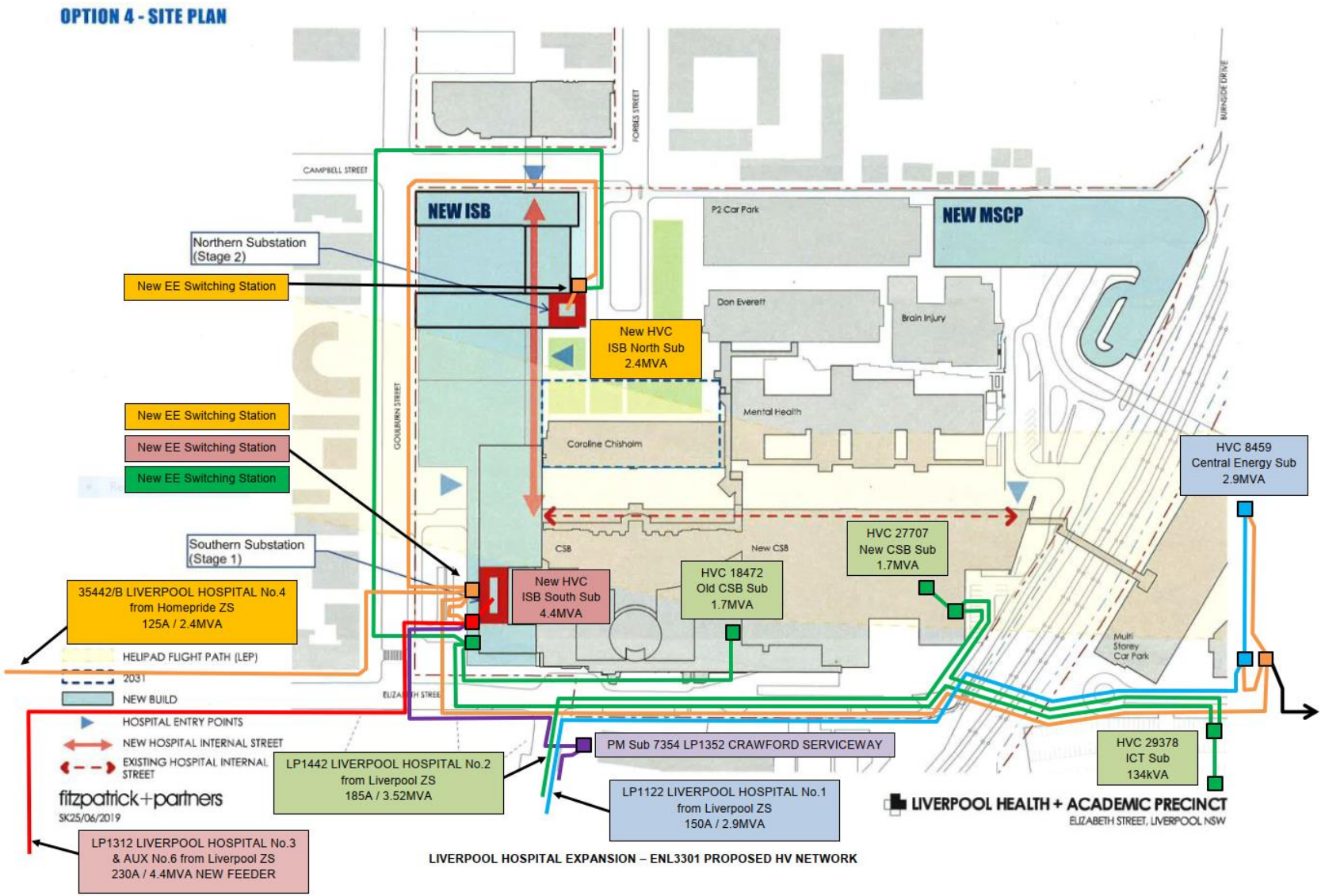

Fig 4 HV network reticulation to the Liverpool Hospital site (supplied by Endeavour Energy)

3. Electrical – Telecommunications Reticulation/Infrastructure

3.1 Stage 1 Construction

The Stage 1 construction does not require any new incoming cable connections from the telecommunications service providers (Telstra, Optus, E-Health, NBN) as this has already been provided during the pre Stage 1 work (known as the "Infrastructure Works").

Stage 1backbone cabling will connect to the existing Campus distributor No 1 which was established in the Infrastructure Works scope of works, which is located on the Ground floor of the existing Clinical Services building (East).

To provide the required redundancy for the Stage 1 work and prior to the Stage 2 work being completed, redundant backbone pathways will be connected back to the existing ICT building located on the eastern campus. This is only a temporary connection which will be removed at the completion of Stage 2 when the second Campus Distributor is commissioned within Stage 2. Refer to Fig 3 below

Stage 1 building will be designed with the required redundancy across the fibre optic backbone cabling and will comprise two building distributors (one located on the Level 1 and the second located on level 4).

Each floor of Stage 1 will also comprise two Floor Distributors (one located towards the northern end of Stage 1 and the second located towards the southern end). Each Floor Distributor will connect directly back to both Building Distributors with multicore single mode fibre optic cables. It is essential that all Floor Distributors are located so that any ICT technical outlet in the workspace shall be no more than 90m cable length from the patch panel (in the Floor Distributor). It is also essential that both the Building Distributors and the Floor Distributors are not located next to a lift shaft and/or an electrical cupboard, electrical riser, electrical switch room or substation.

To provide the required backbone redundancy, both Building Distributors in Stage 1 will also connect directly back to Campus Distributor No 1 (on a permanent basis, located on the ground floor of the CSB -east) as well as to the ICT building located on the eastern campus (on a temporary basis) via the underground services tunnel). This will also be carried out using multicore single mode fibre optic cables.

With regard to the reduced copper backbone network, each Floor Distributor in Stage 1 will connect back directly to the Campus Distributor No 1 only, located on the ground floor of the CSB -east.

Please note that the copper backbone network does not have a redundant pathway but is a single radial network stemming from the Campus Distributor No 1.

The size of all fibre optic and copper backbone cabling is currently in the process of being finalised.

3.2 Stage 2 Construction

The Stage 2 construction will be a continuation of the ICT cabling methodology carried out in Stage 1.

Stage 2 building will be designed with the same required redundancy across the fibre optic backbone cabling and will comprise two building distributors (one located on the Level 1 and the second located on level 6).

Each floor of Stage 2 will also comprise two Floor Distributors (one located towards the northern end of Stage 2 and the second located towards the southern end). Each Floor Distributor will connect directly back to both Building Distributors with multicore single mode fibre optic cables. It is essential that all Floor Distributors are located so that any ICT technical outlet in the workspace shall be no more than 90m cable length from the patch panel (in the Floor Distributor). It is also essential that both the Building Distributors and the Floor Distributors

are not located next to a lift shaft and/or an electrical cupboard, electrical riser, electrical switch room or substation. Refer to Fig 3 below)

A second Campus distributor will also be provided in Stage 2 which will be located at level 6. This Campus distributor will be sized to house the following: -

- The second hospital/site Campus Distributor No 2
- The level 6 Building Distributor for Stage 2
- One of the level 6 Floor Distributors
- The second Telecommunications service provider connection (Carrier Room No 2) for the hospital.
- The DAS distribution head end equipment for Stage 2

Hospital projects of this complexity and size all require two Campus Distributors and Carrier rooms and this provision in Stage 2 construction supports the first Campus Distributor No 1 and Carrier room No 1 established in the Infrastructure Works scope of works (which is located on the ground floor of the existing CSB – east).

Both Campus Distributors No1 and No 2 will be interconnected with backbone fibre optic cable and they will also both connect back to the ICT building on the eastern campus (via the services tunnel) where the hospital File Server room is located.

Also, the two Building Distributors commissioned in Stage 1 construction will be connected back to the second Campus Distributor in Stage 2 which will permanently replace and the temporary (redundant pathway fibre optic link) installed in Stage 1 back to the ICT building on the eastern campus. This temporary fibre link can now be removed, however it probably will remain as a further "back up" cabling connection (if ever required).

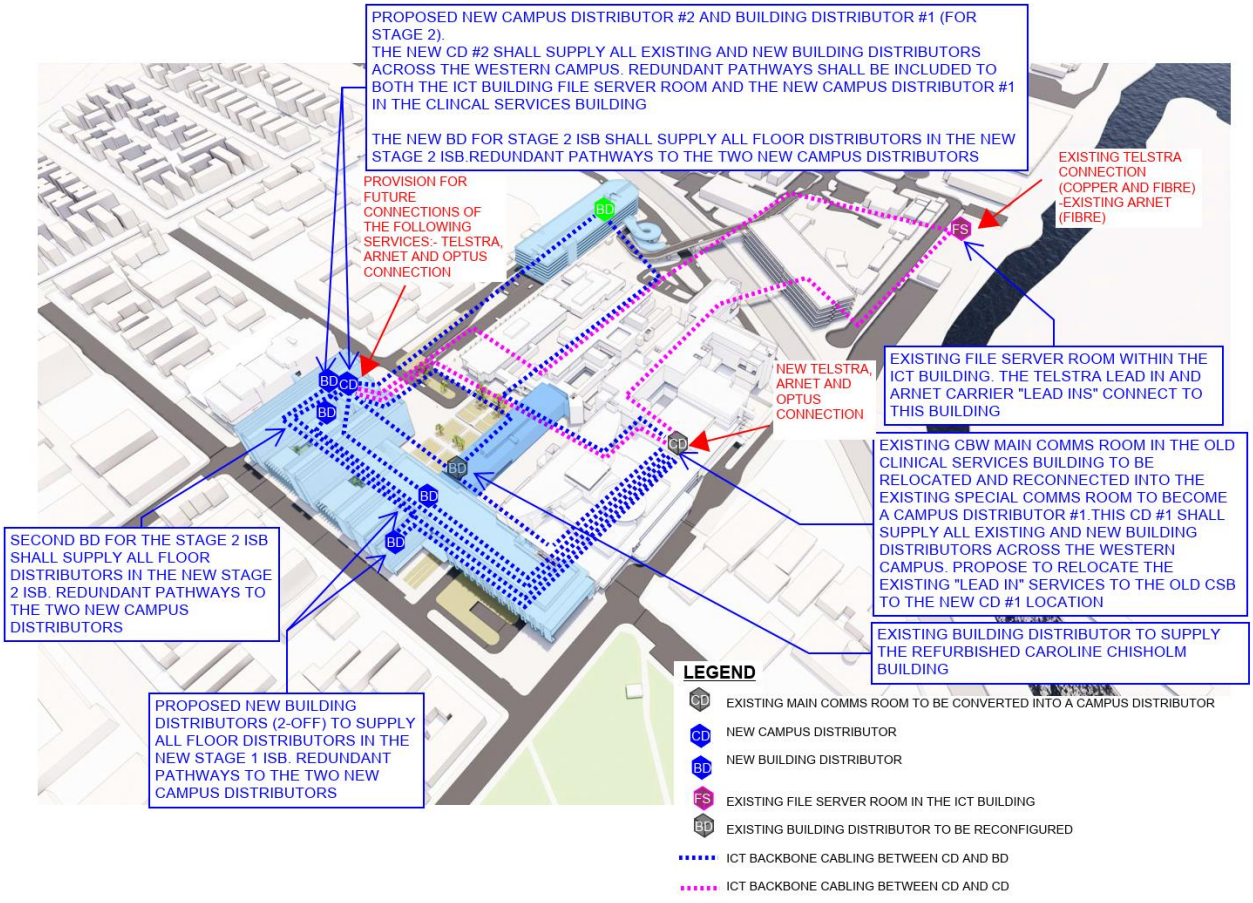

Fig 5 Site ICT layout

3.3 Horizontal Structured Cabling (Stage 1 and Stage 2)

The Structured cabling shall be carried out using 4 pair F/UTP Cat 6A cable to support 10 GBit/sec and a frequency of at least 500 MHz. Cables shall terminate in Cat 6A shielded RJ 45 outlet jacks forming the technical outlet at the workstation.

The maximum fixed cable length to each technical outlet from the Floor Distributor patch panel shall be 90m.

All components of the structural cabling (cable, outlets, patching, etc.) shall be Cat 6A to provide an integrated complying Class Ea system

3.4 Wireless LAN (Stage 1 and Stage 2)

Wireless local area networks (WLAN) shall be provided to comply with IEEE 802.11 a, b, g, n and ac to all levels of both Stage 1 and 2 to provide wireless access to data, voice, video services, RTLS (real time location system - tracking) and wireless duress. The system shall be designed for sufficient signal strength and coverage to locate equipment and/or personnel with an accuracy of 2.0 m radius. Within this scope of work and during the construction process, a building survey will be carried out to cover each stage to determine the exact location of access points required to ensure seamless coverage for the whole building.

F/UTP cabling shall be utilised via a radial topology from the floor distributor to the ceiling WAPs. Two 4 pair Cat 6A F/UTP cables shall be installed to each WAP. Power to these access points shall be provided via PoE (Power over Ethernet). A WAP density allowance of one per 70m2 of total floor space shall be provided and shall be located to ensure that Access point locations include the complete perimeter of each floor to enable compliant “triangulation” of signals from the WAPs. A survey shall be carried out when the building construction of each stage is nearing completion and when all the ceiling services (hydraulic, mechanical, fire and electrical) have been installed, but before the ceiling tiles are installed. The results from the survey may require that in certain locations within the building that a higher density of WAPs is required to achieve the required Wi Fi coverage.

Access points shall be located to give sufficient coverage with total seamless overlap from one access point to another. The designed system shall provide the user to walk/travel anywhere within the new ACB, including lift lobbies, lift cars, fire stairs and plant rooms without access being denied or the service/signal failing.

3.5 Mobile Phone Coverage

In-Building mobile phone coverage shall be provided to cover both Stage 1 and Stage 2 of the redevelopment using the DAS (Distributed Antennae System). The type of system to be installed will be a “passive/active” network. The DAS network is totally separate from the wireless LAN and will only be used for mobile phone coverage associated with the current mobile phone carriers.

The DAS system shall be capable of supporting all frequencies from 700MHZ to 2700MHZ and shall cover the following technologies:-

- 2G (GSM network)
- 3G (Next G or WCDMA network)
- 4G (LTE)

The system shall also be designed and comply with the requirements of “The Mobile Carrier Forum and DAS Design Specification -2014”.

The mobile phone “passive” component and cabling will be carried out using the “fat coax” principal and will terminate in the level 1 Building Distributor for Stage 1 and the level 6 Building Distributor for Stage 2.

The mobile phone “active” component of the overall system will be carried out using fibre optic cable which shall connect each Building Distributor mentioned above for Stage 1 and Stage 2 back to the “head end” for the DAS located in Campus Distributor No 1 on the ground floor of the existing CSB – east building.