WOOD & GRIEVE ENGINEERS

Byron Shire Central Hospital Redevelopment

Schematic Design Report

Electrical, ICT and Security Services

Prepared for
Health Infrastructure, NSW Health
Revision No. 03

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Revision

REVISION	DATE	COMMENT	APPROVED BY
01	22/07/2014	PRELIMINARY ISSUE	MAM
02	25/07/2014	PRELIMINARY ISSUE	MAM
03	31/07/2014	FINAL ISSUE	MAM

Contents

1 Executive Summary

1. The existing Essential Energy Zone Substation in the neighbouring property on the north west boundary and associated overhead and underground cabling on the northern and western boundaries is a source of relevant electromagnetic interference (EMI). This has been considered in siting the building and needs taken into account during the detailed electrical design.

2. A new Essential Energy 1000 kVA padmounted substation will be required on the Ewingsdale Road boundary to supply this development.

3. Essential Energy have have provided a Design Information Package to enable a Level 3 ASP design to be undertaken.

4. Existing Optus and Telstra infrastructure is located along the Ewingsdale Road boundry. LHD will arrange the service to the site via their preferred service provider.

5. Conduit provisions will be made for a primary and secondary lead-in communications service to the site with provision for 2 off campus distributors.

6. A new main switchroom is to be established. The new Main Switchboard to be of Form 3b construction as per AS3439.

7. New Communication Rooms to be established to satisfy the 90m rule.

8. A new prime rated 400kVA standby generator (canopy set type) is to be provided to supply essential power to the facility. This will not have spare capacity to support the Peri-operative Suite and an additional generator will be required if this goes ahead.

9. A new UPS room is to be established to supply continuous power to the facility. The UPS will not have spare capacity to supply the Peri-operative Suite.

10. New distribution boards to be located within each new fire compartment as per the requirements of TS11.

11. Sustainability and energy saving initiatives will be implemented in the design process.

12. It is acknowledged that future Hospitals will rely heavily on information technology and suitable IT Infrastructure must be provided to support this.

13. ICT, Security, Nurse Call, MATV, Audio Visual and Distributed Antenna systems to be further developed in Design Development Stage.

14. WGE Order of Costs does not include for any costs which may result if existing utility services in Ewingsdale Road Reserve need to be relocated and/or additional street lighting is required for Ewingsdale Road or associated bus stop and cycleway.

2 Introduction

2.1 General

Wood and Grieve Engineers have been engaged by Health Infrastructure, NSW Health to provide a consulting service which will assist Woods Bagot in their preparation of a Schematic Design Report for Byron Shire Central Hospital Redevelopment.

This report aims to identify the major project decisions which have been made at the Schematic Design Stage for the Electrical, Communications and Security services.

2.2 Outline of the Development

In general terms the development is split across 2 levels and consists of:

- Ambulatory Care
- Birthing
- Clinical Support
- Emergency Department
- IPU
- Mental Health Unit
- Non Clinical support
- Plant Rooms
- Car Parking
- Possible Peri-operative Unit (Limited provisions only)

2.3 This report has been based on the following:

- Engineering Infrastructure and Services Concept and Feasibility Report
- Architectural Draft DA Drawings produced by Woods Bagot.
- Design Team Meetings.
- ERG meetings held on 12 June 2014, 26 June 2014 and 23 July 2014.

2.4 Limitations of the Report

This report is based on the above information, investigative work carried out by WGE and drawings and information provided by Woods Bagot. We have based our report on the assumption that the as-existing information provided can be taken at face value and in general terms, accurately reflects the installation on site. WGE does not accept any liability in regard to the accuracy of the existing documentation.

3 Design Criteria

The Electrical Services will comply with but will not be limited to the following relevant codes and standards:

NSW Health Engineering Services and Sustainable Development Guidelines - TS11
NSW Health Infrastructure ICT Cabling Standard
Australian Health Facility Guidelines
Building Code of Australia: 2013
Australian Standards

1158	Lighting for roads and public spaces
1680	Interior lighting
1768	Lightning protection
1940	The storage and handling of flammable and combustible liquids
2293.1	Emergency evacuation lighting for buildings
2381.1 + 10	Electrical equipment for explosive gas atmospheres - Selection, installation and maintenance - General requirements
2430	Classification of hazardous areas
2500	Guide to safe use of electricity in patient care
2834	Computer Accommodation
3000	Electrical Installations (Wiring Rules)
3003	Electrical installations - Patient treatment areas of hospitals and medical, dental practices and dialyzing locations
3008.1.1	Electrical installations - Selection of cables - Cables for alternating voltages up to and including 0.6/1 kV
3009	Electrical installations - Emergency power supplies in hospitals
3010	Electrical installations - Generating sets
3013	Electrical installations - Classification of fire and mechanical performance of wiring system elements
3100	Approval and test specification - General requirements for electrical equipment
3200.2.41	Medical electrical equipment - Particular requirements for safety - Surgical luminaires and luminaires for diagnosis
3439.1 + 2	Low-voltage switchgear and control gear assemblies
5000.1	Electric cables - Polymeric insulated - For working voltages up to and including 0.6/1 (1.2) kV

4 Existing Site Electrical Services Arrangement

4.1 Power Services to the site

Existing 11kV overhead power lines and underground cables are located on the Ewingsdale Road boundary. Essential Energy have advised that the takeoff to the new padmounted substation will be via one connection to the overhead line and a second connection to the underground cable.

There is an existing high voltage underground cable which runs from the Essential Energy Zone Substation and clips the south western corner of the site.

The Ambulance Station has an existing Essential Energy supply. Essential Energy has agreed to continue to supply the ambulance station from the existing arrangement.

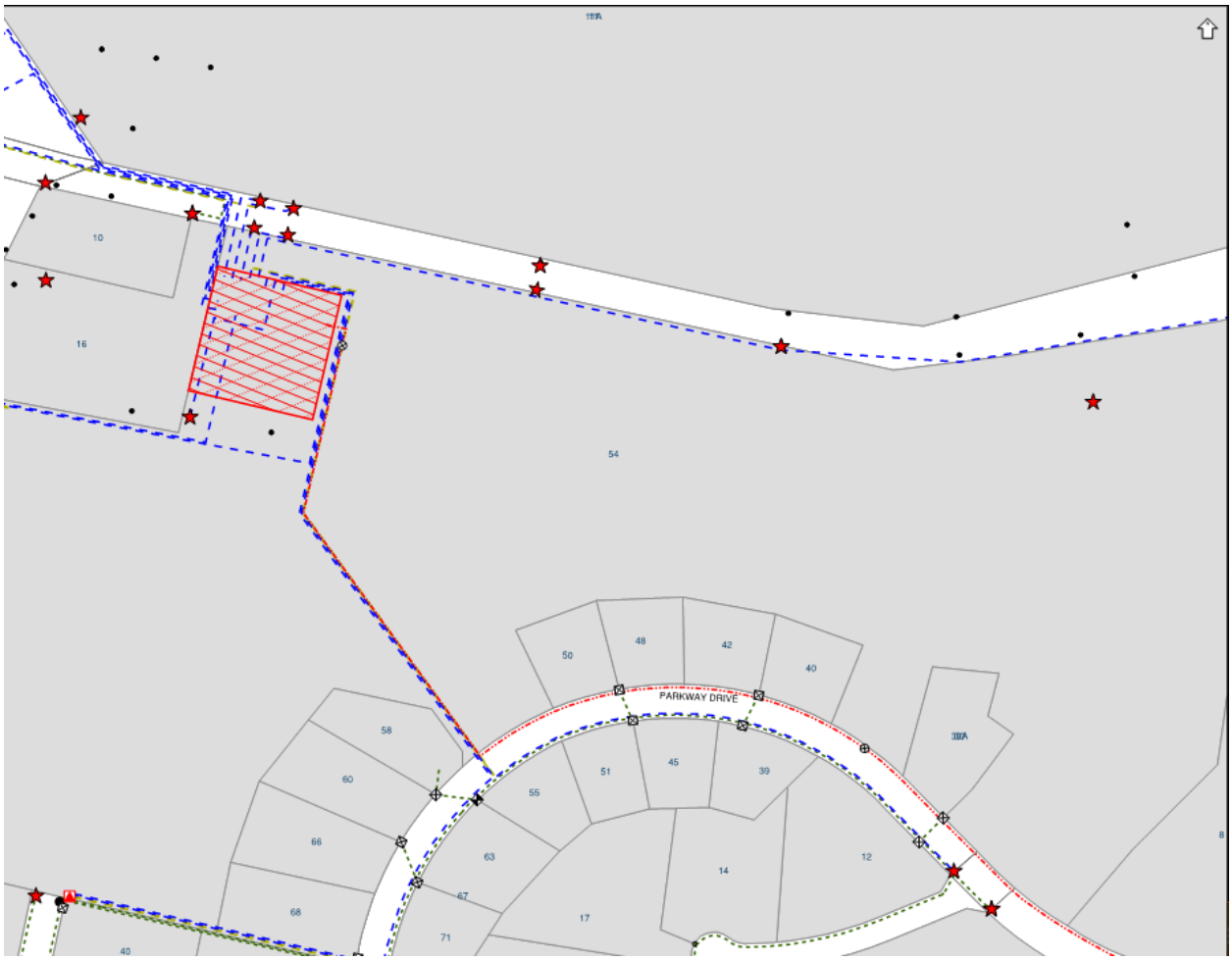


Fig 1 – Dail Before You Dig information from Essential Energy

4.2 Carrier Services

Existing Telstra and Optus infrastructure is located on the Ewingsdale Road boundary.
It has been agreed with Luke Brindly of Health Infrastructure that:

- LHD will be responsible for making an application for carrier services to the site.
- Conduit provisions are to be made for a primary and secondary service to the site with provision for 2 off campus distributors (CD's).

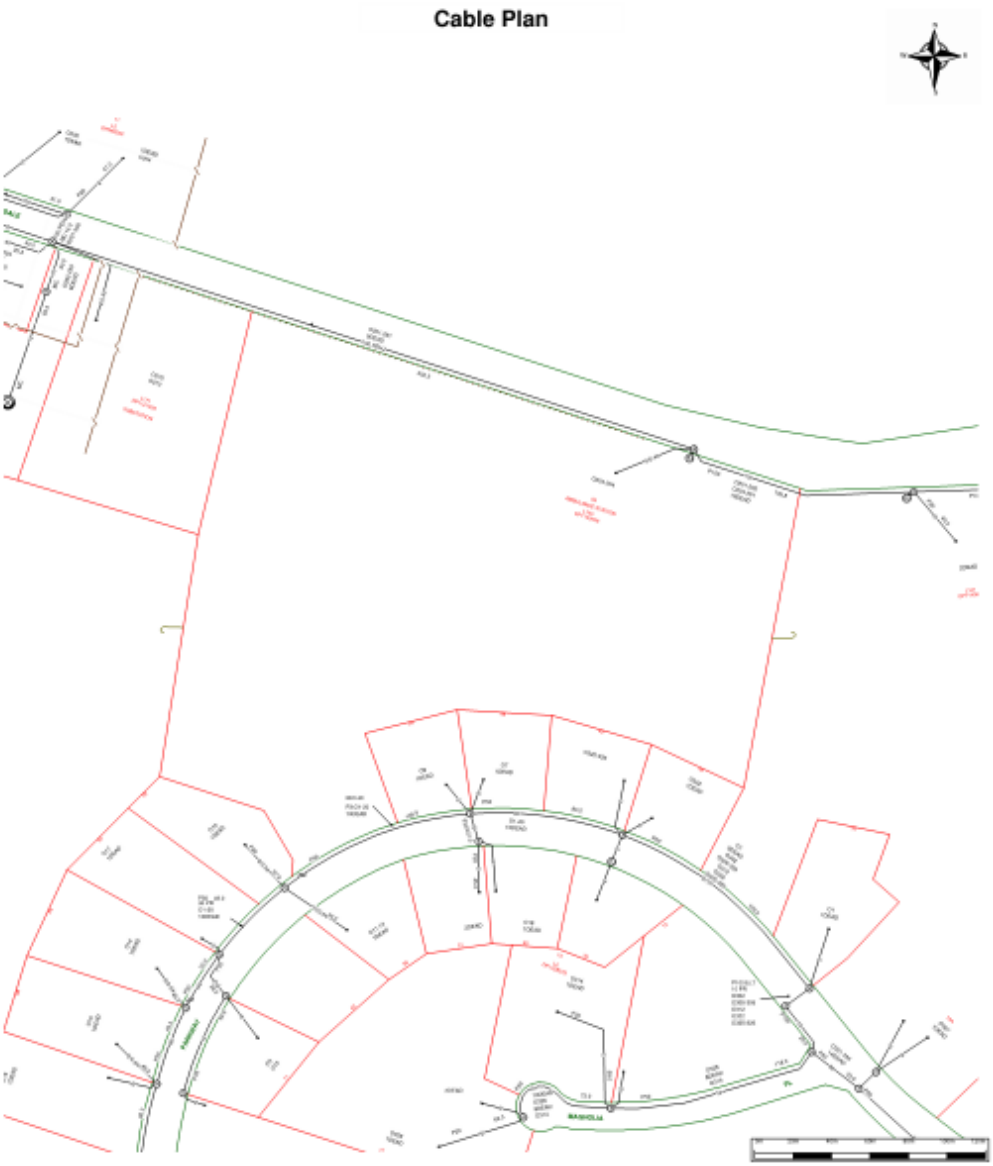


Fig 2 – Dail Before You Dig information from Telstra

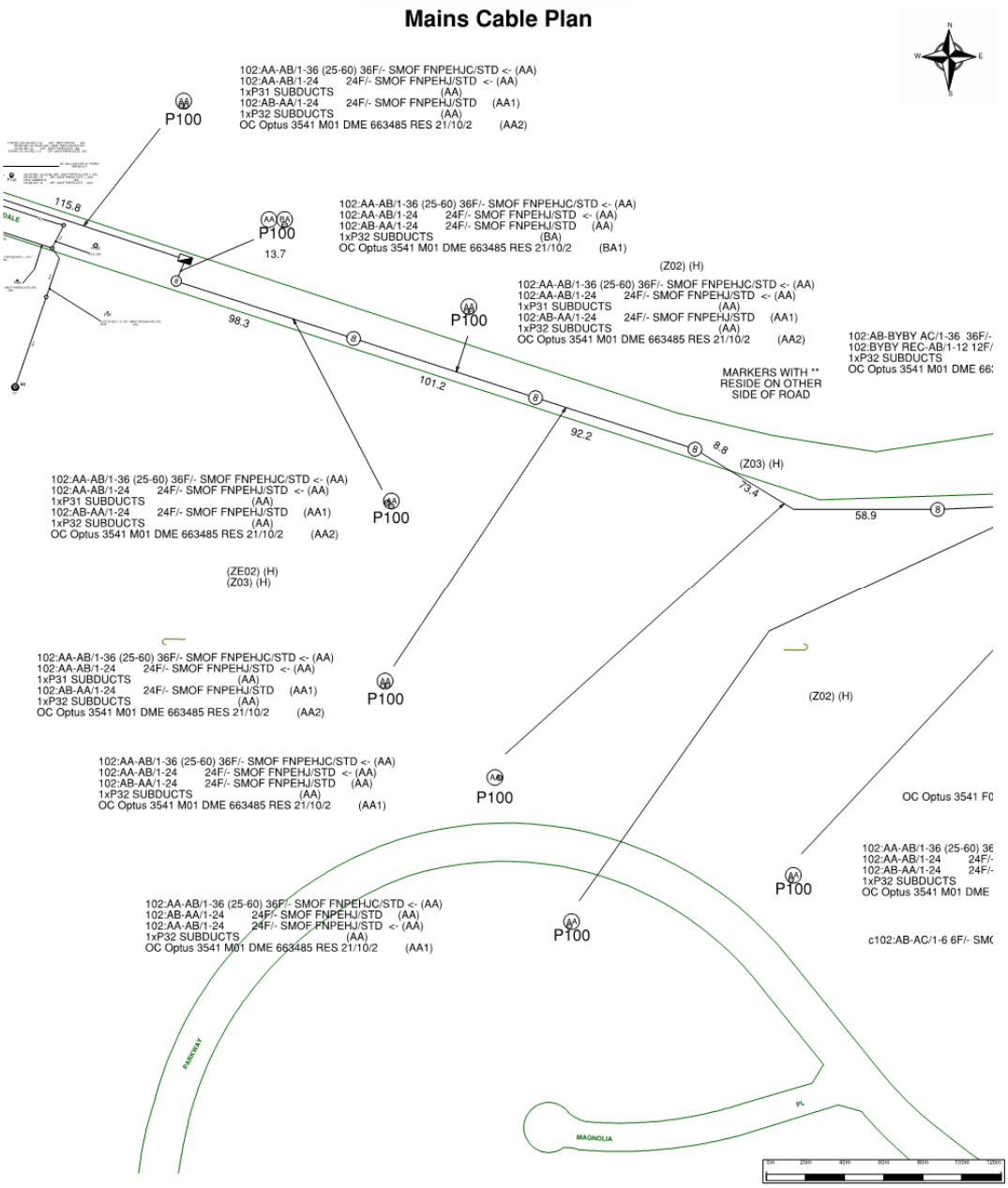


Fig 3 – Dail Before You Dig information from Telstra

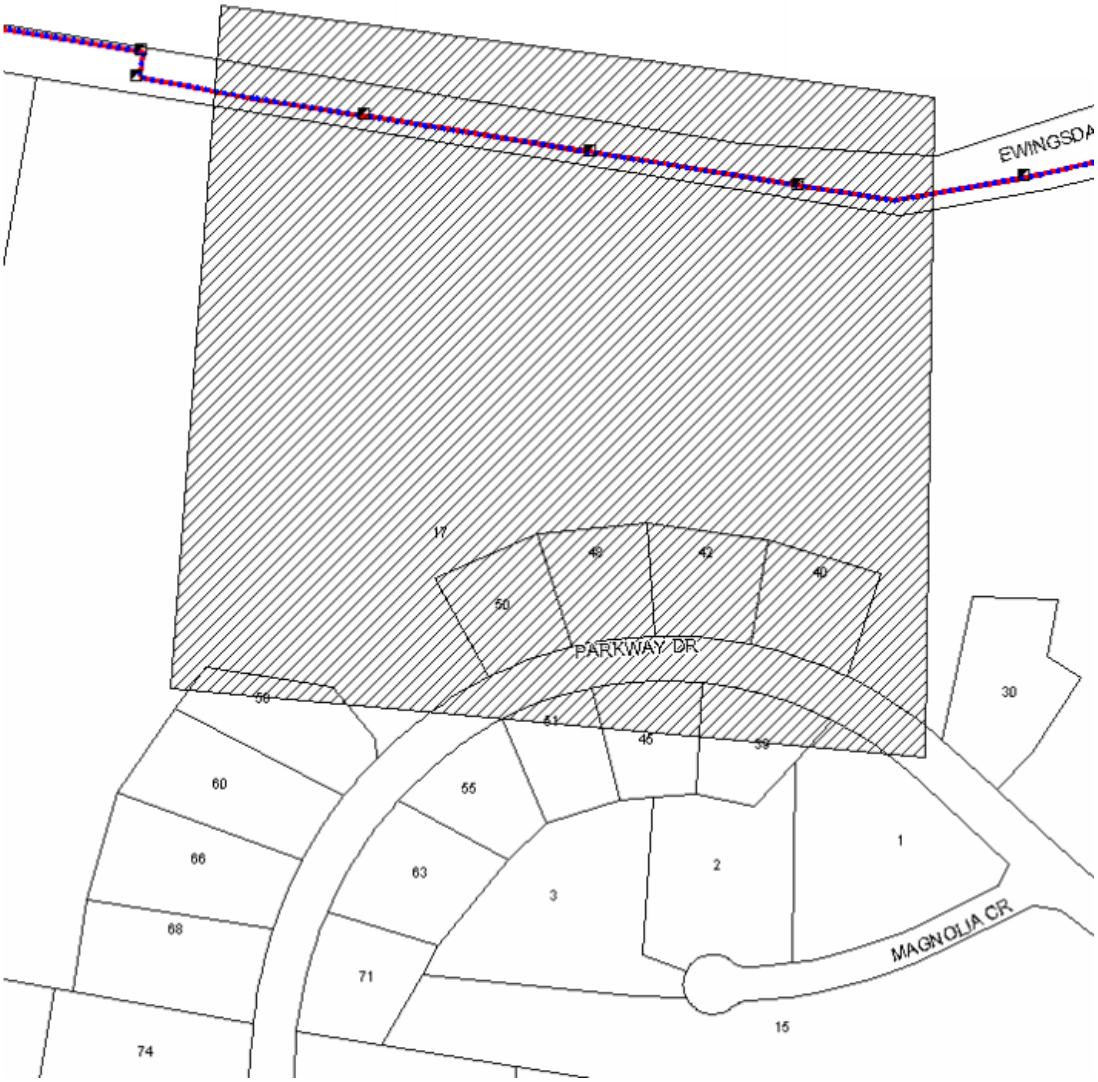


Fig 4 – Dail Before You Dig information from Optus

4.3 Roadworks in Ewingsdale Road

Road works will be undertaken in Ewingsdale Road as part of this development. The extent of these works is not yet confirmed and they may or may not require relocation and or lowering of existing utility services which are located on both sides of this road. These services include overhead high voltage power lines and associated poles, underground power cables and underground Telstra and Optus copper and optic fibre cables and associated cable pits.

In addition Council may require additional street lighting to be provided for the road, traffic circle, cycle way and new bus stop.

To date WGE do not have any details of the above and have not included any of these possible works in the Schematic Design and the Order of Costs.

5 Electromagnetic Interference (EMI)

There is an Essential Energy Zone Substation on the north western boundary of the site, a combination of overhead and underground cables on the northern boundary and an underground cable on the western boundary. These services are all potential sources of EMI which could have a detrimental impact on the operation of the Hospital. Faraday, a company who specialise in providing advice on these matters, were commissioned to undertake a survey to determine the levels of EMI being generated and the impact which they would have on the operation of the hospital.

A report was provided by Faraday which is included in the Appendix of this report. Based on the report WGE advises as follows:

- The electromagnetic fields are strongest on the northern and western site boundaries.
- None of the applicable magnetic field limits should be exceeded within the site boundary when the Zone Substation is loaded to its present maximum capacity.
- When considering the total EMI within the building the field strengths outlined in this report will need to be added to the electromagnetic fields created within the building.
- In order to restrict the effect of these fields within the building we recommend that the buildings be maintained a minimum of 15 metres back from the northern and western boundaries.

6 Proposed Electrical Services Arrangement

The proposed electrical services arrangement to accommodate the Byron Shire Central Hospital redevelopment is as follows:

6.1 New Supply Authority Connection

Maximum Demand

The calculated maximum demand of the redevelopment will be in the order of 840 kVA (1,212A). This is largely based on allowances as described in TS11 and on building areas. The maximum demand above excludes the Peri-operative Unit.

Substation

The Supply Authority is Essential Energy.

A new 1,000kVA kiosk type substation will need to be established to supply the site. It is proposed that this will be located on the Ewingsdale Road Boundary as shown on the attached Site Plan. Essential Energy has agreed to provide this supply and have provided a Design Information Package for this. Essential Energy approval of the substation location is being sought. As discussed with the ERG a Level 3 ASP Designer will be appointed during the Design Development stage to undertake the necessary design for Essential Energy approval.

6.2 Main Switchboard

A new Main Switchroom is to be established.

A new low voltage main switchboard will be provided within the main electrical switchroom. The main switchboard will have a minimum of Form 3B segregation as per AS 3439.

Surge protection will be provided.

A generator supplied essential power section of the main switchboard will be linked to one of the mains busbar sections via a Synchronised Closed Transfer Switch (SCTS).

A preliminary Single Line Diagram is depicted on drawing E-1801 located in Appendix of this report.

6.3 Power Factor Correction

The new main switchboard will be provided with power factor correction. Preliminary calculations indicate that a 400kVAr unit will be provided to the mains supplied busbar section.

6.4 Standby Generator

A new 400 kVA prime rated standby generator is to be provided. Generator sizing is generally in line with TS11.

The generator is not sized to support the Peri-operative Unit. In the event of this going ahead a second generator can be provided for this unit.

The generator has capacity to supply the CT Scanner and X-ray machines as they will be utilised by the Emergency Department for emergency cases.

The generator will be located outside the building and housed within its own acoustic enclosure.

A diesel fuel tank will be provided as an integral part of generator set (skid base tank). This will provide a minimum of 12 hours of standby power at full load in accordance with TS11.

6.5 Uninterruptible Power Supplies (UPS)

A new dedicated/centralized Uninterruptible Power Supply (UPS) room will be provided.

A single 40 kVA UPS with 15 minutes autonomy will be provided to supply the following loads:

- Communications Room racks
- Selected GPO's in ED resuscitation bays and ED Staff station
- Surgical luminaires in the ED resuscitation bays

The UPS is not sized to supply the Peri-operative Unit. In the event of this going ahead a second UPS, housed in the Peri-operative Unit can be provided.

Indication of failure of supply to the UPS will be provided where required to comply with AS/NZS 3003.

6.6 Sub-main Distribution

Sub-mains will be distributed from the main electrical switchroom to respective distribution boards.

Distribution boards have been strategically located to serve the associated fire compartment as per the requirement of TS11.

Fire-rated sub-mains cabling will be provided to supply safety services where required to comply with AS/NZS 3000.

6.7 Distribution Boards

All new distribution boards will be similar or equal to Schneider Isobar range which provides Form 4ah segregation. Switchboard enclosures will be IP42.

Cupboards which house Distribution boards will be illuminated by luminaires connected to the Essential services supply.

Distribution boards will generally comprise a non-essential services section and an essential services section. Essential services submains and sub-circuit cabling will be segregated from non-essential services sub-mains and sub-circuit cabling by metal partitions.

Bus ties will be provided between essential and non-essential distribution board sections.

Surge protection will be provided at each distribution board

6.8 Cardiac- and Body-Protected Areas

Electrical services within body protected protected areas will comply with AS/NZS 3003. Leakage protection devices will consist of 10mA residual current devices. Isolation transformers and line isolation and overload monitors are not proposed to be utilized.

There will be no cardiac protected areas in this development unless otherwise instructed by the Clinical Users during the Design Development stage.

6.9 Power outlets

Power outlets will consist of Non-essential, essential and UPS with colour of each face plate installed with the following colours:

1. Non-Essential = WHITE
2. Essential = RED
3. UPS = BLUE
4. Cleaners = Beige

Each of the circuits will be protected by RCD

6.10 General Lighting

The development will be provided with new energy efficient luminaires using either T5 fluorescent or LED sources.

Luminaire selection will generally be undertaken as follows:

1. Plant Areas - Surface or suspended IP65 luminaires with polycarbonate diffusers.
2. General Service areas, Stores etc - Surface mounted luminaires or recessed fluorescent luminaires with diffusers, dependent on the ceiling type.
3. Non-Patient Offices, Meeting Rooms etc - Recessed or surface mounted fluorescent luminaires.
4. Patient Offices, Meeting Rooms etc - Recessed or surface mounted fluorescent luminaires.
5. Ward Rooms – mixture of Recessed and surface mounted luminaires with diffusing lens to suit the application.
6. Ward Service Rooms - Recessed or surface mounted luminaires to suit the application.
7. Bathrooms - Recessed downlight luminaires with a diffusing lens.
8. Toilets – Recessed downlight luminaires with a diffusing lens.
9. Circulation Areas – Recessed, surface or suspended mounted luminaires with a diffusing lens.
10. Isolation Rooms - Sealed Vandal proof luminaires.
11. External areas – LED luminaires IP-rated to suit the application.

It is not proposed to provide lighting for cyanosis discernment complying with AS/NZS 1680.2.5.

6.11 External Lighting

The following information has been provided with the DA to confirm that the design prepared by WGE will ensure that the impact which the external lighting will have on the adjacent residential land will be minimal and will comply with the relevant standards.

Road, Carpark and Pedestrian Pathway Lighting

General

The following is an overview of the lighting design methodology to be applied for the new internal roads, outside car parks and associated new pathways on the site. A detailed design will be formulated during the design development stage of the project however the main design principles are provided in this report.

The following issues have been considered in this report and will be addressed in the detailed design stage:

- Energy efficient lighting
- Creation of a safe well lit environment
- Limiting spill light adjacent residential land
- Aesthetically suitable lighting arrangement
- Lighting control systems
- Maintenance and ongoing running costs

Design Criteria for External Lighting

The exterior lighting will comply with the following standards and guidelines:

- AS 4282 - Control of obtrusive effects of outdoor lighting
- AS/NZS 1158.3.1 - Pedestrian area lighting (category P)
- AS 3000 - SAA wiring rules

Access Roads within the Site

Lighting to access roads within the site will be designed to comply with both AS/NZS 1158.31 – Pedestrian area lighting (category P), and AS/NZ 4282-1997- control of the obtrusive effects of outdoor lighting as follows

We proposed to provide Category P2 lighting for the roads. We have based this selection on the following selection criteria:

- Local road with mixed vehicle and pedestrian traffic
- Night time pedestrian/cycle activity – High
- Risk of Crime – medium
- Need to enhance prestige- High

The light technical parameters associated with Category P2 lighting are as follows:

- Average horizontal illuminance – 3.5 lux
- Point horizontal illuminance – 0.7 lux
- Illuminance (horizontal uniformity) – 10
- Point vertical illuminance – 0.7 lux

It is proposed to utilise pole mounted luminaries utilising LED fittings. Pole heights will be 7 to 8 metres. Luminaries will have zero degree horizontal cut off to minimise any upward light spill and, were necessary, will be provided with shields to prevent light spill into adjoining properties.

The detailed lighting design will be undertaken during the design development stage and the design will include limiting the obtrusive effects of the lighting on adjacent properties to the limits set in AS 4282.

Outdoor Car Park Lighting

Outdoor car parks will be designed to comply with both AS/NZS 1158.3.1 – Pedestrian area lighting (category P), and AS/NZ 4282-1997 – Control of the obtrusive effects of outdoor lighting as follows:

We proposed to provide Category P11a lighting to the new car park areas and Category P12 to designated parking spaces specifically intended for people with disabilities. We have based this selection on the following selection criteria:

- Night time vehicle or pedestrian movements- high
- Night time occupancy rates greater than 75%
- Risk of crime- medium

The light technical parameters associated with Category P11a lighting are as follows:

- Average horizontal Illuminance-14 lux
- Point horizontal illuminance- 3
- Illuminance (horizontal uniformity) –10
- Point vertical Illuminance -3 lux

Category P12 requires a point horizontal illuminance greater than or equal to 14 lux and greater than or equal to the average horizontal illuminance.

It is proposed to utilise pole mounted luminaries utilising LED fittings. Pole heights will be 7 to 8 metres. Luminaries will have zero degree horizontal cut off to minimise any upward light spill and, were necessary, will be provided with shields to prevent light spill into adjoining properties.

The detailed lighting design will be undertaken during the design development stage and the design will include limiting the obtrusive effects of the lighting on adjacent properties to the limits set in AS 4282.

Pedestrian Pathway Lighting

Pathways will be designed to comply with both AS/NZS 1158.3.1 – Pedestrian area lighting (category P), and AS/NZ 4282-1997– Control of the obtrusive effects of outdoor lighting as follows:

We are of the opinion that there will be occasional high night pedestrian activity, a medium risk of crime and a high need to enhance prestige, the project therefore, fits into light category P2.

The light technical parameters associated with Category P2 lighting are as follows:

- Average horizontal illuminance – 3.5 lux
- Point horizontal illuminance – 0.7 lux
- Illuminance (horizontal uniformity) – 10
- Point vertical illuminance – 0.7 lux

It is proposed to utilize a combination of post top light fittings of 3 to 4 meter height and bollards. Luminaries utilising LED lamps will be specified. Fittings will have zero degree horizontal cut off to minimise any upward light spill and, were necessary, will be provided with shields to prevent light spill into adjoining properties.

The detailed lighting design will be undertaken during the design development stage and the design will include limiting the obtrusive effects of the lighting on adjacent properties to the limits set in AS 4282.

External Lighting Control

It is proposed that a combination of photo electric cell (PE Cell) controlled external lights and PE Cell and time clock controlled external lights be utilised.

This will allow some lights to remain on from dusk to dawn and others to switch off at a preset time at night

Maintenance

Energy efficient lamps, control gear and luminaries will be selected generally utilising LED sources. Vandal resistant luminaries and associated supporting facilities will be selected and ease of maintenance will be considered in the selection and design.

6.12 Exit and Emergency Lighting

Emergency lighting and exit signs will be provided to comply with AS/NZS 2293.1. Emergency lighting will additionally be provided in the following areas:

1. Patient treatment areas
2. Stairs/Toilets/Changerooms
3. Rooms greater than 120m2 that are accessible to patients
4. Fire control Room (where applicable)
5. Staff areas where public address announcements are made
6. Nurse stations
7. Locations where fire locations can be identified (e.g. Fire/mimic Panels)
8. Near manual Call Points
9. Plantrooms

A computer monitored system will be installed.

The emergency lighting and exit signs which will be utilised will be similar or equal to a Stanilite Nexus type system.

6.13 Lighting Control system

A lighting control system will be provided to control the lighting in the following areas:

1. Public corridors (between departments);
2. Inpatient wards (corridors only);
3. Stairs;
4. Departments with non-24 hour operation.
5. Non-Patient office locations

6.14 Assistance (Nurse) Call System

During the design development stage, discussions will be held with LHD and Engineering staff to obtain a list of their preferred assistance call suppliers.

The nurse call systems will comply with the room data sheets and AS 3811. By default, each call device will be enunciated only at its respective area enunciator display panels. However, the system will be capable of transferring calls to other enunciator panels. Over door indicators will be provided to indicate the source of call. Audible chimes will be provided within each zone.

The assistance call system will incorporate staff-staff calls, patient-staff, orderly call (where applicable) and emergency call systems.

The system will offer self-checking and self-diagnostic functions. The system will be hard wired.

6.15 Electronic Security and Access Control

A new Gallagher access control system will be provided for the Hosptal. The system will be fully integrated into the LHD-wide Gallagher system.

There will not be a dedicated Security Room for security staff located at the Hospital.

Door intercom will be provided where required to suit the access control arrangement. Electronic access control provision will generally be limited to departmental perimeters and specific areas of high crime risk, such as high value stores.

A fixed duress alarm system will be provided.

Communications rooms will generally be provided with electronic access control.

6.16 CCTV Surveillance

The proposed facility will utilise IP-based cameras connected to the structured cabling system.

Cameras will be colour and IP-based. As it is not proposed to have a dedicated Security Room, the NVRs and a single viewing monitor shall be located in one of the Communication Rooms.

6.17 Mobile Duress Alarms

As has been implemented on other sites, a Wi-Fi duress system will be provided for the Hospital.

The intention is to provide the ability for telephony, messaging and duress to be incorporated into one device. The system would require the provision of WLAN as well as a Real Time Locating System (RTLS) in order that the source of duress calls can be located with the required level of accuracy.

Wireless Local Area Network (WLAN)

The WLAN will utilise the same network that provides wireless coverage for ICT services.

Duress and Real Time Location System

In order to implement a duress alarm system over the Wi-Fi system, the system would require an RTLS controller. The RTLS controller utilises Received Signal Strength indicator (RSSI) modeling to calculate precise real-time location within the wireless network based on active measurement of all RSSI data from each AP. As this system is Group 3 equipment, apart from the cabling to the APs, it is expected that LHD ICT will nominate the AP locations.

6.18 Pocket Paging System

The requirement for a pocket paging system is to be determined by the LHD during the Design Development stage.

6.19 PA System

The requirement for a PA system and the areas to be covered is to be determined by the LHD during the Design Development stage.

6.20 Mobile Distributed Antenna System

As discussed with the ERG a survey will be arranged during the Design Development stage to determine the level of mobile coverage at the site and the need for a mobile distributed antenna system.

At this stage spacial provisions have been made for an MDAS room.

6.21 Patient Entertainment System

The extent of the Patient Entertainment systems will be determined in consultation with LHD during the Design Development stage. Recently installed systems in other NSW Health hospitals will be used for reference.

6.22 Information and Communication Technology

A preliminary discussion has been held with Luke Brindley of HI and he advised as follows:

- LHD ICT will arrange the carrier service to the site by their preferred service provider
- Conduit provisions are to be made for a primary and secondary service to the site
- Spacial provisions to be made within the building for 2 off campus distributors
- The ICT Strategy Report is not yet available

It is envisaged that regular meetings will be held with LHD ICT during the Design Development Stage.

The following points form the basis of our schematic design and will require LHD ICT approval:

Campus Distributor and Floor Distributor Communication Rooms

- Conduit provisions will be made for primary and secondary carrier lead-in services.
- Spacial provisions have been made within the building for 2 off campus distributors
- Establishment of Communication Rooms to satisfy the 90m rule.
- A central UPS will be provided with 15 minute minimum backup.
- Each rack will be provided with a UPS supply and a non UPS supply. (Both will be generator backed up).
- 4 Post 45RU Open type racks will be used in the Communications Rooms for housing equipment and patch panels, with good horizontal and vertical cable management provisions.
- A front-terminated earth link bar will be provided within each communications rack. A telecommunications reference conductor (TRC) system will be installed in accordance with AS/ACIF S009.
- Communications Rooms will be provided with 24/7 air conditioning.

- UPS and Communications Room temperature to be monitored b the BMS system.

Backbone Cabling

- Backbone cabling will be 12- or 24-core SMOF cable. Each Comms Room will have a redundant optic fibre backbone.
- In addition to the optic fibre backbone cabling, a 25 pair copper cable will be reticulated to each Comms Room.

Horizontal Structured Cabling

- Will be as per the requirements of the NSW ICT Standard and generally consist of Category 6A/Class EA F/UTP (screened) horizontal cabling.
- The route length of all horizontal cable runs from the communications rack patch panels to the telecommunications outlets will not exceed 90m. Horizontal cabling will cross other runs of cables at ninety (90) degrees wherever possible.
- LHD ICT to provide outlet labelling standard arrangement to be used for the development.
- All pairs of all horizontal cabling will be terminated at both ends and will be installed to avoid stretching, kinking, tight bends and damage from adjacent fixtures or plant.
- All cables must appear on to frames in a logical sequence relative to their position on the floor plan. The two or three runs of cable from each position must be terminated on adjacent modules on the frames.
- Telecommunications outlets will be provided within the ceiling void to support wireless access points.
- LHD ICT Department will be consulted during the Design Development phase to ensure that nominated vendors and subcontractors supply and install all structured cabling to the specifications.
- The development of the ICT system will be coordinated with LHD ICT Department to provide a working solution.

Data and Telephony Services

- VoIP provisions will be provided throughout the building.
- Wi-Fi network for data/telephony to be allowed for. Wireless access will be provided throughout the building. As Wi-Fi Mobile Duress will be utilised in certain areas, the wireless access point grid will largely be governed by the Duress requirements. LHD ICT to provide intended Wi-Fi access point location based on the nominated grid spacing from recommended supplier.

The cabling and outlet provisions will be designed to support the following facilities:

- a networked data systems,
- a single service carrier, integrating all modes of data and voice communications;
- client and customer hub concepts, eliminating local solutions that cannot be shared across the broader organisation;
- advances in IT including wireless systems, electronic prescribing and electronic medical records; and
- reticulated through a comprehensive, integrated cabling system capable of broad band transmission.

6.23 Audio Visual Equipment

Audio Visual requirements shall be determined during the Design Development stage. This shall be done in conjunction with LHD, the Architect and input from the relevant User Groups.

6.24 Lightning Protection

A conventional lightning protection system will be provided to cover the new building.

6.25 Design Life and Durability

The electrical systems will be designed and constructed to achieve the design life as outlined below, without requiring undue maintenance.

ITEM	MINIMUM DESIGN LIFE (YEARS)
Main Switchboards	30
Distribution Boards	30
Sub-Mains Cables	30
Sub-Circuit Cabling	25
Luminaires	15
Emergency Lighting Systems (excluding Batteries)	15
Emergency Lighting batteries / single point luminaires(excluding Luminaires)	5

6.26 Risk Items

The following risk items have been identified :

1. New power and telecommunication authority connections. It is proposed that these are finalized early in the Design Development Stage to ensure the risk is mitigated.
2. The need to relocate and/or lower existing utility services in Ewingsdale Road needs to be determined and the costs included in the Cost Plan.
3. The need for additional street lighting in Ewingsdale Road needs to be determined and the associated costs included in the Cost Plan.

6.27 Discrepancies

The following discrepancies (with reference to the NSW Health ICT Cabling Standard) are highlighted :

- Outlet provisions will be as agreed with the LHD. In some cases, this will be less than required by the ICT Cabling Standard.

7 ERG Meetings

ERG meetings were held on 12 June 2014, 26 June 2014 and 23 July 2014. Generally the foregoing was presented at the meetings apart from the proposed UPS supply arrangement for the resuscitation bay procedure lights.

At the ERG meeting on 12 June 2014 WGE's proposed approach was to supply the new resuscitation bay procedure lights with a UPS separate to that of the medical and ICT power, in order that 90 minutes of autonomy is provided. AS/NZS 3009 requires a UPS supply with 90 minutes of autonomy for surgical luminaires. The ERG questioned the categorisation of resuscitation bay procedure lights as surgical luminaires. WGE reviewed the requirements of AS/NZS 3009 and in the case of the proposed Byron Shire Central Hospital, recommend that the procedure lights in the resuscitation bays now be supplied by the common medical power and ICT UPS, which will have battery autonomy of 15 minutes. This would provide a high level of reliability and continuity of service without imposing the additional cost of a second UPS. This report includes this change.

The ERG also questioned WGE's proposal that the CT Scanner and X-ray machine be provided with essential (generator-backed) supplies.

TS-11 states that 100% of power to Critical Care Areas are to be provided with a generator-backed supply. Critical Care Areas are indicated in TS-11 as including "some areas of Medical Imaging". TS-11 defines 'Critical Care Areas' as those areas where acute resuscitation procedures occur on a regular basis. In the proposed Byron Shire Central Hospital, the radiology area appears to be integrated with the emergency department. We expect that the CT Scanner and X-ray machine will be utilised by the emergency department for emergency cases. WGE therefore recommend that they be provided with an essential supply as described in this report and this was agreed at the ERG meeting on 23 July 2014.

As discussed with the ERG at the meeting on 12 June 2014 a survey will be arranged during the Design Development stage to determine the level of mobile coverage at the site and the need for a mobile distributed antenna system. At this stage spacial provisions have been made for an MDAS room.

At the ERG meeting on 23 July 2014 WGE presented the spacial provisions which have been made for the electrical services and apart from being instructed to relocate the standby generator from the loading dock area to an area adjacent to the ambulance bay area the remaining provisions were agreed. ERG to confirm if the DAS Room and Campus Distributor Room are to be a single room or separate rooms.

At the same meeting WGE were advised that the Level 3 ASP design which is required for the substation will be undertaken by the ECI contractor.

8 Order of Costs

ELECTRICAL, ICT AND ELECTRONIC SECURITY SERVICES			
1 **Infrastructure**			
1.1 Substation, HV Works and Consumers Mains			$270,000
1.2 Generator			$250,000
1.3 Main Switchboard			$150,000
1.4 Uninterruptible Power Supply			$ 50,000
1.5 Lightning Protection			$100,000
1.6 External Lighting and Small Power			$200,000
1.7 Conduit Provision for Primary and Secondary Carrier Lead-in Services			$ 40,000
1.8 Mobile Distributed Antenna System			$140,000
Subtotal			**$1,200,000**
2 **Lighting and Small Power**			
2.1 Ambulatory Care	1762	$300.00	$130,000
2.2 Birthing	504	$416.00	$209,664
2.3 Clinical Support (excl. Imaging, incl. Main Entry and FOH circulation)	851	$260.00	$221,260.00
2.4 Emergency Department	754	$777.00	$585,858.00
2.5 Imaging	1849	$427.00	$789,523.00
2.6 Mental Health	1198	$561.00	$672,078.00
2.7 Non-Clinical Support	1509	$260.00	$392,340.00
2.8 Plant	961	$130.00	$124,930.00
Subtotal			**$3,744,165**
3 **ICT, Nurse Call and Electronic Security Services**			
3.1 Ambulatory Care	1762	$248.00	$436,976
3.2 Birthing	504	$300.00	$151,200
3.3 Clinical Support (excl. Imaging, incl. Main Entry and FOH circulation)	851	$200.00	$170,200
3.4 Emergency Department	754	$340.00	$256,360.00
3.5 Imaging	1849	$210.00	$64,680.00
3.6 Mental Health	1198	$222.00	$265,956.00
3.7 Non-Clinical Support	1509	$185.00	$279,165
3.8 Plant	961	$66.00	$63,426

Subtotal			**$2,242,633**
TOTAL			**$7,186,828**

8.1 General Exclusions and Clarifications:

- Active ICT and Audiovisual Equipment
- Digital imaging and monitoring systems
- Furniture, Fixtures and Equipment
- Builders Works
- Mobile distributed antenna system cost is subject to RF specialist detailed design
- Door Hardware
- Builder's mark up and GST
- Builder's Electrical Supplies and Site Preliminary Costs
- Escalation to Tender
- Builder's electrical supplies and preliminary costs
- Fire Detection and Emergency Warning Systems
- White goods and medical equipment
- Medical Pendants
- Future Perioperative Department. However, allowance of $10,000 has been made for cable trays to be installed in this project for the future Perioperative Department.
- Contingency
- Surgical Lights
- EMF Screening
- Televisions, Printers, Fax machines, MFD's Mobile phones, PC, Blu-ray/DVD players
- Software
- Photo voltaic panels
- Electrical works associated with road works to Ewingsdale Road, including service relocations and street lighting

9 Sustainability & Energy Saving Initiatives

The key sustainability objectives are:

- Comfortable and healthy indoor environment.
- Minimise non-renewable resource consumption.
- Cost-effectiveness over whole life span.

Minimisation of electrical consumption by ensuring that the design:

- Utilises energy efficient lamps, luminaires and associated control gear.
- Consider lamp life and maintenance requirements when selecting light fittings.
- Optimise use of natural lighting during daylight hours.
- Provide individual light switching for individual spaces and master switches for each functional area.
- Provide automatic lighting control including:
  - Building management system controls
  - Photoelectric controls
  - Time switches
  - Movement detectors
- Use of sub-metering for substantive energy uses within the building (Greater than 100kVA.)
- Separate sub-metering of lighting and power within new distribution boards.

10 Spacial Requirements

Spacial requirements for the major items of electrical equipment are as follows:

SPACE OR ROOM	SIZE	FIRE INTEGRITY OF SPACE OR ROOM	DOORS	COMMENTS	CODE OR STANDARD REFERENCES
Supply Authority Pad mount Substation (consisting of 1 off kiosk type)	Electrical easement of 7,000mm x 4,200mm.	Refer to Essential Energy Standards as per siting of kiosk type substations	Nil	Locate inside boundary on Ewingsdale Road boundary. Above 1:100 year flood level. 24 Hour truck/crane access.	Essential Energy standards
Main Electrical Switchboard Room.	Room, 12,000mm x 3,000mm with clear headroom of 3m	Walls, ceiling, floor 120/120/120 Doors --/120/30	One set of double equipment access doors 1,800mm wide x 2,400mm high and one single door 800mm wide x 2,100mm high. Doors to be spaced apart and open outwards	Doors to open outwards. Doors to be self closing. Room to have positive mechanical ventilation. Room to be free of island or intruding columns. Needs to be positioned maximum 40 m from kiosk type substation Consumers mains cabling from Substation to Main switchboard needs to be outside areas of possible future expansion. Preferable to follow roads.	AS.3000, clauses 2.9.2 . BCA clause C2.13(b) & (c).
Site UPS Room	Room 3,400mm x 2,500mm with clear headroom of 3,000mm	Walls, ceiling, floor 120/120/120 Doors --/120/30	One and a half leaf doorway required (1,300mm clear door opening). Doors to open outwards	Locate close to the Main Electrical Switchroom. Antistatic floor covering Room requires ventilation and conditioning.	BCA clause C2.12(a)(v)
Standby Generator Room	Canopy type Generator, No Room, required. Generator Size 4,600 x 1,600 (Provide 1,600 clear space around gen)			Canopy type generator located outside the building, close to the Main Switchboard. Acoustic treatment required. Access for diesel truck to refuel. 10m clearance from building to limit acoustic requirements.	
Distribution Board Cupboards	Cupboard 2,400mm wide x 600mm clear depth Clear headroom of 2,400mm.	Walls, ceiling, floor 120/120/120 Doors --/120/30 may be required so that sprinklers can be kept out of the cupboards.	One set of full height double doors	Each fire compartment to have its own DB Cupboard. Door/s to open outwards. Doors to be full height. Where is located in a path of travel to a required exit, doors are to be non-combustible and fitted with smoke seals.	AS.3000,clauses 2.9.9 and 2.9.10. BCA clause D2.7(d).

Communication Rooms	Campus Distributor: 3,400x 3,300 Floor Distributor 3,300mm x 2,600mm with clear headroom of 3,000m	Walls, ceiling, floor 120/120/120 Doors --/120/30	One and a half leaf doorway required (1,300mm clear door opening)	Maximum horizontal cable lengths from the BD to any outlet not to exceed 90m. This distance should be measured orthogonally and includes slack and cable rise/fall. Antistatic floor covering and non-dust creating wall and ceiling finishes Where door is located in a path of travel to a required exit, doors to be non-combustible and fitted with smoke seals. Doors to be solid core. Additional authority requirements may apply. Room requires ventilation, may need conditioning.	BCA clause D2.7(d).
Mobile Coverage : Telco Carrier Service Room	Room, 5,000mm x 4,000mm with clear headroom of 3,000m	Walls, ceiling, floor 120/120/120 Doors --/120/30	One and a half leaf doorway required (1,300mm clear door opening	Antistatic floor covering and non-dust creating wall and ceiling finishes Where door is located in a path of travel to a required exit, doors to be non-combustible and fitted with smoke seals. Doors to be solid core. Additional authority requirements may apply. Room requires ventilation, may need conditioning.	
CCTV	-	None required		At present we have assumed that CCTV NVRs will be housed within one of the communication rooms	

Appendix 1 - Drawings

Drawings Attached

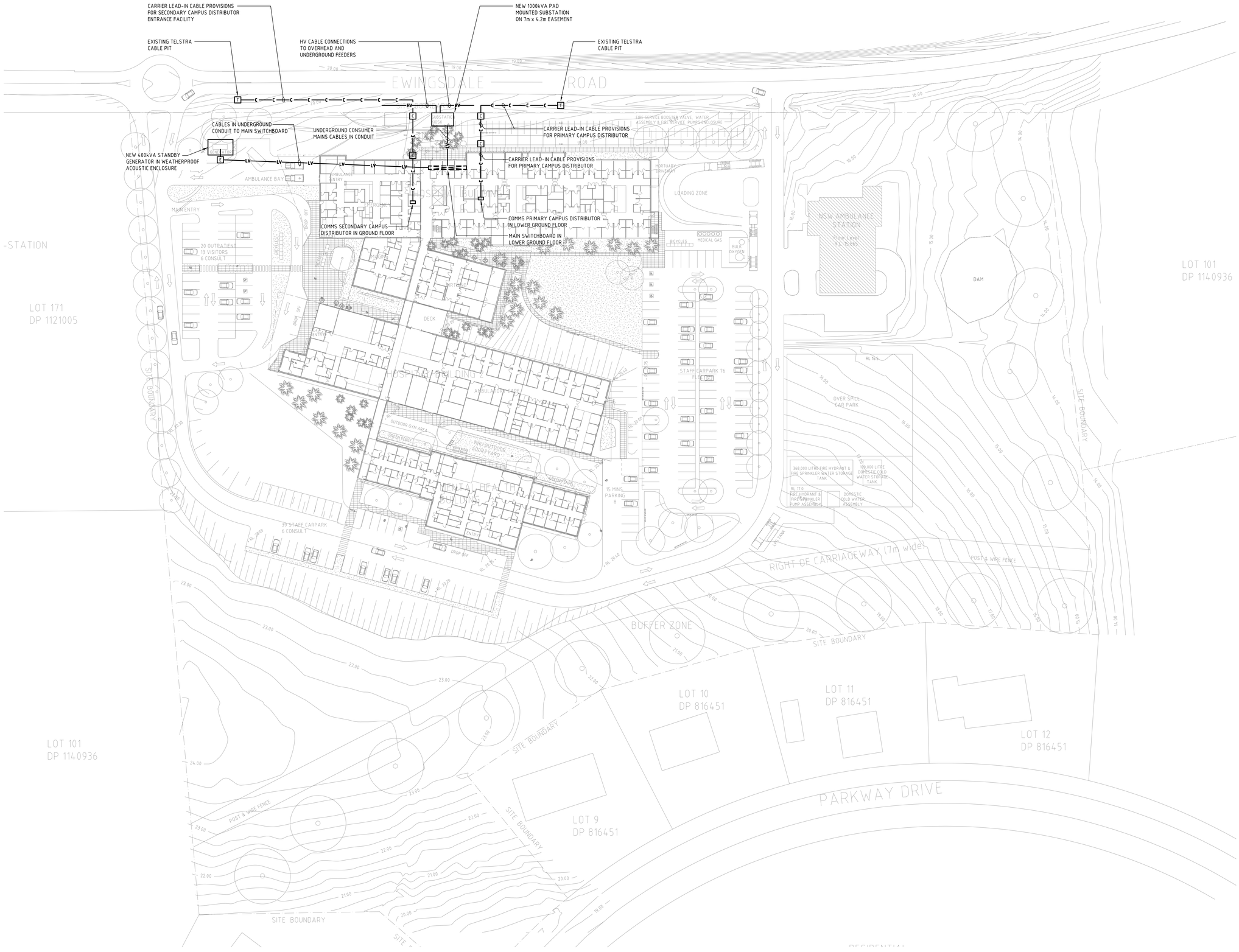
E- 1001 – Electrical Services - Site Infrastructure Plan

E- 1101 – Electrical Services - Lower Ground Floor Cable Containment

E- 1201 – Electrical Services - Ground Floor Cable Containment

E- 1801 – Electrical Services – Single Line Diagram

E- 1802 – Electrical Main Communication Schematic



REV.	DESCRIPTION	DRAWN	APP'D	DATE
C	FINAL SD ISSUE	JRR	MAM	31.07.14
B	PRELIMINARY	JRR	MAM	25.07.14
A	PRELIMINARY	BBB	MAM	22.07.14

CLIENT:

NSW GOVERNMENT Health Infrastructure

ARCHITECT:

WOODS BAGOT
AUSTRALIA
ASIA
MIDDLE EAST
EUROPE
NORTH AMERICA

WOOD & GRIEVE ENGINEERS
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NSW 2065
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Web: www.wge.com.au
PERTH
MELBOURNE
SYDNEY
BRISBANE
GOLD COAST
ALBANY
BUSSELTON
SHENZHEN
DARWIN

PROJECT:

BYRON SHIRE CENTRAL HOSPITAL

TITLE:

ELECTRICAL SERVICES
SITE INFRASTRUCTURE PLAN

PRELIMINARY
NOT FOR CONSTRUCTION

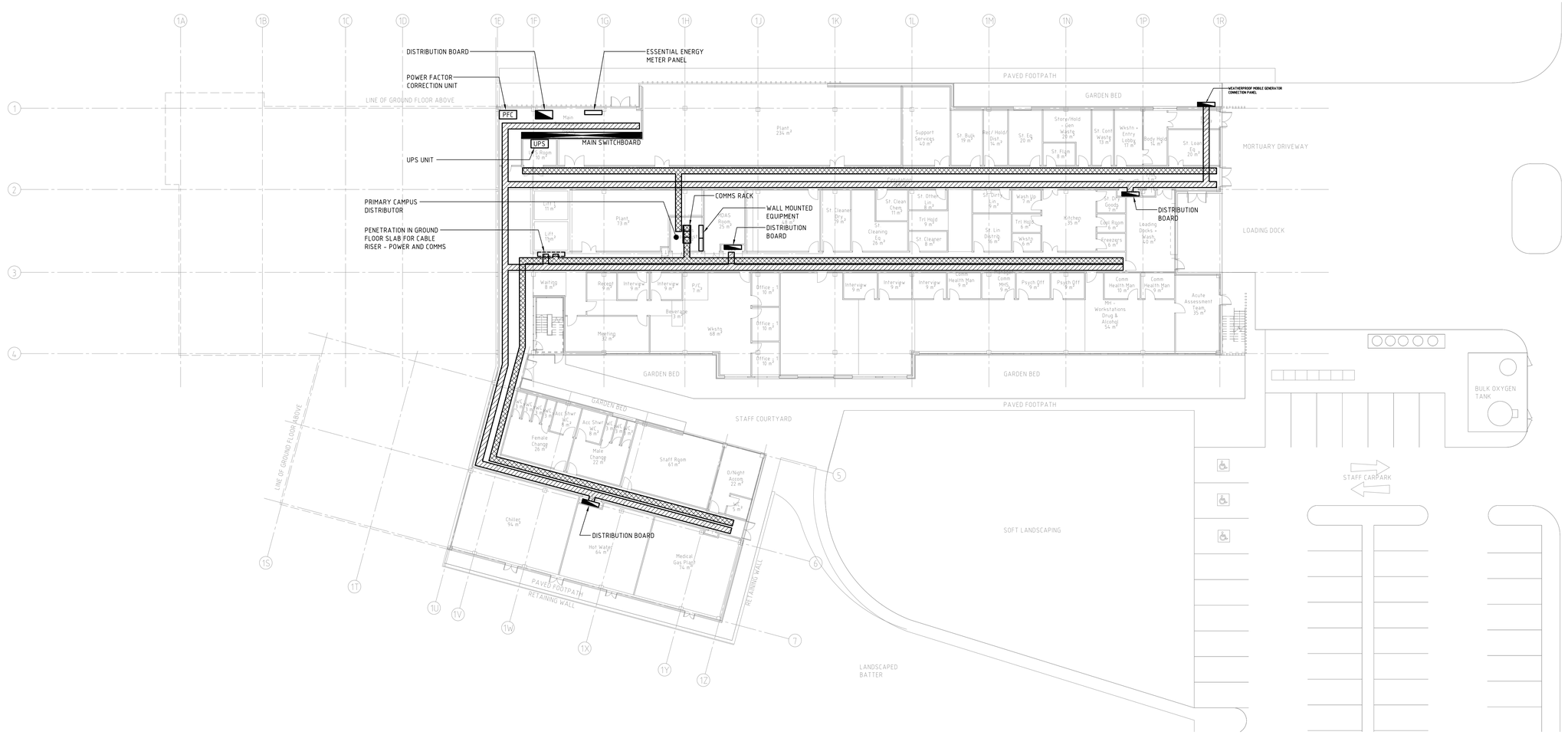
DESIGNED :	MAM	VERIFIED :	---
DRAWN :	BBB	APPROVED FOR TENDER :	---
SCALE :	1:500@B1	APPROVED FOR CONSTRUCTION :	---

CAD FILE: E-1001 - SITE INFRASTRUCTURE PLAN.dwg PLOT DATE/TIME: 31.07.14 10:38 AM

PROJECT No.	DRAWING No.	REVISION
26609-SYD	E-1001	C

North

B1 DRAWING - BUILDING SERVICES GROUP



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PERTH
MELBOURNE
SYDNEY
BRISBANE
GOLD COAST
ADAMY
BUSSELTON
SHENZHEN
DARWIN

PROJECT:

BYRON SHIRE CENTRAL HOSPITAL

TITLE:

ELECTRICAL SERVICES
LOWER GROUND FLOOR
CABLE CONTAINMENT

PRELIMINARY
NOT FOR CONSTRUCTION

DESIGNED :	MAM	VERIFIED :	---
DRAWN :	BBB	APPROVED FOR TENDER :	---
SCALE :	1:200@B1	APPROVED FOR CONSTRUCTION :	---

CAD FILE: E-1101 - LOWER GROUND FLOOR CABLE CONTAINMENT.dwg PLOT DATE/TIME: 30.07.14 10:37 AM

PROJECT No.	DRAWING No.	REVISION
26609-SYD	E-1101	B

B1 DRAWING - BUILDING SERVICES GROUP

DISTRIBUTION BOARD
SECONDARY CAMPUS DISTRIBUTOR
COMMS RACKS
POWER & COMMS RISERS
WALL MOUNTED EQUIPMENT
DISTRIBUTION BOARD
DISTRIBUTION BOARD
WALL MOUNTED EQUIPMENT
DISTRIBUTION BOARD
FLOOR DISTRIBUTOR
COMMS RACKS
DISTRIBUTION BOARD
DISTRIBUTION BOARD
DISTRIBUTION BOARD
WALL MOUNTED EQUIPMENT
FLOOR DISTRIBUTOR
DISTRIBUTION BOARD
COMMS RACKS
DISTRIBUTION BOARD
WALL MOUNTED EQUIPMENT
FLOOR DISTRIBUTOR

REV.	DESCRIPTION	DRAWN	APP'D	DATE
B	FINAL SD ISSUE	JRR	MAM	30.07.14
A	PRELIMINARY	BBB	MAM	22.07.14

CLIENT:

NSW GOVERNMENT Health Infrastructure

ARCHITECT:

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Email: sydney@wge.com.au
Web: www.wge.com.au
PERTH MELBOURNE SYDNEY BRISBANE GOLD COAST ALBANY BUSSELTON SHENZHEN DARWIN

PROJECT:

BYRON SHIRE CENTRAL HOSPITAL

TITLE:

ELECTRICAL SERVICES
GROUND FLOOR
CABLE CONTAINMENT

PRELIMINARY
NOT FOR CONSTRUCTION

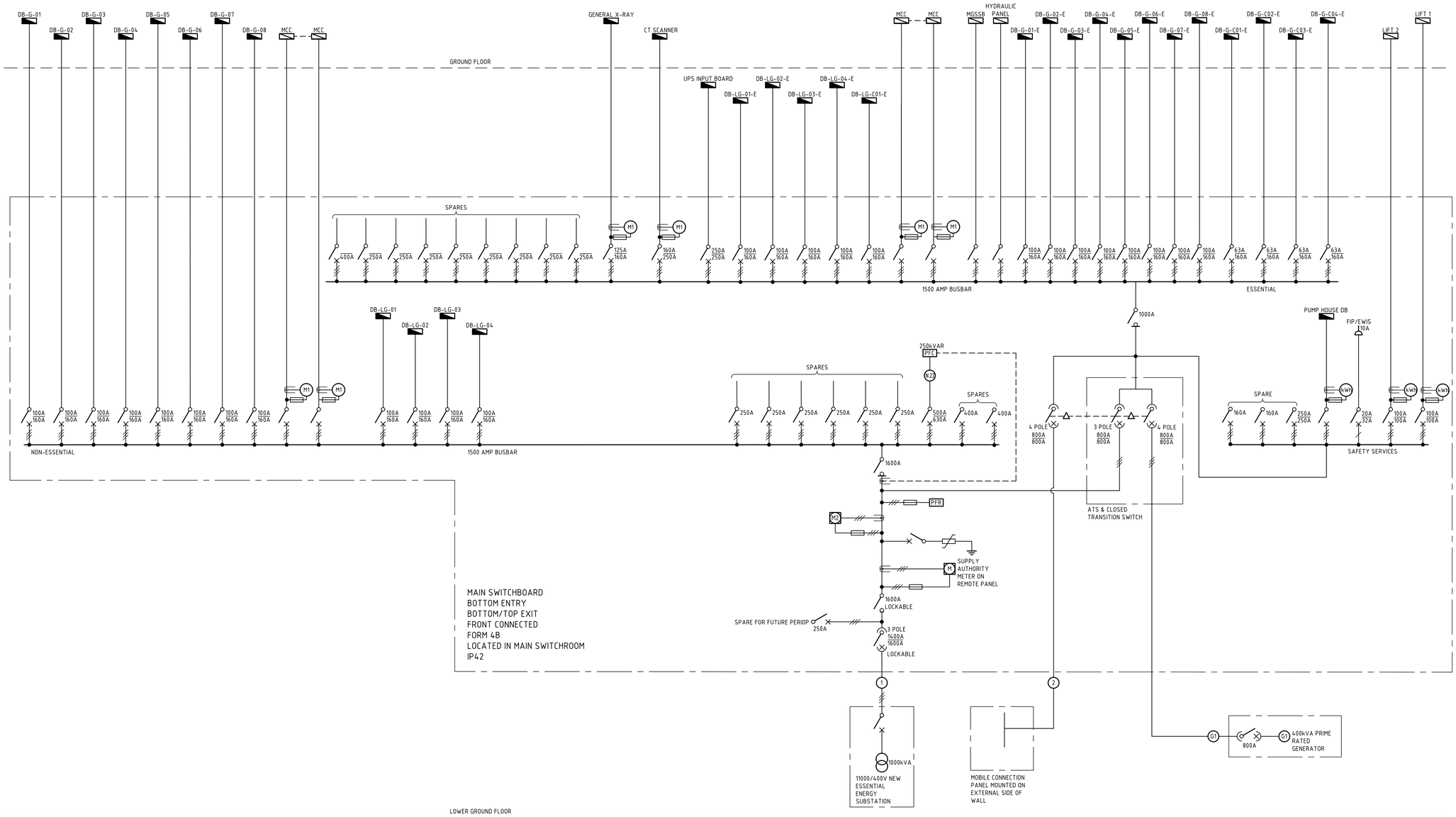
DESIGNED :	MAM	VERIFIED :	---
DRAWN :	BBB	APPROVED FOR TENDER :	---
SCALE :	1:200@B1	APPROVED FOR CONSTRUCTION :	---

CAD FILE: E-1201 - GROUND FLOOR CABLE CONTAINMENT.dwg PLOT DATE/TIME: 30.07.14 10:46 AM

PROJECT No.	DRAWING No.	REVISION
26609-SYD	E-1201	B

North

B1 DRAWING – BUILDING SERVICES GROUP



REV.	DESCRIPTION	DRAWN	APP'D	DATE
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A	PRELIMINARY	BBB	MAM	22.07.14

CLIENT:

NSW GOVERNMENT Health Infrastructure

ARCHITECT:

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SYDNEY
BRISBANE
GOLD COAST
ALBANY
BUSSELTON
SHENZHEN
DARWIN

PROJECT:

BYRON SHIRE CENTRAL HOSPITAL

TITLE:

ELECTRICAL SERVICES SINGLE LINE DIAGRAM

PRELIMINARY
NOT FOR CONSTRUCTION

DESIGNED :	---	VERIFIED :	---
DRAWN :	BBB	APPROVED FOR TENDER :	---
SCALE :	NTS@B1	APPROVED FOR CONSTRUCTION :	---

CAD FILE: E-1801 - SINGLE LINE DIAGRAM.dwg PLOT DATE/TIME: 30.07.14 10:47 AM

PROJECT No.	DRAWING No.	REVISION
26609-SYD	E-1801	C

North

B1 DRAWING – BUILDING SERVICES GROUP

LEGEND

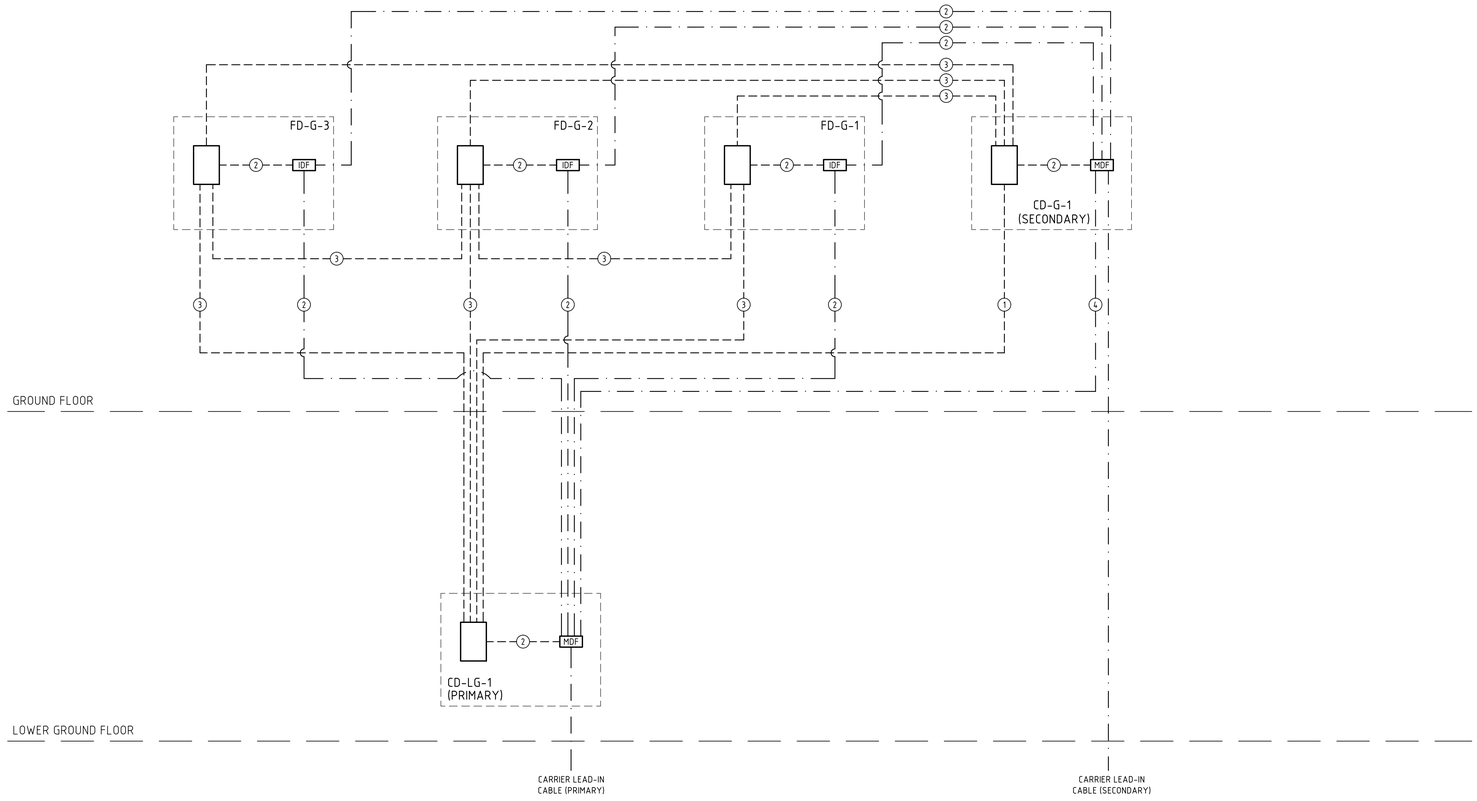
1. 24-CORE OS1 SINGLE MODE OPTIC FIBRE CABLE
2. 25-PAIR CATEGORY 3 CABLE
3. 12-CORE OS1 SINGLE MODE OPTIC FIBRE CABLE
4. 50-PAIR CATEGORY 3 CABLE

— · — CATEGORY 3 BACKBONE CABLE

– – – OPTIC FIBRE BACKBONE CABLE

NOTES

1. PROVIDE PACK-MOUNTED PATCH PANELS FOR ALL COPPER AND FIBRE CORES TERMINATED IN ALL NEW RACKS.
2. TERMINATE BOTH ENDS OF ALL CARES IN ALL CORES OF ALL CABLES.



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CLIENT:

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ARCHITECT:

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PERTH
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SYDNEY
BRISBANE
GOLD COAST
ALBANY
BUSSELTON
SHENZHEN
DARWIN

PROJECT:

BYRON SHIRE CENTRAL HOSPITAL

TITLE:

ELECTRICAL SERVICES
COMMUNICATIONS BACKBONE
SCHEMATIC

PRELIMINARY
NOT FOR CONSTRUCTION

DESIGNED :	MAM	VERIFIED :	---
DRAWN :	BBB	APPROVED FOR TENDER :	---
SCALE :	NTS@B1	APPROVED FOR CONSTRUCTION :	---

CAD FILE: E-1802 - COMMUNICATIONS BACKBONE SCHEMATIC.dwg PLOT DATE/TIME: 30.07.14 10:49 AM

PROJECT No.	DRAWING No.	REVISION
26609-SYD	E-1802	B

North

B1 DRAWING – BUILDING SERVICES GROUP

Appendix 2 – Essential Energy Design Information Package

DESIGN INFORMATION PACKAGE FOR Project: 105907 New Supply-Ewingsdale Road Bryon Bay-Byron Central Hospital Master Planning

Design Information Issue Date: 18/09/2013.

AECOM Australia Pty Ltd
PO Box Q410, QVB Post Office
SYDNEY NSW 1230

Introduction

Thank you for your application requesting electrical reticulation design information for the proposed supply to **Lot 100, DP 1140936**

Project Address: Ewingsdale Road Byron Bay NSW 2481

Customer Name: Daniel Lingwood (AURORA Project Pty Ltd)

General

1. The project number **105907** has been established and shall be used for all future reference and payment transactions.

2. The content of this design information package has been compiled on the basis of certain conditions and restrictions. The designer shall incorporate these requirements within the electrical reticulation design prepared for presentation to Essential Energy.

3. The design package will be valid for a period of 3 months from the above date.

4. Essential Energy is providing this information in good faith, to assist you to complete designs for certification. Essential Energy cannot and does not warrant the accuracy or completeness of the information and does not accept any liability for inaccuracies or lack of information. It is the responsibility of the applicant or Accredited Service Provider to independently confirm the accuracy or otherwise, of any information.

Connection Point & Specific Design Information

The nominated connection points on the network will be
1 Overhead: Between Zone Sub and Pole 78570.
2 Underground: At site to be agreed on..

Connection Point Voltage: **11,000 Volts 3Ø**

Existing Asset Details

The existing Overhead High Voltage Conductor is: **19/3.75 AAAC**
The existing Undeground High voltage conductor is. 11kV 240mm2 Al XLPE
The existing Low Voltage Conductor is: **Not Applicable**

The existing Substation is: **Not Applicable**

- Existing Substation HV Fuses are: **Not Applicable**
- Existing Substation LV Fuses are: **Not Applicable**

New Asset Details:

The Minimum size for the New HV conductor / cable required: **11kV 240mm 3 Core AL XLPE Extra heavy duty screening.**

The Minimum size for the New LV conductor / cable required: **Not Applicable**

The New Substation / size required is: **1000 kVA 3Ø**

- New Substation HV Fuses are: **80 Amp (Padmount)**
- New Substation LV Fuses are: **Circuit Breaker**

Pre Allocated Asset Numbers are as follows:
To be determinded and requested by Level 3 ASP

The Primary Tap setting

Primary Tap setting for this transformer is to be included on the drawing for certification.

The primary tap setting for this transformer is, 11550/250

General / Specific Project Comments:

Upgrade for Byron Central Hospital

Supply proposal for proposed hospital project.

The main supply will be from an overhead connection on the bottom circuit of the dual circuit construction located on the Southern side of Ewingsdale Road. This may require the installation of an inline pole as nearby Poles already have HV equipment mounted on them..

A second connection is to be used as an alternate soppy via the underground cable located in Ewingsdale Road.

11KV schematic diagram will be provided when connection poits have beeen determined.

Does this Project involve multiple stages?: **No**

This project involves a joint venture or materials to be supplied by Essential Energy: **No**

The nearest Essential Energy Depot is: **Ewingsdale**

Design Proposal

All design proposals or drawings must comply with the requirements of;

- CEOM7001 – Network Services – Design Construction Drawings,
- CEOM7097 – Overhead Design Manual,
- CEOM7098 – Underground Design Manual, and
- Relevant standards.

Please ensure the following are shown or noted on drawings;

- Trees of heritage or environmental significance,

- Locations of near by airstrips,
- Location of Telstra infrastructure,
- The local government land zoning, and
- Whether the construction is located within a SEPP area.

Designer to ensure that design does not impact on other services, e.g. Telstra, gas, water etc.

Essential Energy may require access to your property for the installation and future maintenance of Essential Energy's assets. You should keep this in mind when planning building works, earth works or tree planting to ensure clear access to our poles, substations, switches, etc – especially for cases of emergency such as storm or fire.

Network Connection Access

Design should endeavour to eliminate Customers outage where possible.

- A standard outage and access permit will be issued for this project.
- No outage is permitted, all construction works are to be completed in readiness for the connection, this means that all tails and Live Line clamps are to be fitted to the top of the EDO's, and Live Line type stirrups are to be left onsite for connection by the field operator.
- Unless approved, interruption to the existing customers must be avoided. This may require the ASP to:

    1. Provide a mobile generator, and it's connection
    2. Use of "Live Line Techniques".
    3. Arrange for LV interconnection by Essential Energy staff, where possible.
    4. The ASP is to carry out the connection work using Live LV work methods, that comply with the Electrical Safety Rules, (CEOP8030)

The cost of any required construction Live Line work shall be borne by the customer and suitable arrangements are to be made by the Level 1 Accredited service Provider (This work can be undertaken by Essential Energy at cost - contact Local Area Manager at an early stage for costs and scheduling of works).

Attached is Customer to Premise to Substation Relationships form. A copy of the completed form must be submitted to **contestablework.north@essentialenergy.com.au** as soon as practical after customers have been changed to another substation.

The Quality Compliance Coordinator for this project is.

Joel Myres . Phone.....

Project Funding & Reimbursement

All costs associated with the installation of the new electrical reticulation assets and the special requirements outlined in this package, including any live line work, shall be the customer's responsibility unless otherwise specified.

Attached is a Re-imbursement Form - customer is required to sign this form regardless of a re-imbursement scheme being implemented or not. Submit this form when plans are submitted for certification.

*Essential Energy's records indicate that there **is not** a pre-existing reimbursement scheme attached to the infrastructure where you request a connection.*

The amount payable to Essential Energy by your customer is **$ .00**

Please provide all details of the new customer's name, and address, so as Essential Energy can invoice your customer for the amount noted above.

Essential Energy will make this amount payable to the Original customer before connection of the new customer will be permitted.

Compulsory Network Fees

Compulsory network fees for this project are calculated in accordance with the Independent Pricing and Regulatory Tribunal of New South Wales, Rule 2000/1, Charges for Monopoly Services.

Your client is to be advised of any compulsory network fees that are applicable to this project.

Design Information Fees applicable for this project are $ 240.00

Some of the other typical compulsory network fees that may be applicable to this project are:

Design Certification (minimum fee)	$ 240.00

Note – some of the above fees may be subject to change due to design and outage requirements for the project.

The Schedule of rates is available on Essential Energy's website:

www.essentialenergy.com.au/content/Electricity-Network-Pricing-And-Information

GENERAL DESIGN INFORMATION

The design, construction, future maintenance and operation must comply with all relevant acts, regulations and policies including;

- Workcover NSW standards, guides and directives.
- Environmental Protection Authority of NSW standards, guides and directives.
- Relevant Essential Energy Policies and Guides.
- Department of Conservation and Land Management "Urban Erosion & Sediment Control - Field Guide"

All assets installed in the installation are to be in accordance with Essential Energy's manuals, General Terms and Conditions and Non-electrical Work Requirements as well as other documents referred to in these documents.

All materials used in construction must comply with Essential Energy Construction Standards. (Material used outside this standard will need to be approved prior to certification of design).

- Pole Locations as shown on the reticulation plan may not be accurate and should be checked in the field
- All Electronic information should be submitted to:

contestablework.north@essentialenergy.com.au

Easements

It is the applicant's responsibility to obtain easements in favour of Essential Energy over the power line routes through any properties that are affected as outlined in Essential Energy's document CEOP8046 Network Planning: Easement Requirements.

The applicant is responsible for all expense resulting from the establishment of easements including compensation to landholders, solicitors' fees and surveyors' fees.

Before design certification, Essential Energy must have a written undertaking from your Solicitor confirming that all Easement issues, including those associated with compensation to property owners, have been arranged. Your solicitor must provide us with written evidence that all affected property owners consent to the creation of the Easements required, advise us that the Easements are in the process of being created and provide us with a copy of the Deposited Plan showing the Easement when Easement creation has been finalised.

Property owners' names and addresses can be obtained from the Rates Department of the Local Council or the Land & Property Information (LPI).

Your Solicitor and Surveyor should be made aware that Essential Energy's standard recitals have been registered with the Land & Property Information (LPI) (Memorandum AG189384). In your case they should refer to Part A (overhead powerlines), Part B (underground powerlines) and Part C (multipurpose electrical installations) of this Memorandum. Wordings other than the standard recitals as registered with the Land & Property Information (LPI) will not be accepted by Essential Energy.

All negotiation and/or compensation which may be necessary by the creation of an easement for electricity purposes shall be the customer's responsibility.

Essential Energy's brief assessment indicates that Easements are required: **Yes**

Approvals

The customer shall be required to seek the necessary approvals from other relevant authorities that may be affected by the provision of electricity supply to the development site.

The Electricity Supply Act 1995 (NSW) has specific requirements regarding works on public roads and public reserves.

Section 45 of this Act requires that notice of proposed work must be given to the Local Councils and they must be given up to 40 days to comment. Power line construction works must **not** commence in public roads or reserves until 40 days after notice has been given.

This requirement can only be waived if the Local Council has provided comment within 40 days and Essential Energy Networks has given due consideration to the comments made.

A copy of the Local Councils comments is to be provided to Essential Energy for consideration before any designs will be approved or released.

If 40 days has lapsed and no comment has been received from the Local Council then the level 3 service provider is to provide to Essential Energy a copy of the notice submitted to the Council in concern.

Design Certification

1. In addition to the specific design parameters outlined in aforementioned clauses, the electrical design shall be prepared in accordance with the technical design requirements as specified in Essential Energy's Standards Manual.

2. The construction plan presented to Essential Energy's Officer for certification shall be prepared in accordance with the standards and specifications outlined in Essential Energy's Drawing Manual.

3. Failure to comply with either, Essential Energy's technical or drawing standards and specifications may result in the rejection of the design or drawing.

4. Plans must be submitted electronically.

5. Certification will remain valid for a period of 6 months from date certified.

6. All signed agreement documents shall be submitted in accompaniment with the plans presented for certification.

7. Further details of procedures and fees will be provided upon certification of the design.

8. Return designs for Certification to:

contestablework.north@essentialenergy.com.au

Advice on Capital Contributions & Repayments for Connections to our Network

IPART requires that Essential Energy administer a Reimbursement Scheme for rural and large load customers from 1 July 2002. (IPART Determination No. 1 2002, Capital Contributions and Repayments for Connection to Electricity Distribution Networks in NSW)

As an accredited service provider, you will be required to ascertain if a customer is eligible to participate in a reimbursement scheme prior to advising customers of any costs and connecting to the network system.

Failure to comply with the requirements of the Reimbursement Scheme may result in the withdrawal of authorisation.

Requirements of the Reimbursement Scheme are outlined in Essential Energy's document CEOP8020, available on the Essential Energy website at www.essentialenergy.com.au.

Additional advice on the Reimbursement Scheme may be obtained from Essential Energy's Manager Planning in the region in which the work is to be carried out or by telephoning Essential Energy's Business Data Co-ordinator on 13 23 91.

Essential Energy may request the Authorised Accredited Service Provider to undertake associated related works on behalf of Essential Energy. Essential Energy will require a quote before the Notification of Commence Construction is received. Payment for the Essential Energy funded component will be undertaken upon completion and receipt of an invoice from the Authorised Accredited Service Provider.

Environmental

An environmental impact assessment will be required. The assessment is to be completed in accordance with Essential Energy's Environmental Impact Assessment Policy CECM1000.70.

A completed Environmental Assessment Checklist must be submitted with Design Construction Plans for certification by Essential Energy.

Tree Clearing

All trees clearing along the route of the power line shall be the responsibility of the applicant. This work must be done in accordance with the requirements of Essential Energy's standard specification. Clearing should not commence until the consent of all affected landowners and Government bodies has been obtained by the applicant.

Erosion and Sediment Control

Trenching and other civil works involved in electricity installations have the potential to cause site erosion and sediment deposits in waterways if not properly managed. The Clean Waters Act 1970 (NSW) makes it an offence for corporations, employees or contractors to pollute any waters, or cause or permit any waters to be polluted, unless the polluter holds a licence to do so. The Clean Waters Act defines polluting waters very broadly. The definition encompasses the introduction of almost any matter into waters which cause a change of condition of the water. Pollutants include soil, metal, earth and clay.

The applicant shall meet the cost of and carry out any works necessary to implement suitable erosion and sediment control associated with trenching or other civil works. This shall include the development of erosion and sediment control plans.

Erosion and sediment control shall be installed according to the Department of Land and Water Conservation's field guide for erosion and sediment control.

Underground Electrical Works

All underground electricity assets must be located in the correct footpath allocations to comply with Essential Energy and Local Council allocations.

Underground electrical work to be inspected by Essential Energy Quality Compliance Coordinators when trenches are open with conduits installed prior to backfilling and on completion of works.

The developer is responsible to ensure that trench depths comply with mandatory separations between electricity, gas and Telstra as per Essential Energy Underground Construction Standards and or Essential Energy Shared Trench Agreement.

Substation Sites

- Unimpeded access is to be provided for Essential Energy vehicles and staff to the substation sites at all times.
- All padmount substations that are to be installed in area's that may effected by flooding are to be positioned above the 1:100 year flood level, evidence is to be provided by the local council, and made available to Essential Energy.
- All substations shall be positioned in such a location that allows access at all times, by a crane borer/erector.
- If an existing substation structure is being altered for any reason, then the structure is to be brought up to the current Essential Energy standards, in the case of an upgrade of the transformer only, then from the bottom of the EDO's down is to be brought up to the current standard. If there are no Live Line clamps connecting the EDO's to the main, the ASP to fit these during the outage provided.
- It is Essential Energy's preference for DEEP earthing always to be used over shallow earthing.
- Where practical, the preferred earthing system for distribution substations, (excluding SWER substations), is the Common Multiple Earth Neutral (CMEN) system. To achieve this single earthing system common to both the high voltage and low voltage at the substation, it is necessary to achieve impedance values for the substation local earth with and without the LV system Neutral connection.
- The type of earthing to be used based on the field information obtained, is to be specified on the construction drawing for certification.
- Should the ASP be upgrading an existing substation, then the existing earthing should be inspected to see if it is suitable for the new transformer being installed, if not then the earthing is to be upgraded to the current standards by the ASP.
- MDI's should be installed on substations as per Overhead & Underground Construction Standards.
- Where High Fault Levels Exist, it maybe appropriate that Fault Tamer / SMD 20 fuses are used. Where Fault Tamer Fuse's are designated by the Design Information Issuer, consultation will be required with Network Planning regarding fuse sizes and types.

Street Lighting

All lighting designs to comply with Australian Standard 1158.
42 watt compact fluorescent luminaires are to be used as the standard for all minor road lighting.

All street lighting in an underground supplied subdivision is to comply with the Underground Construction Manual CEOM7199 (Document CEOM7206)

All street lighting in an overhead supplied situation is to comply with the same lamp sizes as indicated in the underground manual. Refer to CEOM7199 (Document CEOM7206.05)

Restoration of Site

The applicant shall be required to reinstate, restore and clean up trench routes, road crossings and the site generally to the appropriate standards acceptable to the local Council or adjacent property owners which may be affected by such work.

It shall remain the applicant's responsibility to contact the local Council for further details regarding the Local Council's Standard Footpaths and Roadways Restoration Policy and make necessary inspection arrangements as required. Essential Energy will not accept any responsibility for footpaths or roadways requiring attention upon completion of the work performed by the applicant, and subsequent inspection and approval by the local Council.

All removed materials from this project are to be returned to the closest Essential Energy Field Service Centre.

Preventing Interference to Other Network Customers

All motor starting must comply with the NSW Service and Installation Rules. Motors will require an approved form of reduced current starting, and motor re-starting to be delayed or non-automatic (manual) following a power outage.

Large motors, arc furnaces, rectifiers (eg welders), large inverters, single phase to three phase converters, x-ray machines etc. can degrade the power quality at the customer's own installation and cause adverse effects to the supply of other customers and also to Essential Energy's equipment e.g. interference with the frequency injection signal.
The effects from such equipment on power quality may include:

- Voltage sags and swells;
- Harmonics & Inter-harmonics;
- Voltage fluctuations;
- Voltage unbalance;
- Impulsive and oscillatory transients;
- Notching.

Any new load must comply with the relevant Australian Standards, NSW Service and Installation Rules and the Electricity Supply Act 1995 to prevent interference to other customers and electrical equipment.

A power quality logger should be installed before and after the connection where it is suspected that the new load may cause interference to other customers.

Inverter Equipment

Inverter equipment can cause harmonic distortion problems to the distribution network - particularly high impedance rural networks. Single phase to three phase inverters or any motor supply inverter equipment is not to be connected to distribution network unless written approval is granted from Essential Energy. This approval is subject to a report being submitted to Essential Energy proving that harmonic emission levels meet the requirements of AS 61000 series. This should be done on a site by site basis based on impedance levels at the point of connection in the distribution network.

To ensure compliance inverter equipment may need to be fitted with suitable harmonic filtering devices.

Acceptability of Loads and Emission Allocations

Low Voltage Installations

At this stage there is no Australian or IEC standard for the allocation of emissions for low voltage installations/loads. Low voltage equipment must however meet equipment standards such as: AS/NZS61000.3.3, AS/NZS61000.3.5 and AS/NZS61000.3.11 for voltage fluctuations/flicker emissions; AS/NZS61000.3.2, AS/NZS61000.3.4, AS/NZS61000.3.12 for harmonic current emissions.

Customers should be advised that the connection of new equipment must meet these standards.

Compliance with these standards does not assure that the installation will not cause interference to others customers

Medium Voltage Installations

Medium voltage installations/loads are to be considered and allocated emission limits using the guidance of:

- Harmonics HB264 Clause 1.4 to 1.6;
- Voltage Fluctuations/Flicker HB264 Clause 3.5;
- Voltage Unbalance IEC/TR 61000-3-13;
- Voltage Swells Figure S5.1a.1 of the National Electricity Rules should not be exceeded.

Schedule of Forms submitted to Essential Energy:

CEOF9096 - Solicitors' Undertaking that Easement will be Created.

CEOF9090 – Solicitors' Undertaking that Easement has been Created.

CEOF9082 – Consent Form – Customer Funded Project.

CEOF9093 – Consent Form – Schedule of Works Required.

CEOF9097 – Terms of Easement for Overhead Powerlines

CEOF9098 – Terms of Easement for Underground Powerlines.

CEOF9099 – Term of Easement for Multi-purpose Electrical Installation.

CEOF6127 – Public Lighting: Installation and Connection Consent.

CEOF6010 – Design Information

CEOF6011 – Design Submission

CEOF6012 – Notification to Commence Construction

CEOF6013 – Notice of Required Outage / Connection

CEOF6302 – Completion Notice

CEOF6024 – Environmental Impact Assessment Checklist

All these forms and more are available from Essential Energy's website:

www.essentialenergy.com.au/content/contestable-works

Customer - Premise to Substation Relationship Change Record

Description of changes:

Town or Locality:

Field initiated change? Tick Appropriate	**If 'Yes' Changes authorised by:**
Yes ☐ **No** ☐	Employee Name

If **Yes** complete **Field Data Collection Section** below and forward this sheet to the **Planning Manager** for the appropriate region

Or

Project raised by: Tick Appropriate	**Planner**		**Design**	✓	**Power Quality**	
Responsible officer			Number of Premises to be impacted			
WASP No.		Section or Department Reference (**optional**)				

Changed network data collected by		**Field Changes made to the network by**	
Employee Name		Employee Name	

Premise address detail Street No/Name	Substation No. before change	Substation No. after change	Meter No.	Date of change

When the field data capture has been completed this form is to be forwarded to the **Planning Manager** for the region in which the change took place. The Planning Manager will then forward the form to the **Network Support Systems Section** at 8 Buller St. Port Macquarie.

Planning Manager Review and Sign Off	Authorising Officer	Date Reviewed	**Forward completed form to NSS Section 8 Buller St. Port Macquarie**
	_____	__/__/__	

Data entry completed by the Network Support Systems Section.	Entered by	Date Entered
ENERGY records updated	_____	__/__/__

Shared Asset Reimbursement Scheme Original Customer Agreement

*This Form **MUST** be completed and returned with the submitted design even if not participating in an available reimbursement scheme, provided the customer is eligible to participate*

I/We.....own the land described as:

.....

Lot No:..... DP No:.....

I have submitted an Application for Connection; Reference No:.....

☐ **I/We wish to participate** in the Shared Asset Reimbursement Scheme. **Yes** I wish to participate
(If you do wish to participate, please complete the section titled "My Selected Number of Prospective New Customers".)

☐ **I/We do not wish to participate** in the Shared Asset Reimbursement Scheme. **I do not** wish to participate
(If you do not wish to participate, please complete your contact details at the bottom of the page, sign and return.)

My Authorised Service Provider has:

- Provided me with information regarding the Shared Asset Reimbursement Scheme.
- Consulted with me to determine the Number of Prospective New Customers.

(If you have not been consulted and need more information regarding the Number of Prospective New Customer please contact your Authorised Service Provider.)

I agree that the box below indicates My Selected Number of Prospective New Customers, connecting to the shared network funded by me: (Please complete)

Description of Contributed Assets	Suggested Number of Prospective New Customers **(Service Provider use only)**	My Selected Number of Prospective New Customers **(Not including myself)**
High Voltage line		
Distribution Substation		
Low Voltage line		

The effective commencement date will be the date of the acceptance of offer.

I accept that any reimbursement will be paid only after each New Customer pays a reimbursement to Essential Energy.

I also agree that should I sell the property within the 7 year period I will advise Essential Energy of the date of sale and the name and address of the purchaser, any reimbursement will be paid to the then owner of the property described above.

Expenses for easements and clearing may be added if copies of applicable tax invoices are supplied to the Essential Energy Reimbursement Coordinator before any quotations are prepared for new customers.

My postal address is:.....

Telephone No./s:.....

.....	.....	...../...../.....
Signature of Owner	Name of Owner (PRINTED)	Date

Please Return to Authorised Service Provider at:.....

Appendix 3 – Electromagnetic Interference Report

ELF EMF Measurement

FOR:

NSW GOVERNMENT HEALTH INFRASTRUCTURE
c/o Wood & Grieve Engineers
6/207 Pacific Hwy
St Leonards, NSW 2065

PROJECT:

BYRON SHIRE CENTRAL HOSPITAL DEVELOPMENT
Evingsdale Road
Byron Bay, NSW 2481

REPORT: **F1019**
DATE: June 2014

ELF EMF Measurement

Report: **F1019**
Issue: June 2014

Test Location: Lot 54
Evingsdale Road
Byron Bay, NSW 2481

Client Details: NSW Government Health Infrastructure

c/o: Mark Mulholland

Wood & Grieve Engineers
6/207 Pacific Hwy
St Leonards, NSW 2065

Tel: 02 8484 7000 / 02 8484 8002 / 0409 884 318
E-mail: mark.mulholland@wge.com.au

Specification: National Health & Medical Research Council (NH&MRC)
Interim guidelines on limits of exposure to 50/60 Hz electric and magnetic fields (1989), Radiation Health Series No.30.

AS/NZS™ 61000.6.1:2006 Electromagnetic Compatibility (EMC) Generic standards – Immunity for residential, commercial and light-industrial environments

AS/NZS™ 61000.4.8:2012 Electromagnetic compatibility (EMC) - Testing and measurement techniques - Power frequency magnetic field immunity test

AS/NZS™ 3003:2011
Electrical installations – Patient areas

Issued by:

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Prepared by:	Checked by:	
		16/06/2014
Darek Ocias	John Kennett	Date
(Project Engineer)	(Project Manager)	

REVISION HISTORY

Revision	Issue date	Changes
Draft	10/06/2014	n/a
0	16/06/2014	**p. 4**, second opening paragraph: word "*eastern*" corrected with "*western*"
		Section 2: conversion table expanded
		Section 4.3.1.2: references to specific MRI unit manufacturer removed sentence about application of HV transformer distances to cables removed
		Section 8.4: explanatory sentence "*where the cables' distance to the ground was the shortest*" removed
		Section 8.5: words "*where the cables' distance to the ground was the shortest*"
		Section 9.1: measured minimum and maximum magnetic field levels inserted
		Section 9.2: first paragraph: *"up to 68% (winter load)"* was replaced with *"to up to 68% (winter load) of the substation's total capacity"* second paragraph: last sentence revised and moved to Section 9.3
		Section 9.3: "first paragraph revised"
		Spelling, grammatical and syntax errors corrected

ELF EMF MEASUREMENT
for

NSW GOVERNMENT HEALTH INFRANSTRUCTURE c/o WOOD & GRIEVE ENGINEERS

Contents

ELF EMF MEASUREMENT
for

NSW GOVERNMENT HEALTH INFRANSTRUCTURE c/o WOOD & GRIEVE ENGINEERS

SUMMARY

As part of the development of Byron Shire Central Hospital, new buildings will be constructed on Lot 54 at Evingsdale Road, Byron Bay, NSW.

Lot 54 is adjacent to the electrical Zone Substation owned by Essential Energy. High Voltage (HV) cabling is distributed overhead along the northern boundary of the lot, while the western, and in parts southern boundaries have the HV and Low Voltage (LV) services laid underground. See Fig. 1 in Appendix A.

Concerns were raised about the possible impact of the electrical services on people, and medical equipment/instrumentation sensitive to electromagnetic interference.

Faraday Pty Ltd was engaged to:

- conduct power frequency electromagnetic field (EMF) measurements within Lot 54 to establish the levels of the electromagnetic interference (EMI) from the Zone Substation and associated overhead and underground cabling
- extrapolate the levels of EMI at present, and considering future maximum demand
- assess the measured and calculated EMI levels against limits set in the relevant standards and guidelines
- recommend solutions in cases of non-compliance, including EMF mitigation and/or establishing of exclusion zones, if necessary.

The following documents were taken into consideration in establishing the required levels of exposure for the new facility:

- National Health & Medical Research Council (NH&MRC)
  Interim guidelines on limits of exposure to 50/60 Hz electric and magnetic fields
- UK National Radiological Protection Board - Advisory Group on Non-Ionising Radiation (AGNIR)
  Power Frequency Electromagnetic Fields and the Risk of Cancer
- Australian and New Zealand Standard AS/NZS™ 61000.6.1:2006
  Electromagnetic Compatibility (EMC) Generic standards – Immunity for residential, commercial and light-industrial environments
- Australian and New Zealand Standard AS/NZS™ 61000.4.8:2012
  Electromagnetic compatibility (EMC) - Testing and measurement techniques - Power frequency magnetic field immunity test
- Australian/New Zealand Standard AS/NZS™ 3003:2011
  Electrical installations – Patient areas
- various MRI units installation manuals

The 50Hz magnetic field measurements were taken along Lot 54's boundaries and reported as the combined field value of the three axes.

All readings were taken at the present (as on 4/06/2014, between 10:am and 3pm) load conditions for the existing electrical system.

Field levels varied between less than 10nT (0.01μT) and 830nT (0.83 μT) with the load fluctuations at the time of the measurements not exceeding ±5%.

The harmonic content of the measured magnetic field did not exceed 2.5% and registered the highest value of 4nT with the fundamental of 160nT.

A significant reduction of the magnetic field was observed when the measurements were taken inside Lot 54's boundaries, away from the electrical services. The minimum decrease of 34% (from 0.35μT to 0.23μT) occurred 5m into the property, gradually reaching 72% (from 0.23μT to 0.065μT) at 20m.

From the measurements, none of the magnetic field limits prescribed in the reference standards and guidelines were exceeded within the boundaries of Lot 54.

The 132kV load data obtained from Essential Energy indicate that the electrical system was loaded to 46.2% at the time of measurement.

The company forecasts the increase in power consumption to up to 68% (winter load) of the substation's total capacity by 2019.

There are presently no plans to increase the designed capacity of the substation, but the recorded magnetic field may still double after 2019. However, for the next five years, the magnetic field should not increase to levels exceeding its current values by 50%.

Considering the information obtained to date, none of the magnetic field limits, as stated in the referenced standards and guidelines, should be exceeded in the event of the Zone Substation being loaded to its maximum capacity. This is with the exception of faults or severely unbalanced phase loads.

The expected increases in the magnetic field level may impact only on the most sensitive hospital equipment as defined in section 4.3.2 of this report. This is because the externally generated field will combine with the field generated by in-building electrical services.

Irrespective of the above, magnetic shielding may be required to some of the in-building electrical services to protect the highly sensitive hospital equipment. The future shielding requirement, if any, can be determined based on the magnetic field calculations considering the field sources external and internal to the building.

ELF EMF MEASUREMENT
for

NSW GOVERNMENT HEALTH INFRANSTRUCTURE c/o WOOD & GRIEVE ENGINEERS

As part of the development of Byron Shire Central Hospital, new buildings will be constructed on Lot 54 at Evingsdale Road, Byron Bay, NSW.

Lot 54 is adjacent to the electrical, 30MVA (N-1) Zone Substation owned by Essential Energy. High Voltage (HV) cabling is distributed overhead and underground along northern boundary of the lot, while the western, and in parts southern boundaries have the HV and Low Voltage (LV) services laid underground only. See Fig. 1 in Appendix A.

Concerns were raised about the possible impact of the electrical services on people, and medical equipment/instrumentation sensitive to electromagnetic interference.

1. SCOPE

Faraday Pty Ltd was engaged to:

- conduct power frequency electromagnetic field (EMF) measurements within Lot 54 to establish the levels of the electromagnetic interference (EMI) from the Zone Substation and associated overhead and underground cabling
- extrapolate the levels of EMI at present, and considering future maximum demand
- assess the measured and calculated EMI levels against limits set in the relevant standards and guidelines – see specification on page 2 of this report
- recommend solutions in cases of non-compliance, including EMF mitigation and/or establishing of exclusion zones, if necessary.

2. UNITS

For the purpose of this report, the magnetic flux densities have been expressed in Tesla, abbreviated as T.

Note that the older unit, used prior to year 1988 (when full transition from the Imperial to the International System of Units, SI, occurred in Australia), was Gauss - abbreviated as Gs or G:

1 T = 10 kGs	1 kGs = 0.1 T	1 T = 10^6 µT
1 mT = 10 Gs	1 Gs = 0.1 mT	1 µT = 10^3 nT
1 µT = 10 mGs	1 mGs = 0.1 µT	1 nT = 10^{-3} µT
1 nT = 10 µGs	1 µGs = 0.1 nT	

3. REGULATIONS

3. 1 Human exposure to power frequency magnetic field

3.1.1 Currently there is no standard in Australia regulating human exposure to power frequencies electromagnetic field.

In December 2006 Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) released the draft *Radiation Protection Standard: Exposure Limits for Electric and Magnetic Fields 0Hz – 3kHz*. The standard, however, has not been ratified to date.

3.1.2 Human exposure to power frequency magnetic fields is currently regulated by the National Health and Medical Research Council (NHMRC) *Interim guidelines on limits of exposure to 50/60 Hz electric and magnetic fields (1989), Radiation Health Series No.30*.

3. 2 Electronic and electrical equipment exposure to magnetic fields

3.2.1 The following standards regulate exposure to power frequencies magnetic field for general and medical electronic and electrical equipment:

- Australian and New Zealand standard *AS/NZS™ 61000.6.1:2006 Electromagnetic Compatibility (EMC) Generic standards – Immunity for residential, commercial and light-industrial environments*
- Australian and New Zealand standard *AS/NZS™ 61000.4.8:2012 Electromagnetic compatibility (EMC) - Testing and measurement techniques - Power frequency magnetic field immunity test*
- Australian and New Zealand standard *AS/NZS™* 3003:2011 *Electrical installations – Patient areas.*

3.2.2 The most sensitive to electromagnetic interference medical equipment has the immunity levels individually specified by the manufacturer. This includes Magnetic Resonance Imaging (MRI), Electroencephalography (EEG), Electromyography EMG), and Electronystagmography (ENG), devices.

4. EXPOSURE LIMITS

4. 1 Human exposure limits

4.1.1 The NHMRC guidelines recommend the following limits of exposure to the power frequency magnetic field:

- *members of the general public should not be exposed on a continuous basis to unperturbed magnetic flux densities exceeding 0.1mT. This restriction applies to areas in which members of the general public might reasonably be expected to spend a substantial part of the day*

- *for the general public, exposures to magnetic flux densities between 0.1mT and 1mT should be limited to a few hours per day. When necessary, exposures to magnetic flux densities in excess of 1mT should be limited to a few minutes per day*

- *continuous occupational exposure during the working day should be limited to magnetic flux densities not greater than 0.5mT*

- *short-term occupational whole body exposure for up to two hours per workday should not exceed a magnetic flux density of 5mT. When restricted to the limbs, exposures up to 25mT can be permitted.*

4.1.1.1 Concerns about the NH&MRC values were already summarised in the NSW Government commissioned comprehensive report by Sir Harry Gibbs: *Inquiry into Community Needs and High Voltage Transmission Line Development (1991)*.

The report outlines that the recommended exposure levels are well above the levels at which the fields may create a risk, as suggested in the guidelines. However, it should be recognised that the guidelines were established on the basis of instantaneous or short term exposure to the EMF. The limits, therefore, do not apply to the avoidance of a risk resulting from chronic exposures to power frequency electromagnetic fields.

4.1.1.2 The scientific report published in 2000 by the British Journal of Cancer, *A pooled analysis of magnetic fields and childhood leukaemia, 83(5), 692–698 (2000)*, suggests a statistical correlation between the time weighted long term average exposure level of 0.4μT and increased occurrences of childhood leukaemia.

4.1.1.3 The UK National Radiological Protection Board Advisory Group on Non-Ionising Radiation (AGNIR) accepted the BJC's report findings: *Power Frequency Electromagnetic Fields and the Risk of Cancer (2001).*

4.1.1.4 Due to increasing concerns about the effect of magnetic fields on people, a growing number of scientific and health organizations around the world tend to agree that the limit for continuous exposure to power frequency magnetic field should be set below 0.4μT time weighted average.

4.1.1.5 Considering the limit given above, a 24 hour continuous exposure to 0.4μT magnetic field is equivalent to 1.2μT exposure over an 8 hour (typical workday) period:

$$0.4\mu T \cdot 24 \text{ hours} \equiv 1.2\mu T \cdot 8 \text{ hours}$$

As it is impossible to guarantee no exposure to magnetic field after the 8 work hours, the calculated 1.2μT level needed to be reduced to 1μT. This allows for the additional continuous average exposure of 0.1μT during the rest of the day:

$$0.4\mu T \cdot 24 \text{ hours} \equiv 1\mu T \cdot 8 \text{ hours} + 0.1\mu T \cdot 16 \text{ hours}$$

4.1.2 The 1μT human exposure level as stated above is to be considered as an alternative to the 100μT non-occupational limit prescribed by NH&MRC.

4. 2 Electronic and electrical equipment exposure limits by Standards

4.2.1 *AS/NZS™ 61000.6.1:2006* sets the generic limit for immunity to power frequency magnetic fields as:

- 3A/m (equivalent to approximately 3.75μT) for all equipment
- 1A/m (equivalent to approximately 1.25μT) for magnetic deflection screen based equipment (ie Cathode-Ray Tube (CRT) Visual Display Units (VDUs).

4.2.2 AS/NZS 61000.4.8:2012 sets the 3A/m (equivalent to approximately 3.75μT) for all medical electrical equipment.

4.2.3 AS/NZS™ 3003:2011 sets the maximum allowed power frequencies magnetic field level in patient areas, where low-voltage medical equipment will contact patients at:

- 3μT – broadband total
- 1.6μT – individual harmonics.

4.2.3.1 Patient areas, are defined as:

- cardiac catheterisation laboratories
- intensive care units
- coronary care units
- resuscitation units
- accident and emergency departments
- outpatient departments for diagnostic, i.e. ECG
- stress testing units.

4. 3 Specific medical equipment exposure limits to electromagnetic interference

4.3.1 MRI equipment manufacturers typically specify minimum required distances to the magnet for various types of electromagnetic disturbance sources e.g. ferromagnetic objects in motion (not in the scope of this report), power transformers. Some manufacturers also identify permissible magnetic field levels depending on the source's distance to the magnet.

4.3.1.1 MRI units are typically susceptible to 50Hz magnetic fields of approximately 2μT level.

4.3.1.2 The table below gives typical distances to 1.5T MRI units at which HV power transformers are allowed to be present not to cause interference:

Transformer	Minimum distance to iso-center of a magnet [m]	
	perpendicular to patient table	along patient table
< 100kVA	5.5	6.5
100 – 250kVA	6	7
250 – 650kVA	6.5	8
650 – 1600kVA	7	9.5

4.3.1.3 As the exposure limits vary between the MRI systems' manufactures and also differ depending on the type of magnet, the above given values are not to be applied universally.

4.3.2 An electromagnetic environment for EEG, EMG, ENG equipment; equipment used for electrophysiological and vestibular assessments is substantially more restrictive. The manufacturers often do not specify immunity levels as they depend on the equipment setup, patient's physical condition, and nature of the conducted medical examinations.

Some of the devices are sensitive to magnetic fields even below 0.1μT.

5 TEST EQUIPMENT

MAGNETIC FIELD MEASURING SYSTEM			
DEVICE	**MAKE/MODEL**	**SERIAL NO.**	**Cal. Due**
LF Spectrum Analyser	Aaronia AG / Spectran NF-5035	42538	21/01/2016

6 TEST METHODOLOGY

6.1 The 50Hz magnetic field measurements were taken along Lot 54's boundaries at regular intervals 1m above the ground.

6.2 The measurements were taken with the test equipment set to measure the combined field value of the three axes.

6.3 Spot measurements were taken where required to check the field reduction rate with distance.

6.4 Harmonics' level was monitored to establish its content in relation to the fundamental frequency.

7 LIMITATIONS

5.1 Measurements were taken at the present (as on 4/06/2014, between 10:am and 3pm) load conditions for the existing electrical system.

The load conditions are as per Table 1.

5.2 Following changes in power consumption, it may be necessary to investigate the possibility of increased magnetic field emissions.

Table 1. Phase load in Amperes [A], averaged over 5 minute periods.

Date / Time	132kV	11kV
4/06/2014 10:00	112	394
4/06/2014 10:05	106	394
4/06/2014 10:10	106	394
4/06/2014 10:15	106	394
4/06/2014 10:20	106	394
4/06/2014 10:25	106	394
4/06/2014 10:30	106	394
4/06/2014 10:35	108	407
4/06/2014 10:40	108	408
4/06/2014 10:45	108	408
4/06/2014 10:50	108	408
4/06/2014 10:55	108	407
4/06/2014 11:00	114	404
4/06/2014 11:05	115	406
4/06/2014 11:10	109	397
4/06/2014 11:15	107	397
4/06/2014 11:20	101	380
4/06/2014 11:25	101	379
4/06/2014 11:30	101	375
4/06/2014 11:35	101	375
4/06/2014 11:40	101	375
4/06/2014 11:45	101	375
4/06/2014 11:50	93	375
4/06/2014 11:55	93	381
4/06/2014 12:00	93	374
4/06/2014 12:05	95	379
4/06/2014 12:10	95	376
4/06/2014 12:15	95	378
4/06/2014 12:20	99	386
4/06/2014 12:25	100	375
4/06/2014 12:30	100	375
4/06/2014 12:35	94	373
4/06/2014 12:40	94	378
4/06/2014 12:45	97	372
4/06/2014 12:50	99	371
4/06/2014 12:55	102	371
4/06/2014 13:00	104	378

8 MEASUREMENT RESULTS

8.1 The measurement results taken along each of the boundaries of Lot 54 are given it table 2.

Table 2. Magnetic field, in nT, measured along boundaries of Lot 54

Boundary A (at each post)	Boundary B (each ~5m)	Boundary C	Boundary D (each ~10m)
345 (corner)	830 (corner)	<10 (corner)	340 (corner)
195 (2.6m from corner)	695	<10 (~5m from prev.)	265
140 (each 4.2m)	190	<10 ↓	350
100 ↓	80	10 ↓	350
70 ↓	50	10 ↓	355
55 ↓	35	10 ↓	320
45 ↓	25	15 ↓	305
25 ↓	20	15 ↓	275
20 ↓	15	15 ↓	245
30 ↓	15	20 ↓	225
55 ↓	10	20 ↓	230
75 ↓	10	25 ↓	250
105 ↓	<10	25 (C2 - gate)	270
155 ↓	<10	30 (4.1m from prev.)	305
165 ↓	<10	30 ↓	320
150 ↓	<10	30 ↓	335
140 ↓	<10	35 ↓	350
135 ↓	<10	35 ↓	345
140 ↓	<10	35 ↓	350
130 ↓	<10	40 ↓	350 (corner)
135 ↓	<10	40 ↓	
135 ↓	<10	40 ↓	
135 ↓	<10	45 ↓	
135 ↓	<10	55 ↓	
130 ↓	<10	70 ↓	
135 ↓	<10	80 ↓	
130 ↓	<10	100 ↓	
125 ↓	<10	135 ↓	
130 ↓	<10	175 ↓	
135 ↓	<10	230 ↓	
120 (2.5m from prev.)	<10	335 ↓	
130 (each 4.2m)	<10		
135 ↓	<10		
135 ↓	<10		
140 ↓	<10		
130 ↓	<10		
135 ↓	<10		
160 ↓	<10		
155 ↓	<10		
140 ↓			
180 ↓			
290 (5m from prev.)			
530 (2.5m from prev.)			
830 (4.1m from prev.)			

8.2 The harmonic content of the measured magnetic field did not exceed 2.5% and registered the highest value of 4nT with the fundamental of 160nT.

They were the 5th and 3rd harmonics, in the order of effect, having the biggest impact on the measured field.

8.3 Measurements taken inside Lot 54's boundaries, at various distances from the electrical cabling resulted in the following minimum reductions in the magnetic field levels as compared with the levels obtained at the boundaries:

- at 5m distance: 34% reduction (from 350nT to 230nT)
- at 10m distance: 48% reduction (from 230nT to 120nT)
- at 15m distance: 63% reduction (from 230nT to 85nT)
- at 20m distance: 72% reduction (from 230nT to 65nT)

8.4 The magnetic field measured directly under the overhead HV cabling reached the maximum of 570nT.

8.5 The substation load fluctuations at the time of the measurements did not exceed ±5%.

9 ANALYSIS, CONCLUSIONS, RECOMMENDATIONS

9.1 From the measurements, none of the magnetic field limits prescribed in the reference standards and guidelines were currently exceeded within the boundaries of Lot 54. The field levels varied between less than 10nT (0.01μT) and 830nT (0.83 μT). However, the recorded values will increase, following the increased load on electrical system as well as expansion of services by Essential Energy.

9.2 The 132kV load data obtained from Essential Energy indicate that the electrical system was loaded to 46.2% at the time of measurement.

Essential Energy forecasts the increase in power consumption to up to 68% (winter load) of the substation's total capacity by 2019.

9.3 There are presently no plans to increase the designed capacity of the substation, but the recorded magnetic field may still double after 2019. However, for the next five years, the magnetic field should not increase to levels exceeding its current values by 50%.

None of the magnetic field limits, as stated in the referenced standards and guidelines, should be exceeded in the event of the Zone Substation being loaded to its maximum capacity. This is with the exception of faults or severely unbalanced phase loads.

9.4 The expected increases in the magnetic field level may impact only on the most sensitive hospital equipment as defined in section 4.3.2 of this report. This is because the externally generated field will combine with the field generated by in-building electrical services.

Irrespective of the above, magnetic shielding may be required to some of the in-building electrical services to protect the highly sensitive hospital equipment. The future shielding requirement, if any, can be determined based on the magnetic field calculations considering the field sources external and internal to the building.

APPENDIX A

Drawings

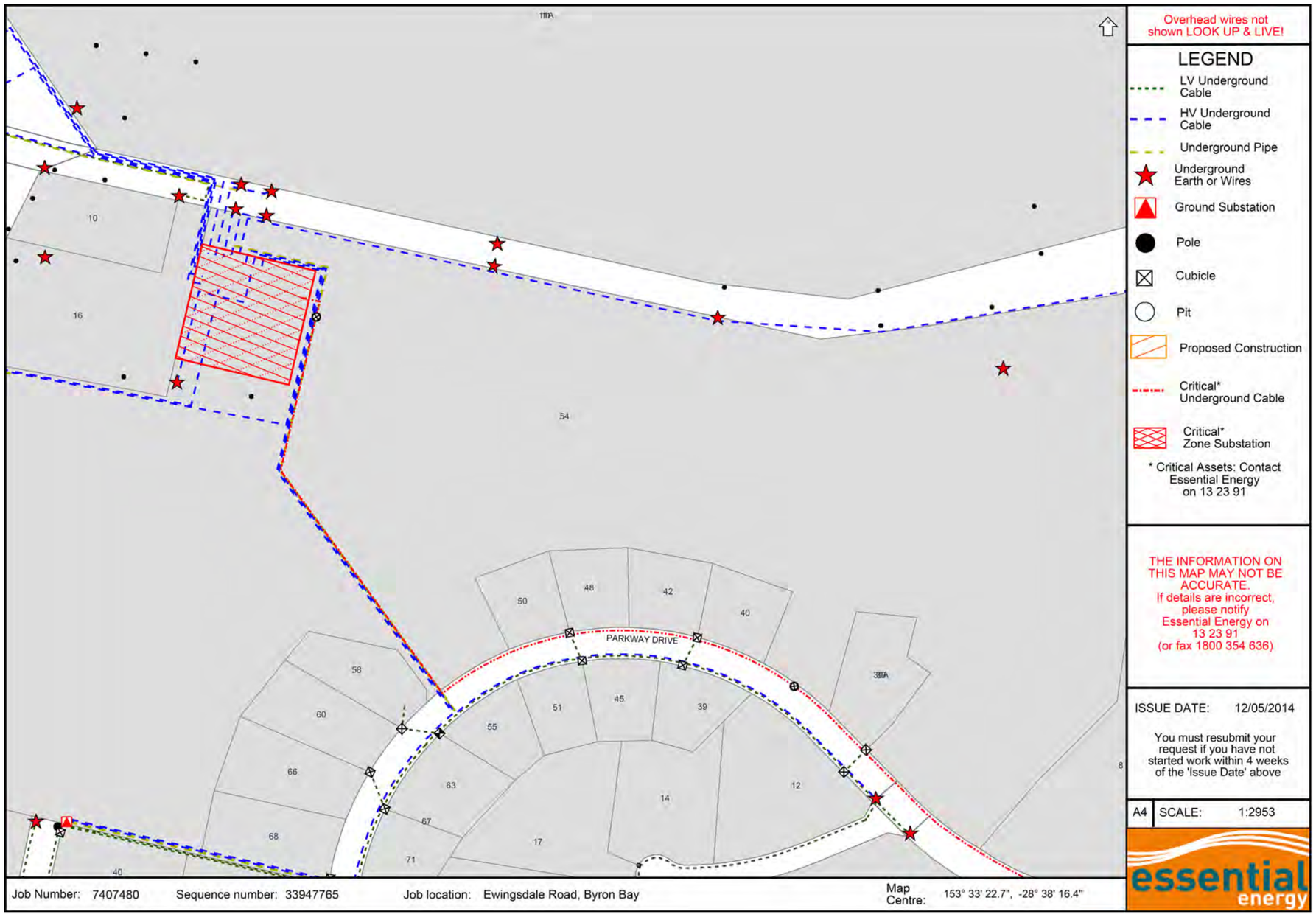

Fig. 1. Location of electrical Evingsdale Road Zone Substation and relevant cable network

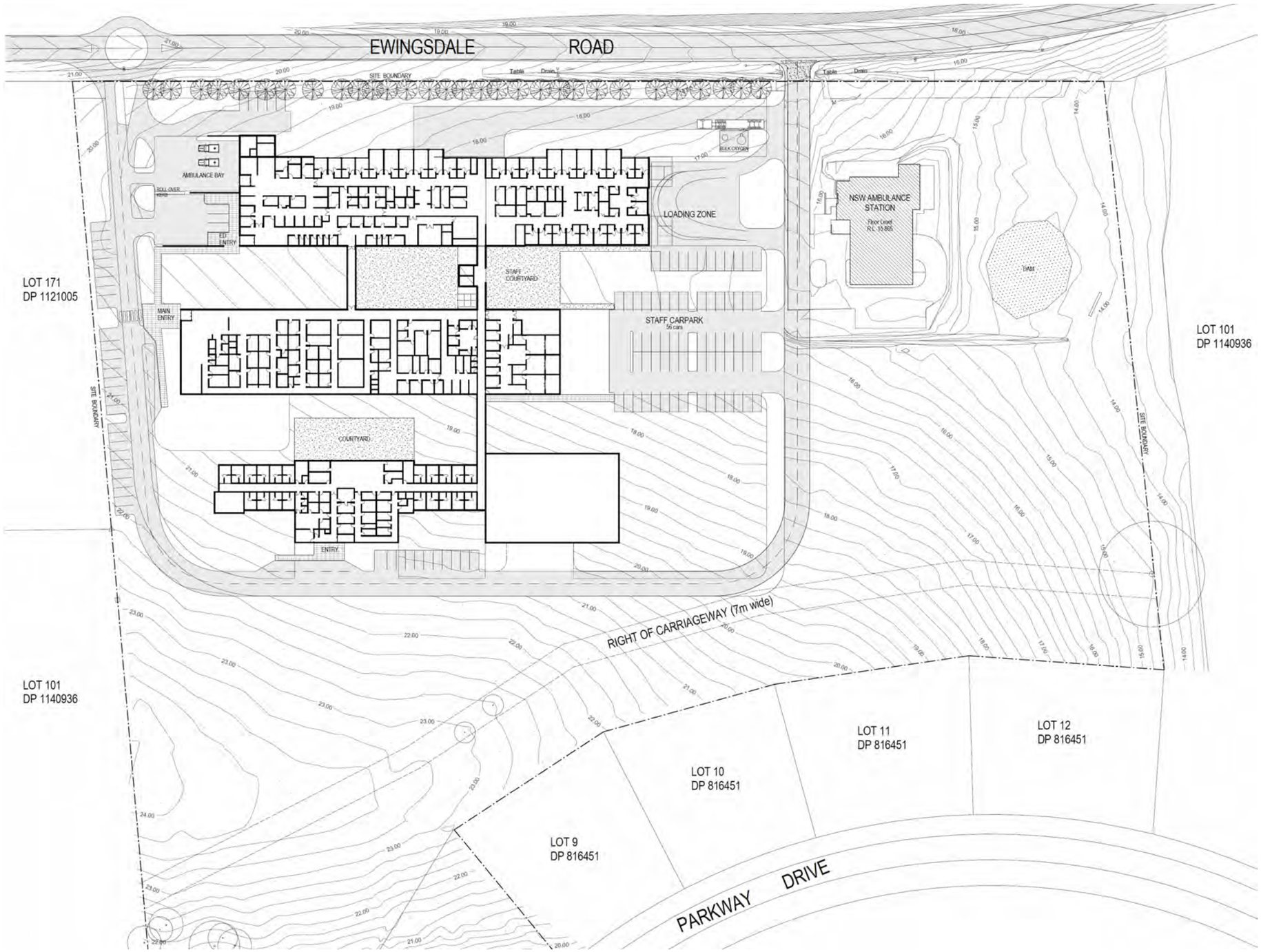

Fig. 2 Proposed Byron Shire Central Hospital Development

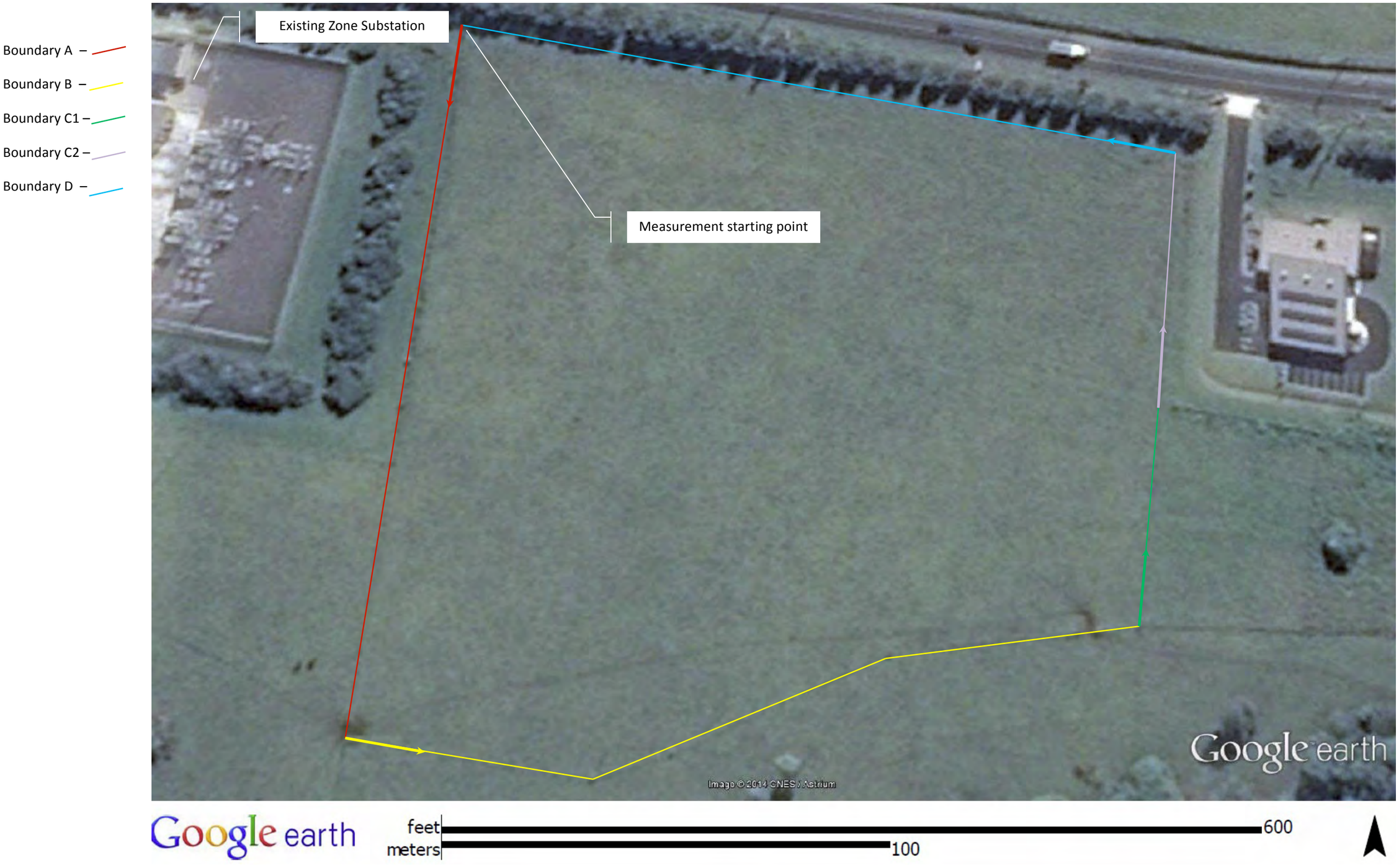

Fig. 3. Test points location

APPENDIX A

Photographs

Phot. 1. View of boundary A (red marked)

Phot. 1. View of boundary B (yellow marked)

Phot. 1. View of boundary C1 (green marked)

Phot. 1. View of boundary C2 (purple marked)