BE Consulting Engineers

South Melbourne Town Hall

Electrical Services Inspection Report

Rev No: P3

Project No: 2019-028

Discipline: Electrical

Prepared By:

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1 EXECUTIVE SUMMARY

1.1 SUMMARY

BE Consulting Engineers (BECE) have been engaged to prepare a report to assess the existing electrical services at South Melbourne Town Hall by Port Phillip City Council.

As requested, the report mainly focuses on assessment of the existing artificial general lighting and the low voltage distribution system of the building and provides key remedial recommendations to meet compliance and future proof the electrical capacity for upcoming renovations and upgrade of the HVAC system.

Two site inspections of the above electrical services by BECE engineers with the guidance of the building managers and contractors were conducted on the 9th and 10th of January 2020 respectively.

As part of BECE's scope of works, it was critical to monitor the power consumption of the mechanical load to ascertain available power capacity to cater for future HVAC upgrades.

Lighting level measurements have also been carried out in typical areas to help assess the performance of the existing general lighting systems of the building.

1.2 PROJECT OBJECTIVE

- Electrical assessment and report of the above building services of the entire building to determine the requirements to meet compliance and future proof the electrical capacity for future renovation including the upgrade of the HVAC system.
- Development of remedial options and Cost Plan.

1.3 MAIN FINDINGS

- The site appears to have sufficient spare capacity to facilitate future HVAC system upgrade works
- Upgrade works are required for general lighting systems to comply with relevant lighting standards (AS/NZS 1680) and BCA requirements
- Upgrade works are required for sub switchboards to make them compliant with the latest standard requirements (AS/NZS 3000)

2 INTRODUCTION

2.1 COMMISSION

This building services assessment report has been prepared by BE Consulting Engineers for the office building at South Melbourne Town Hall – 208-220 Bank Street, South Melbourne, Victoria 3205. Authority to undertake this report was provided by Jarrad Unsworth from Port Philip City Council on 22 December 2019.

Auditors Names:

Electrical Services: Henry Xie

Company Name: BE Consulting Engineers

Date of Inspection: Thursday 9th and 10th January 2020

Full address of the property: 208-220 Bank Street, South Melbourne, Victoria 3205

This report contains a written description of building service conditions as per site inspections and necessary electrical measurements. Observed non-invasive defects and non-compliances have also been noted. The report also contains an estimation of the existing Authority infrastructure capacity. Authority capacities are to be confirmed by the relevant Authorities prior to any budgeting of works.

2.2 PURPOSE

This report has been produced following BECE's proposal of 18 December 2019.

The purpose of this report is to provide an audit of the general condition for the above-mentioned building services at 208-220 Bank Street, South Melbourne, Victoria 3205, specifically.

- A written report of the condition of the above-mentioned building services including descriptions and photographs.
- Description of non-invasive defects and non-compliances identified on site

This report shall not be relied upon as providing any warranty or guarantee of the building, its services or equipment.

2.3 BACKGROUND

2.3.1 Site Location

South Melbourne Town Hall – 208-220 Bank Street, South Melbourne, Victoria 3205.

2.3.2 Building Description

South Melbourne Town Hall (originally known as Emerald Hill Town Hall) is of historical and social significance to the municipality identified as one of Victoria's grandest Town Halls.

South Melbourne Town Hall is listed on the Victorian Heritage Register VHR H0217 for its architectural, historical and social significance to the State of Victoria. Built in 1880, it is an important and sophisticated example of the work of Charles Webb, one of the leading architects of the nineteenth century.

It is an outstanding example of a Victorian Academic Classical style building with French Second Empire influences with a monumental symmetrical front façade and well resolved side and rear façades. South Melbourne Town Hall has outstanding landmark qualities as it is set on a hill in a carefully planned streetscape providing it with a prominence unparalleled in Victoria.

This building includes two building wings across two levels with the Main Hall centrally located. The east wing of is leased out to the Australian National Academy of Music (ANAM), the major tenant of the building, and the west wing is mainly occupied by the city council.

On the 18 October, a portion of the first-floor west wing ceiling collapsed in the South Melbourne Town Hall damaging the fire sprinkler system and causing extensive water damage to the ground and first floor of the building. Since the incident investigation by a structural engineer has identified major structural works to restore and renew parts of the building.

As part of the restoration project, this building service investigation seeks to assess the existing electrical service condition including the power supply capacity, to identify any non-compliance issues as well as to provide recommendations for bringing the existing services up to Standard and Code requirements.

2.4 REPORT LIMITATIONS

2.4.1 Work Undertaken

BE Consulting Engineers have compiled this report based on the following activities:

- Walk-through visual inspections of the relevant electrical services reported on.
- Perusal of the information listed below.
- Discussions with parties as listed below.
- Power demand and lighting level measurements.

Apart from where noted in the specific sections of this report, we have not verified the written and verbal information provided. As per the project engagement agreement, the following services were excluded from our scope of works:

- Emergency lighting
- Fire detection
- Comms/data/Security / CCTV
- Emergency power distribution

In addition, the following work has not been undertaken:

- Verification of the design.
- Checks of design calculations.
- Assessment of electrical services other than the general lighting system and the low voltage distribution system.
- Detailed inspections of equipment condition or disassembly of equipment.
- Inspection of equipment not readily accessible (e.g. in ceilings and risers).
- Assessment of compliance with original or current codes beyond visual inspections.
- Assessment of external envelopes, internal fabrics and security services to the buildings.

2.4.2 Documentation Sighted

The following documentation has been sighted:

- Existing mechanical equipment layout drawings by Rudds Consulting Engineers
- Power bills for the last two years
- MHA thermal imaging report & schematic drawing

2.4.3 Documentation Not Sighted

- The following information was not available:
- Specifications.
- As-installed drawings.
- Asset registers (excluding building fabric).
- Operating and maintenance manuals.
- Logbooks.

2.4.4 Verbal Information Received

Some of the following information included in this report was provided verbally by persons as indicated hereunder:

- Jarrad Unsworth – CoPP project manager

2.4.5 Liability

This report is prepared in good faith and with due care for information purposes only and should not be relied upon as providing any warranty or guarantee as to the nature and condition of the building and/or its services or equipment. In particular, attention is drawn to the nature of the inspection and investigations undertaken and the limitations these impose in determining with accuracy the state of the building, its services or equipment.

Due to the limitations of our involvement in the preparation of this report, users of this report should not rely on any statements or representations contained within, but should undertake further and more detailed investigations to satisfy themselves as to the correctness of any statement or representation contained in this report.

BE Consulting shall not be held liable for any loss or damage resulting from any defect of the building or its services or equipment or for any non-compliance of the building or its services or equipment with any legislative or operational requirements, whether or not such defect or non-compliance is referred to or reported upon in this report, unless such defect or non-compliance should have been apparent to a competent Engineer undertaking inspection of the type undertaken for the purpose of preparation of this report.

3 ELECTRICAL SERVICES

3.1 SUMMARY

The existing electrical services installation was inspected for general condition on 9th and 10th January 2020. The services were also reviewed with respect to the building code and Australian Standards compliance.

Apart from some music studio rooms, offices and corridors in the ANAM tenancy area (refer to Appendix D for more information) that appear to have been refurbished in recent years, most electrical services within the building are generally in a poor condition.

The major items that were determined during the inspections were related to the low voltage switchboards and general lighting and its controls throughout the building.

As the building was originally designed as a single-tenant building, it is difficult to delineate between base building services and tenant services. This review assesses the electrical systems based under the one entity.

3.2 GENERAL LIGHTING

Visual inspections of the existing lighting systems and associated controls have been carried out to identify the light fitting types, to assess the existing conditions and to check the lighting control methods. Lighting level measurements have been done in typical rooms and areas to assess the lighting performance.

3.2.1 Luminaire Types

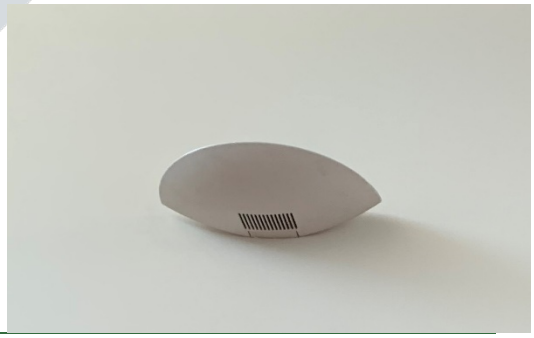
The existing lighting system is a mixture of various types of light sources throughout the building, including high pressure metal halide lamps, low voltage downlights, T8 fluorescent lamps, T5 fluorescent lamps, compact fluorescent lamps, T8 to T5 retrofit lamps, T8 LED retrofit lamps and recent LED lights etc. Some lights are still using old style magnetic ballasts. See photos below.

There are several types of light fittings in this building such as vintage type pendant lights, recessed 2 x 36W fluorescent lights, battens, downlights, wall lights, linear extrusions, LED panel lights etc.

Most of these types of light fittings, such as fluorescent lights, metal halides, LV downlights, have already been phased out nowadays due to the following main reasons:

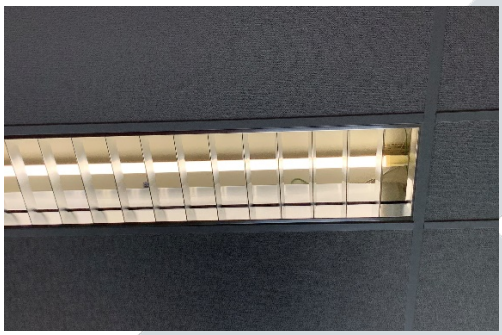
- Low lighting efficiencies – low light output
- Poor lighting performance – low colour rendering index, discolouring light, glare issues
- High running and maintenance cost – high energy consumption, short life expectancy
- Environmental impact – fluorescent lights containing mercury
- Safety concerns – mainly the retrofit type

The majority of the existing light fittings in this building appear to be of old types.



Metal Halide Light

Fluorescent Batten



Retrofit Louvre Fitting

CFL Wall Light

3.2.2 Lighting Performance

In the majority part of the building, the lighting performance of the existing lighting system appears low. The following main issues have been identified during the site inspections:

- Inconsistent colour temperatures – mixed use of warm, warm white and cool white lights can be seen even in the same type of spaces or rooms. For most office areas or commercial areas, warm white with a colour temperature of 4000K is the norm which tends to be better for concentrating or seeing details. Warmer colour temperatures such as 2700K tends to appear more relaxing which is more suitable for residential buildings, such as houses, hotels, aged care facilities etc.
- Low uniformity – due to possible lack of proper design and careful considerations, the lighting uniformity in most spaces appears low: some areas look much brighter than the others, or patchy light patterns can be seen on the floor or working surfaces. Although, an uneven lighting may be used to create a specific effect for the interiors, this should normally be done with careful design for special purposes only.
- Glare issues – these can be observed in various locations mainly due to old age or bad quality of the light fittings, or incorrect installations including selection of the light fittings.

Lighting level measurements have been carried out at night-time in some typical rooms or areas of this building, such as offices, meeting rooms, staff rooms, corridors, toilets, etc., to check the lighting levels of these spaces against AS/NZS 1680 recommendations. Refer to Appendix A for the measurements.

As shown in Appendix A, the following can be observed:

- Some areas' lighting levels are well below the recommended levels

- In some areas, although the average lighting level is above the recommended level, the uniformity is not good enough
- In some areas the lighting levels are excessive being a few times more than the recommended values.

3.2.3 Lighting Control

The existing lighting control in this building is mainly of local manual control. In a few recently renovated toilets, motion sensors are used. In some meeting rooms, dimmable lighting is provided.

The dimming technology is mostly 1-10v or other analogue methods. No programmable lighting control systems have been observed on site.

There a few issues with lighting control are identified:

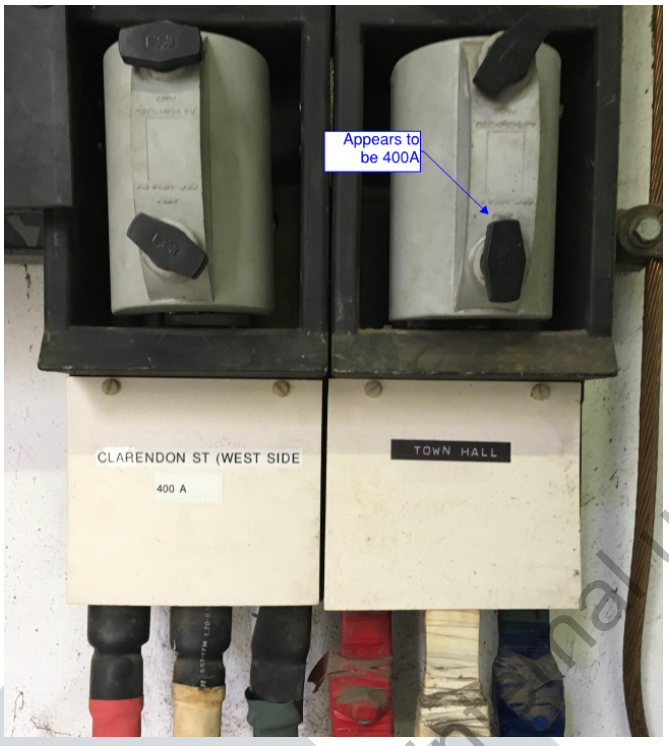
- In some areas, the light switch is not located immediately in at the entry of that area, which makes it difficult to find the right light switch.
- Common area lighting, such as that in the corridors, is not controlled from a convenient location such as the reception desk, but rather from some inconsistent locations, which could result in people forgetting to turn of the lights after work
- Lack of occupancy sensing control or programmable control technologies. In most cases, this can cause unnecessary use of lighting hence high running costs.
- It is possible that the existing lighting systems are not compliant with the new BCA Section J6 requirements due to inefficient light fittings and associated manual control methods.

3.3 LOW VOLTAGE DISTRIBUTION SYSTEM

3.3.1 Power Supply

Power supply to this building is via an indoor substation located at the north end of the west wing of this building.

According to information provided by the power authority (CitiPower), the capacity of the indoor substation is 1,000 kVA (1,390 A). This transformer is NOT dedicated to this building. CitiPower have no records showing the agreed supply capacity to this building. However, as per the information provided by CitiPower, the rating of the LV feeder (fuse switch) for this building is 400 A (see below figure).



LV Feeder for the Town Hall

Also refer to Appendix E for the single line diagram of the substation.

3.3.2 Main Switchboard

There is one existing main switchboard in the main switch room located at the north end of the building behind the Main Hall. It is next to the indoor substation (Refer to Appendix C

The existing main switchboard appears to consist of four sections:

- Municipal Offices Lighting, Power and Mechanical services, supplying:
  - MSSB-1 – 400A, **decommissioned**
  - Lighting & power – 800A, feeding
    - Council roof top MSSB-3,
    - Dimmers & Winches SB,
    - Stage Lighting SB,
    - Academy of Music MSSB-2,
    - 1x spare.
    - The ratings of the above circuits are not labelled on the switchboard. However, they appear to be rated as 200A – 250A each, according to the physical size of the individual switch chambers.
- Essential services – lifts
- Municipal Offices Auxiliary Services feeding:
  - Records Office SB, 200A, **open**
  - Engineering Building Planning Departments
  - First Floor SB - DB1A
  - Academy Musical M1 & M2
  - Frist Floor Computer SB
  - DB6

- The ratings of the above circuits are not labelled on the switchboard. However, they appear to be rated as 200A – 250A each, according to the physical size of the individual switch chambers.

- Public Area Auxiliary Services supplying:
  - Public Lighting & Power SB
  - MS Power feeding Kitchen DB & New Public DB in the ANAM area
  - 2 x Spare

The existing main switchboard is old but appears to be in a good condition. The current rating is possibly 800A – 1,000A. The construction of the board appears to be Form 3a which is not deemed to be sufficiently provided with internal separation to reduce the probability of the initiation of an internal arcing fault as per the latest AS/NZS 3000 requirements. Compliance with AS/NZS 3000 is not retrospective until alterations or additions are carried out to the switchboard. However, extra safety precautions shall be taken when working on the switchboard.

Existing Main Switchboard

3.3.3 Distribution Switchboards

As detailed in the above section, there are several distribution switchboards and associated sub switchboards throughout the building which can be separated into two groups geologically:

- West Wing (the council) has
  - DB6 (in the main switchroom)
  - DB1, DB2, DB3 & DB4 (fed from DB6), Ground Floor
  - Frist Floor Computer SB

  - First Floor SB - DB1A
  - Council roof top MSSB-3
  - Stage Lighting DB (north to the Main Hall)
- East Wing (ANAM) has
  - Academy M1 & M2, Ground Floor
  - Public SB L &P, Ground Floor
  - New Public SB (fed from Public SB L & P)
  - Kitchen DB (fed from Public SB L & P)
  - Dimmers & Winches DB (in the Main Hall)
  - DB-1A (Frist Floor)
  - Computer SB (ATS)

The following issues have been identified:

- Most DBs are old and some are in poor conditions
- Majority of lighting and power sub-circuits in the DBs are not provided with RCD protection as per AS/NZS 3000 requirements.
- No time clock control for boiling water unit control as per BCA requirements.
- No external lighting controls as per BCA requirements.
- No energy monitoring for lighting, power, mechanical and lift services as per BCA requirements.
- Where located in a passage to a required exit, which is the case for most DBs, the DB or the cupboard is not smoke sealed as per BCA and AS/NZS 3000 requirements.
- Breakers in the DBs are mostly old-style circuit breakers.
- Majority of the DBs have no spare poles.
- Labelling of most DBs is not clear and no circuit schedules provided.

Refer to Appendix B for indicative DB location layout diagrams.

East Wing GF – Public L&P DB

West Wing 1F –DB1A

3.3.4 Submains & Cable Reticulation

Submains within the building are generally copper XLPE/PVC type cables reticulated on cable trays and ladders.

It was noted on site that several penetrations are not suitably fire sealed particularly penetrations through the slab. It is recommended engaging a passive fire contractor/surveyor to review and provide fire rating advice through all areas of the building.

3.4 EMERGENCY POWER SUPPLY

There is an existing connection point for a portable emergency generator, located on an external wall of the courtyard (0G.34). This connection point is rated as 160A and appears to be connected to the First Floor Computer SB of the West Wing via an ATS.

No other emergency power supply was identified on site.

3.5 OTHER SERVICES

There is a power factor correction unit located in the main switch room. This does not appear to be a requirement from the power authority.

4 SPARE CAPACITY

As mentioned in section 3.3.1, total supply capacity to this building is likely to be 400A.

4.1 CONNECTED LOADS

Based on the load information collected from the site visits, the major load of the building would be the air conditioning load. With MSSB-1 decommissioned, it is very likely that the major air-conditioning load is fed from two mechanical services switchboards MSSB-2 and MSSB-3.

Although the stage lighting and associated audio-visual equipment (which appears to be lightly equipped only) has been provided with a dedicated 200A DB, the full capacity should not be reached in most cases, i.e. it is oversized.

No commercial kitchen equipment was found.

The rest of the loads would be normal lighting and power loads which normally represents 30-40% of this type of buildings (offices).

4.2 DATA LOGGING

To help estimate available spare capacity for future AC upgrade, data logging was carried out on the main switchboard.

The selected measuring point is the 800A main circuit of the Municipal Offices Lighting, Power and Mechanical Services section of the MSB (refer to page 1 of Appendix C). This 800A circuit supplies both MSSB-2 and MSSB-3 which should represent the main mechanical services consumption of the building.

The logging period started at 10:12pm of 29/01/2020 and ended at 7:32pm of 31/01/2020. The maximum outdoor temperature on 29th reached 31°C and 41°C on 31st.

Data logging equipment: Fluke Energy Analyser 1738.

Recorded maximum current is 290.7A on Phase C. It is very likely that this was a recorded spike triggered by starting of the mechanical equipment in the morning (around 7:00 am). The average maximum is 71.4A on Phase C which has included the low base load at night-time.

Based on the recorded load profile, the maximum demand at the selected measuring point and during the logging period is in the order of 90A ~ 130A on Phase C. Refer to Appendix C for more detailed information.

Assuming the total mechanical load represents about 60% of the total existing load, the estimated total maximum demand is in the order of 150A ~ 217A.

4.3 HISTORICAL DEMAND

According to CitiPower, the recorded maximum demand for the site is 141A on 31st Jan 2020, which is lower than the maximum demand 195A as stated in the power bills from 2017 to 2018.

Note that the "Electrical Services Conditions Report" prepared by Mandis Hannah in June 2017 indicates the maximum demand of this building is approximately 214A.

The reduction in the maximum demand may have been resulted from decommission of part of aged mechanical equipment.

4.4 ESTIMATED SPARE CAPACITY

Based on the above information, the estimated spare capacity is in the range of **183A ~ 250A,** with the following assumptions.

- Supply capacity is 400A
- Lighting and power load equals 40% of the total load
- Mechanical load represents 60% of the total load.

The spare capacity should be sufficient to facilitate major upgrade works in this building. In case of more supply capacity required, there will be no need to upgrade the main switchboard (MSB) or incoming mains which are already rated at min 800A.

5 RECOMMENDATIONS

5.1 LIGHTING UPGRADE

To bring the general lighting in the building to standard compliance, lighting upgrade is required – Replacing the existing lighting systems with new systems consisting of modern-look highly efficient LED fittings and programmable lighting control technologies. This can be done in a few stages with the least efficient lights being replaced first, such as the fluorescent lights and metal halides, retrofit light fittings and then other fittings.

Modern lighting control systems, such as KNX control systems, should be adopted, with motion and occupancy sensors, daylight saving sensors, and DALI dimming technologies to further improve the energy efficiency as well as lighting control flexibility. To enable staged upgrades, the control system shall be expandable.

Proper lighting design is highly recommended to achieve optimal lighting performance, so as to comply with the latest BCA requirements, improve the workplace environment and enhance the building aesthetics.

5.2 POWER UPGRADE

5.2.1 Sub Switchboard Upgrade

To facilitate future restoration works and any future refurbishment works, it is necessary to bring the non-compliant switchboards to Code and Standard requirements:

- AS/NZS 61439 compliant switchboards for higher quality and safer switchboards.
- RCD protection for lighting and power circuits.
- Time clock for boiling water and external lighting controls.
- Separate multi-function meters for lighting, power and mechanical services energy monitoring.
- Provide smoke sealed cupboards to accommodate the DBs where practical.
- 30% future spare poles

The upgrade works can be staged and combined with relevant building renovation works.

5.2.2 Emergency Power Supply System Upgrade

The existing system has only one connection point for a portable generator, which can only provide emergency power to one single switchboard (Computer DB). To provide emergency backup power to more areas in the building, the following is recommended:

- Install a permanently connected 150kVA diesel emergency generator. An outdoor canopy set can be used and located in the Courtyard.
- Replace the existing DB6 in the main switchroom with a new switchboard that includes an automatic transfer switch and distribute emergency power to more areas as required.

6 INDICATIVE UPGRADE COST

Given the heritage status of this building, additional costs resulted from difficult situations, requirements for the installation works and associated building works should be expected.

6.1 LIGHTING UPGRADE

Depending on what type of light fittings and control systems to be used, the upgrade cost can be very different. This shall be determined through proper engineering design.

However, \$150-\$250 / m^2 may be used as an indicative rate at this stage.

Estimated floor area of the building is:

Ground - 2500 m^2

Level 1 - 800 m^2

6.2 POWER UPGRADE

6.2.1 Sub Distribution Boards

The following indicative costs (supply & installation) are for information only.

- DBs directly fed from the MSB - \$8,000 each, 8 no. DBs to be upgrade, total cost \$65,000
- Sub DBs fed from the above DBs - \$5,000 each, 8 no. sub DBs to be upgraded, total cost \$40,000

- Mechanical services switchboards - $10,000 ~ $15,000 each, 2 no. MSSBs to be upgraded, total cost $30,000
- Contingency 20%
- Estimated total DB upgrade cost: $162,000 + GST.

6.2.2 Emergency Generator

A 200kVA canopy diesel generator should be adequate to provide emergency power supply to 80% of the building services load including all essential services.

Estimated cost for the above generator is in the order of $80,000 ~ $120,000 + GST.

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APPENDIX A – LIGHTING LEVEL MEASUREMENTS

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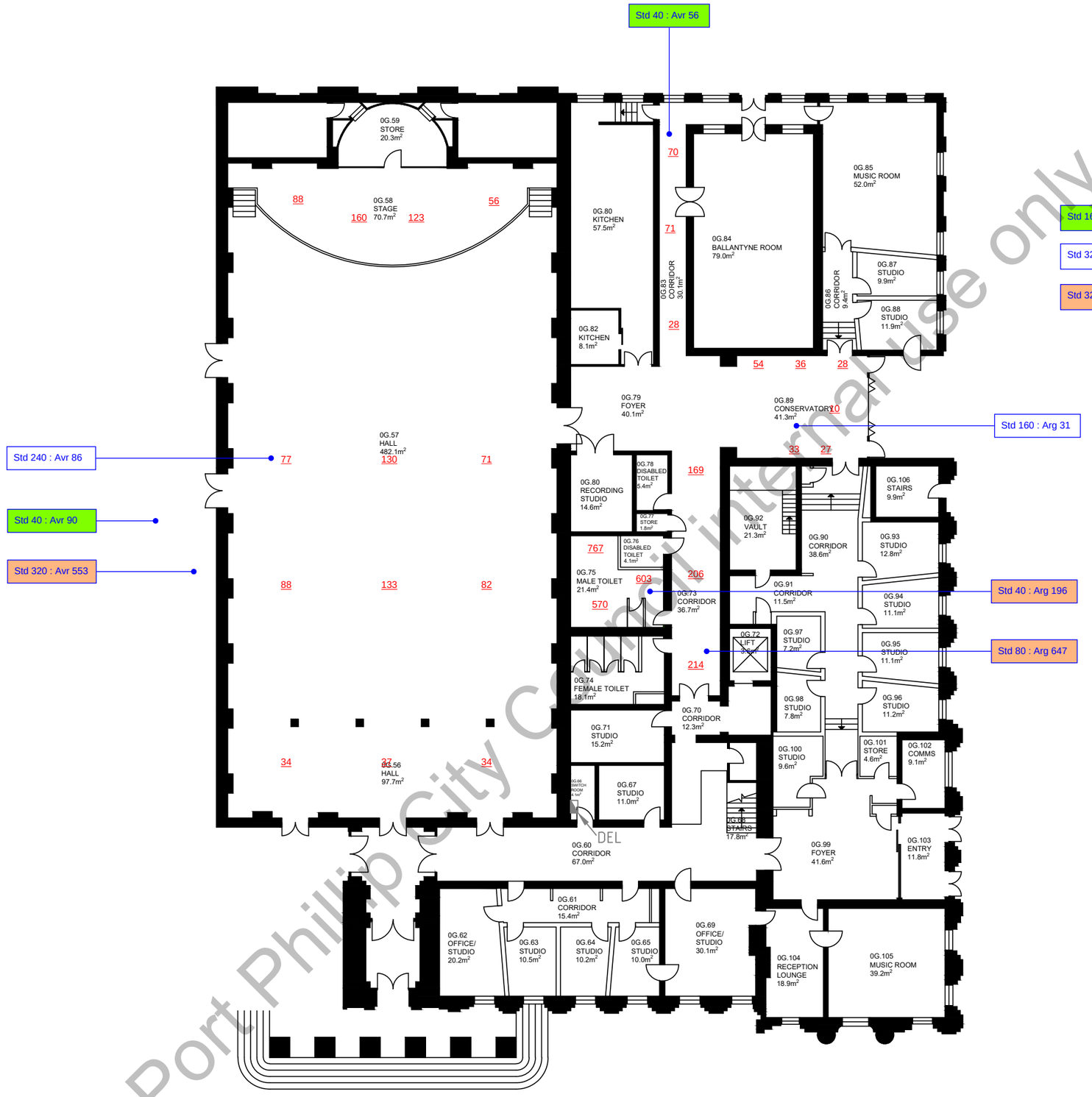


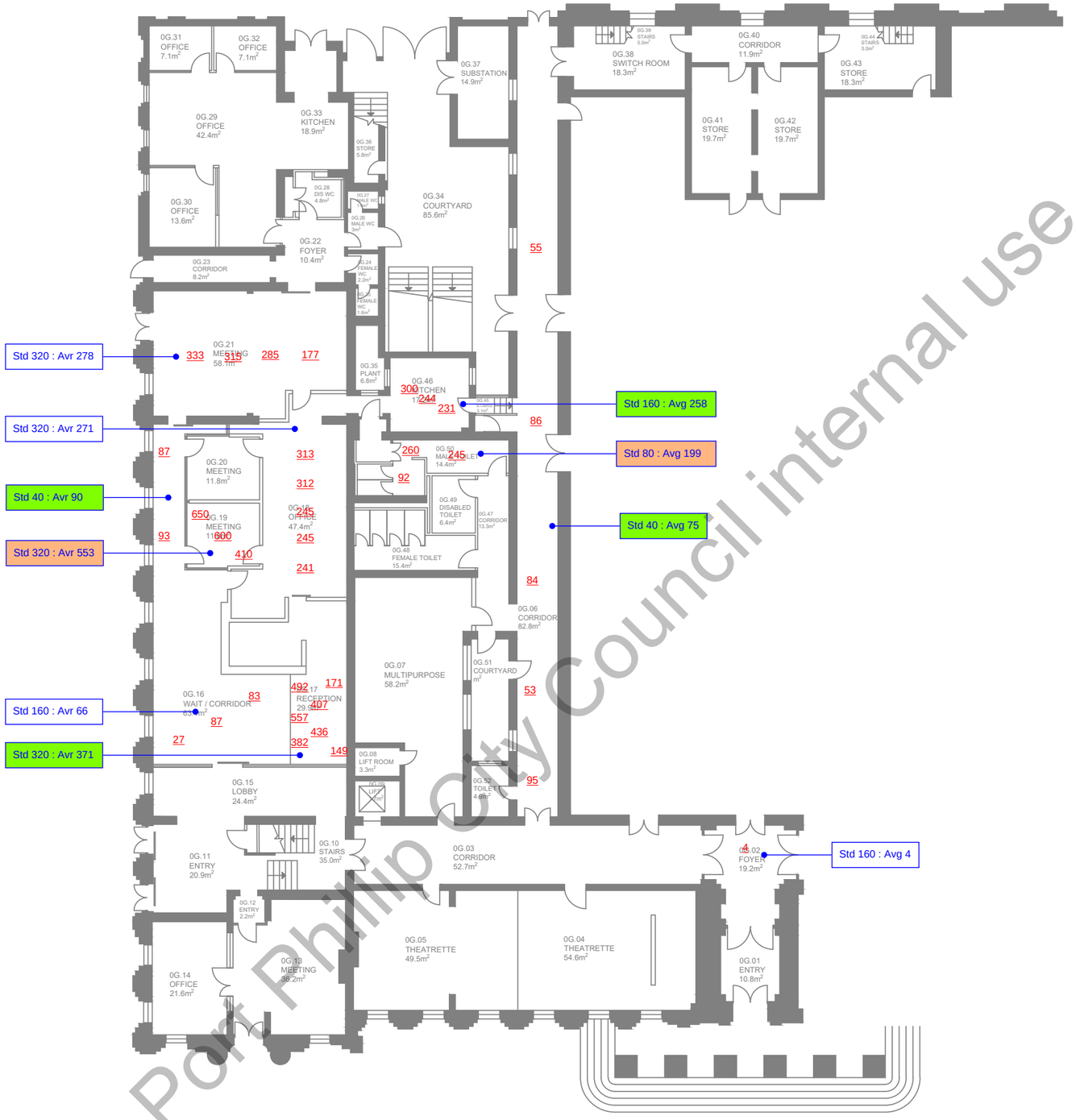
Std 160 : Avg 200 - Average lighting level is above recommended value

Std 320 : Avg 150 - Average lighting level is below recommended value

Std 320 : Avg 553 - Average lighting level is much higher than recommended value, which may cause glare issue or waste of energy

EAST WING - GROUND FLOOR

TYPICAL ROOM LIGHTING LEVEL MEASUREMENTS



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WEST WING - GROUND FLOOR

TYPICAL ROOM LIGHTING LEVEL MEASUREMENTS

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APPENDIX B – INDICATIVE SWITCHBOARD LOCATION LAYOUTS

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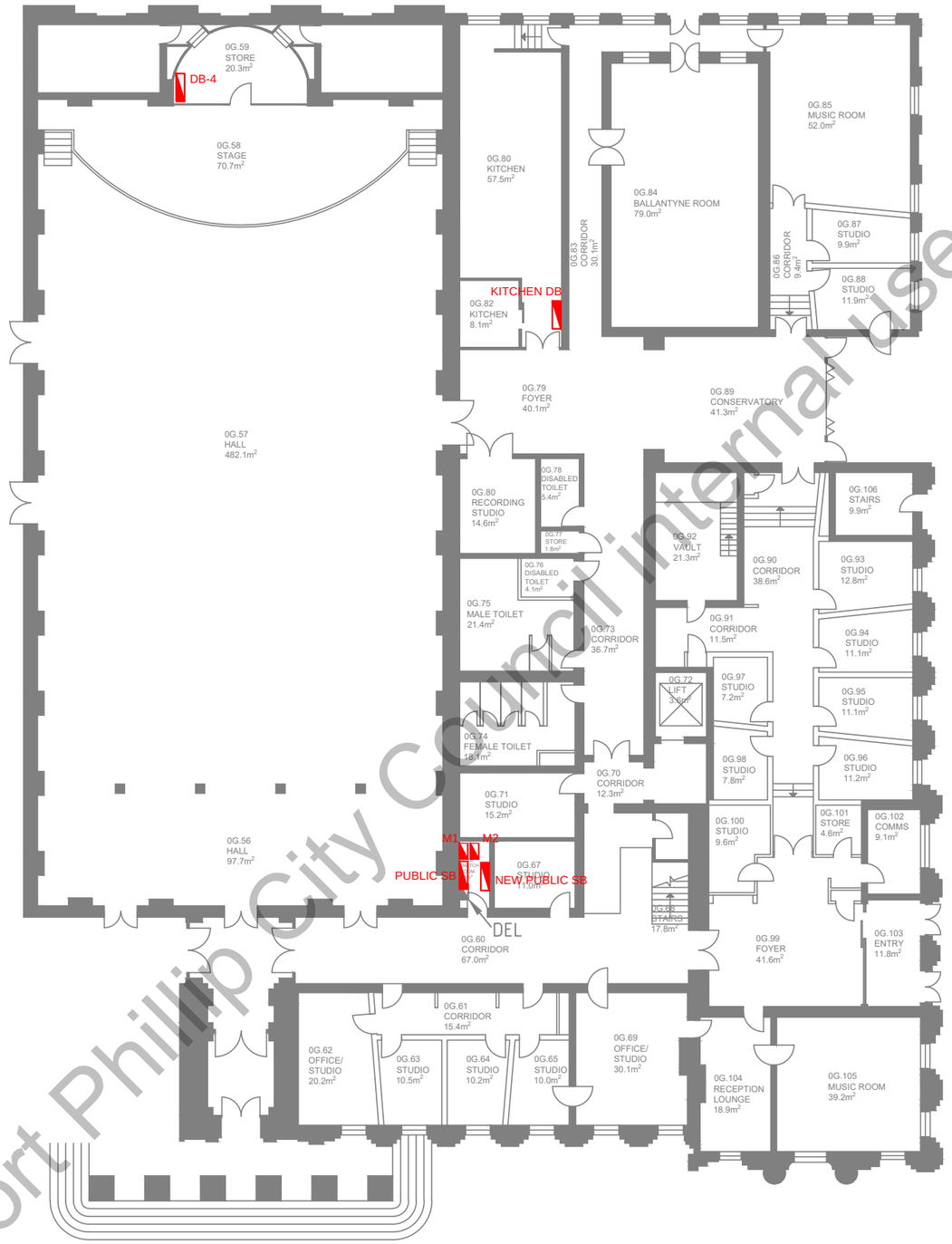
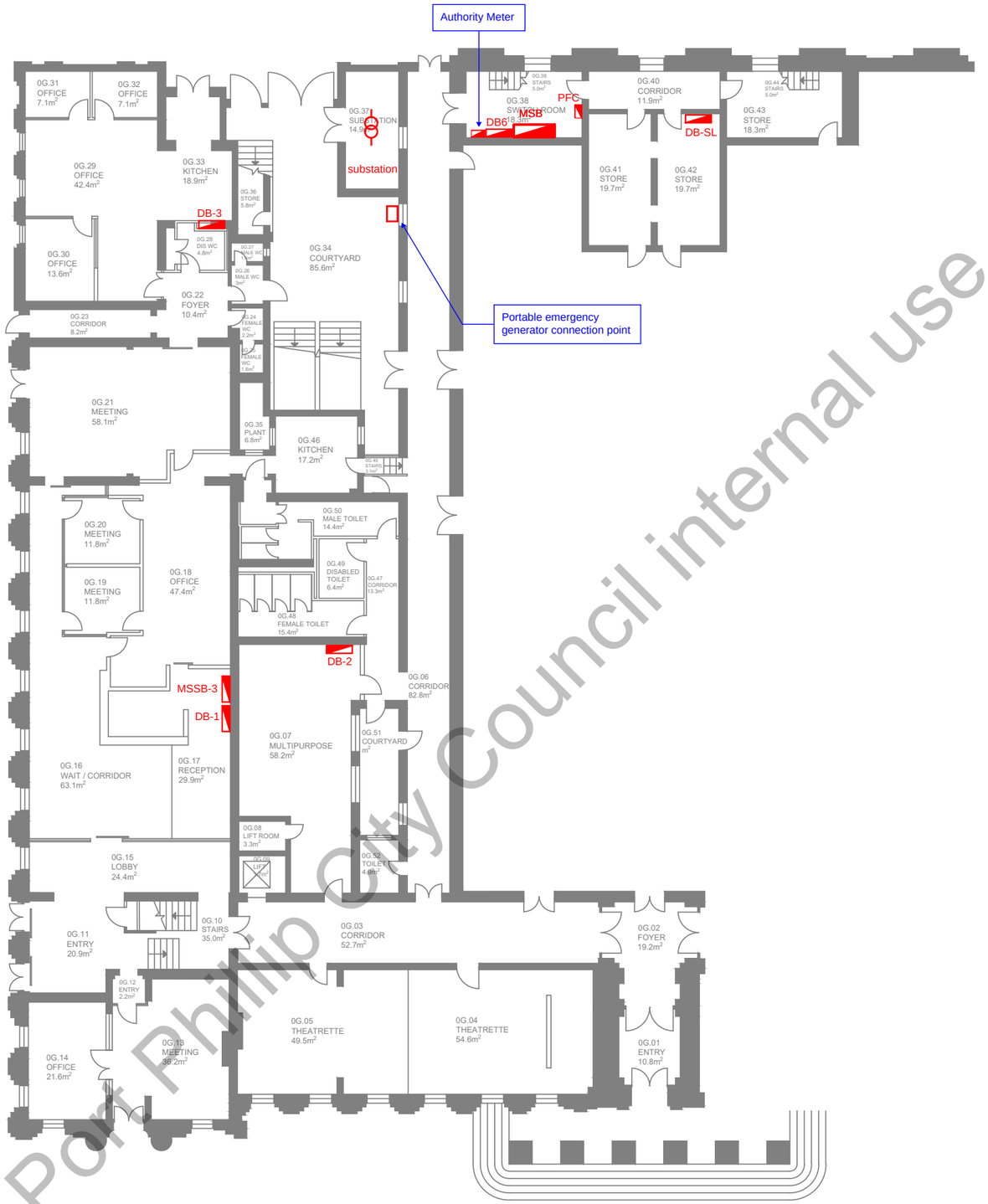


EAST WING - GROUND FLOOR

SWITCHBOARD LOCATION



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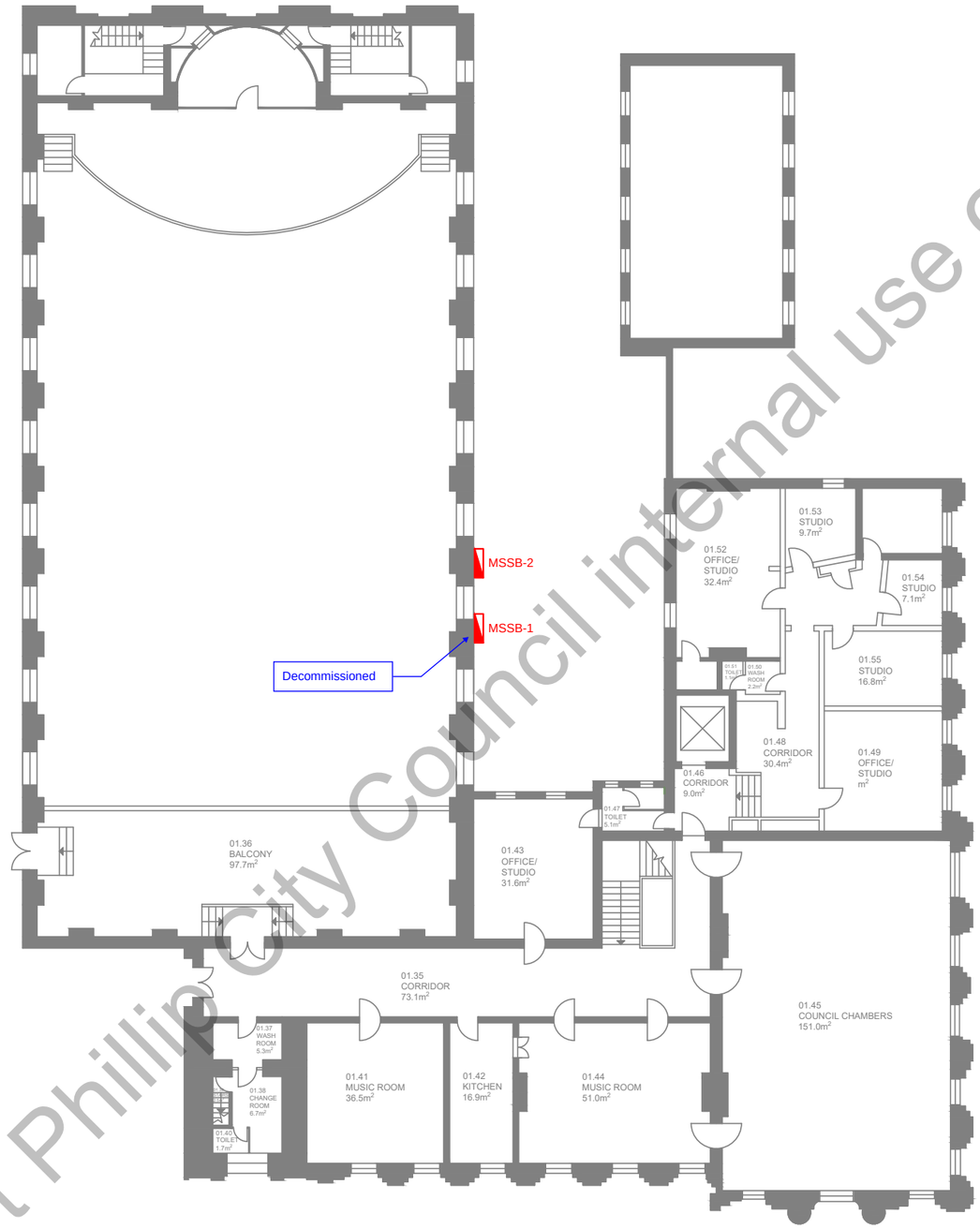
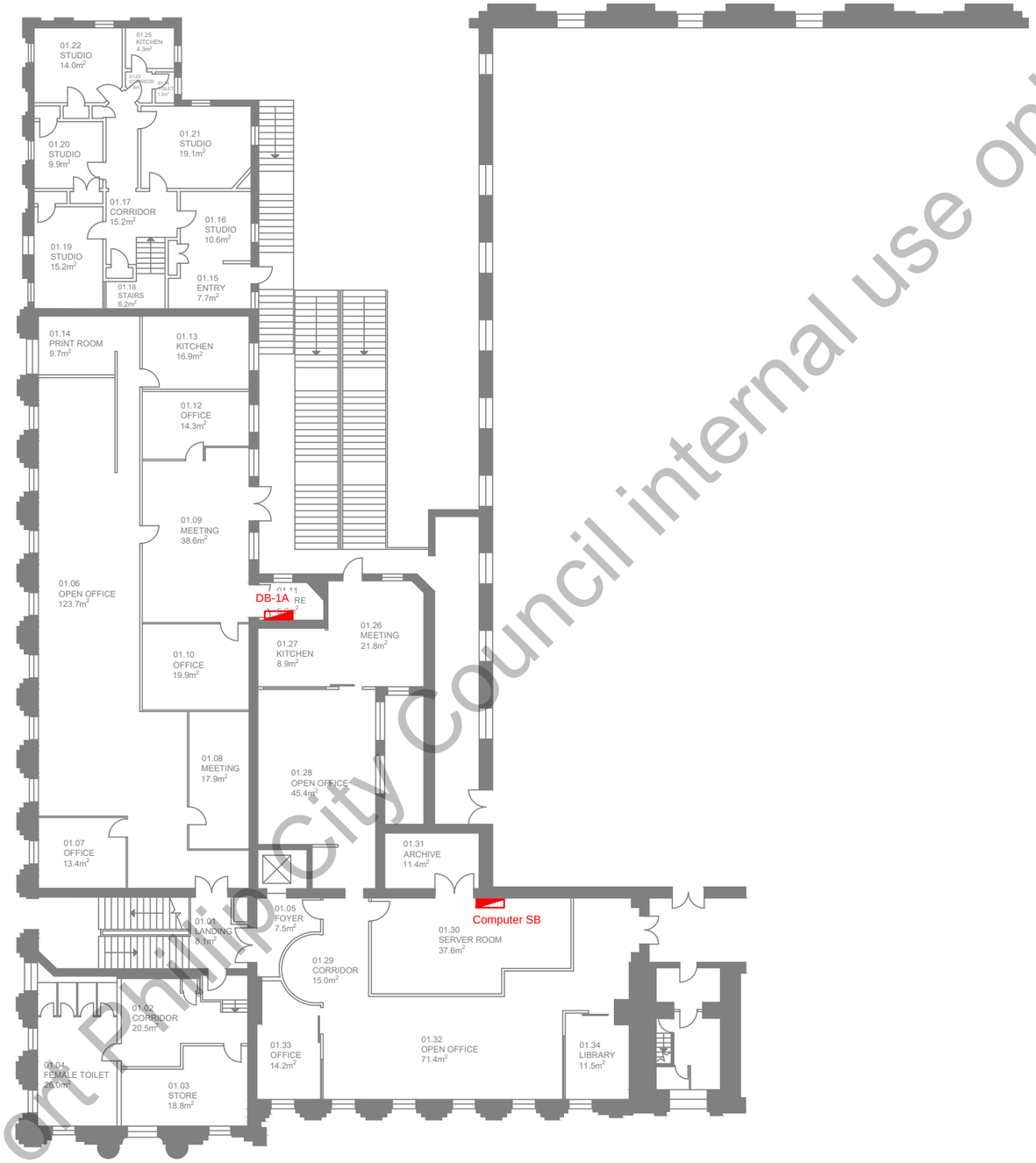
SWITCHBOARD LOCATION



EAST WING - FRIST FLOOR

SWITCHBOARD LOCATION



WEST WING - FRIST FLOOR

SWITCHBOARD LOCATION

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APPENDIX C – DATA LOGGING REPORTS

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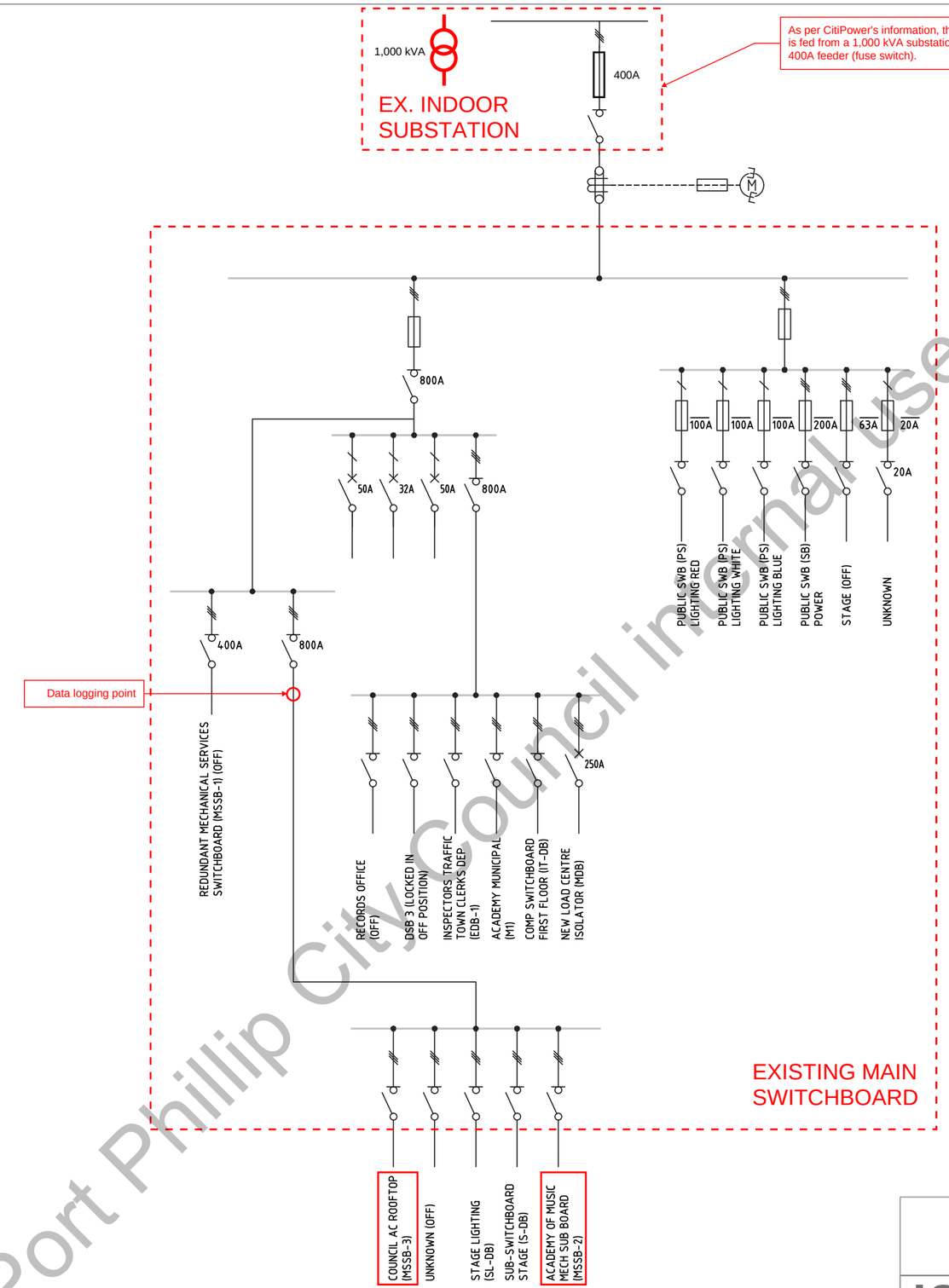

- Data logging period: 10:12pm 29th Jan 2020 - 7:32pm 31st Jan 2020.
- Maximum outdoor temperature on 29th reached 31°C and 41°C on 31st.
- Data logging equipment: Fluke Energy Analyser 1738.

ISSUED FOR INFORMATION

DOCUMENT ISSUED FOR INFORMATION AND COMMENTS

REV	DATE	DESCRIPTION	Drn.	Chkd.
I1	26/05/17	ISSUED FOR INFORMATION	J.I.	

CLIENT:

MHA
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CITY OF PORT PHILLIP
SOUTH MELBOURNE TOWN HALL

ELECTRICAL SERVICES

SCALE:	@A3
DRAWN:	J.I.
DATE:	26/05/17
PROJ. No:	17022
DRG No:	
REV:	I1

MS800

Voltage [V]	AN	BN	CN	N
Max	251.1 V 30/01/2020 9:40:00 AM	250.9 V 30/01/2020 9:40:00 AM	253.0 V 30/01/2020 9:41:00 AM	
Avg	243.7 V	242.8 V	244.6 V	
Min	183.1 V 31/01/2020 2:25:00 PM	184.3 V 31/01/2020 2:25:00 PM	185.4 V 31/01/2020 2:25:00 PM	

Current [A]	A	B	C	N
Max	258.4 A 30/01/2020 9:38:00 AM	264.8 A 31/01/2020 7:03:00 AM	290.7 A 31/01/2020 7:03:00 AM	0.0000 A 29/01/2020 10:13:00 PM
Avg	61.4 A	63.4 A	71.4 A	0.0000 A
Min	3.2 A 31/01/2020 12:43:00 AM	4.4 A 31/01/2020 12:43:00 AM	9.3 A 31/01/2020 4:54:00 AM	0.0000 A 29/01/2020 10:13:00 PM

Frequency [Hz]	AN
Max	50.30 Hz 31/01/2020 2:25:00 PM
Avg	50.00 Hz
Min	49.65 Hz 31/01/2020 2:31:00 PM

V THD [%]	AN	BN	CN	N
Max	2.7 % 30/01/2020 4:05:00 AM	2.8 % 30/01/2020 4:10:00 AM	2.4 % 31/01/2020 12:43:00 AM	
Avg	1.7 %	1.6 %	1.5 %	
Min	1.1 % 30/01/2020 7:42:00 PM	0.96 % 30/01/2020 9:37:00 AM	1.0 % 30/01/2020 9:15:00 PM	

A THD [%]	A	B	C	N
Max	18.0 % 30/01/2020 7:44:00 AM	36.3 % 30/01/2020 7:44:00 AM	49.3 % 30/01/2020 11:00:00 PM	
Avg	1.5 %	2.2 %	7.2 %	
Min	0.93 % 30/01/2020 7:14:00 PM	1.3 % 31/01/2020 7:03:00 AM	3.3 % 31/01/2020 11:05:00 AM	

% V Unbalance [%]	AN	BN	CN	Total
Max				0.855 % 31/01/2020 7:20:00 PM
Avg				0.389 %
Min				0.041 % 30/01/2020 6:35:00 AM

% A Unbalance [not supported]
Avg

Logging Information

Study type:
Energy study

Topology:
3-ph Wye

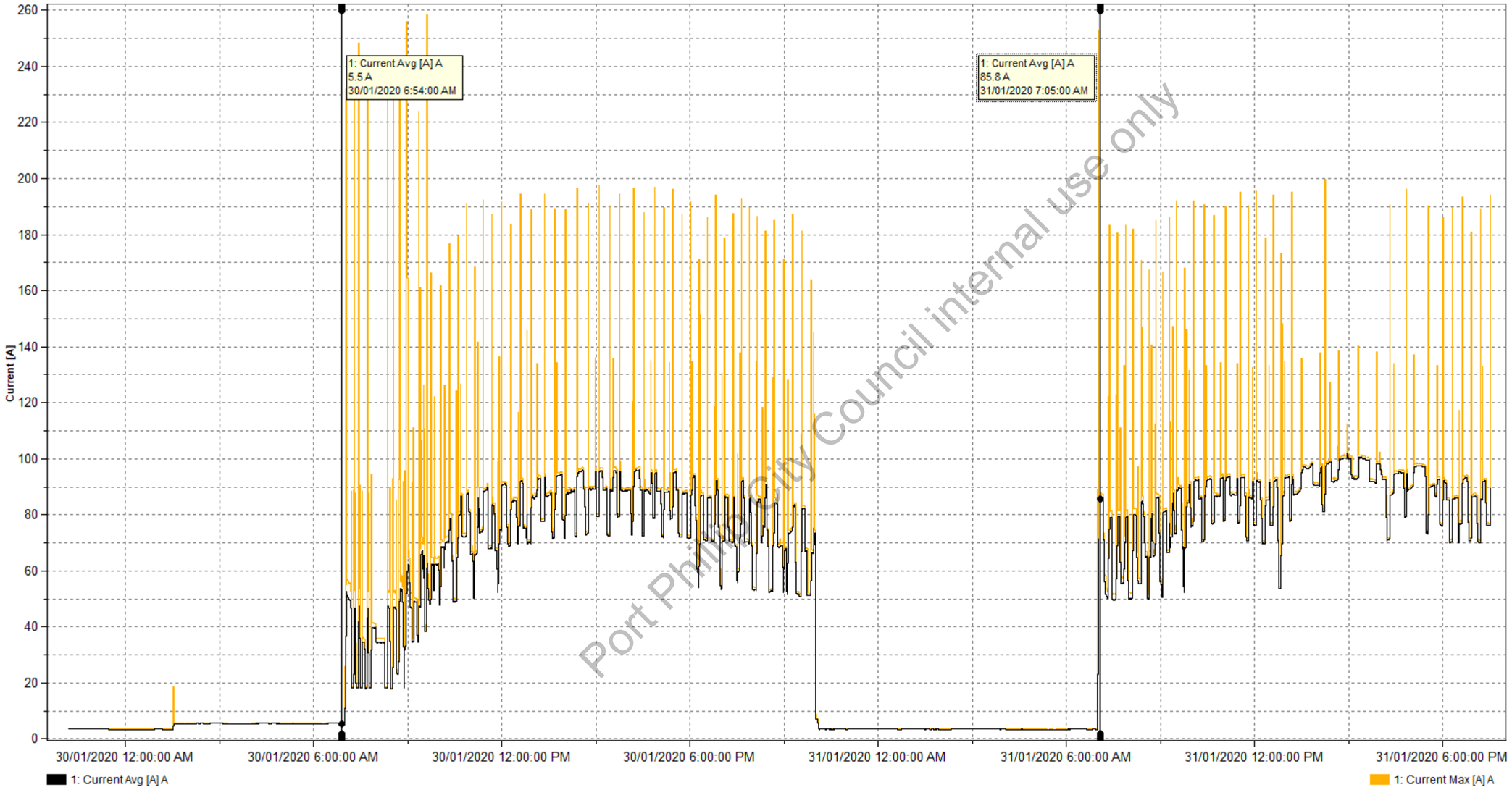
Start date:
29/01/2020 10:12:00 PM

End date:
31/01/2020 7:32:00 PM

Duration:
1d 21h 20m 0s

Averaging interval:
1min

Number of averaging intervals:
2720 (2720)



Graph options

Session

1 MS800

Left scale options

Volt | Curr [A] | Freq | Unbal

A B C N

Max Min Show Limit

0 A

Right scale options

V THD [%] | A THD | Aux

A B C

Max Min Show Limit

0 %

Time range

1 Hour
1 Day
1 Week
Individual

Set time range

Begin 29/01/2020 10:12:00 PM

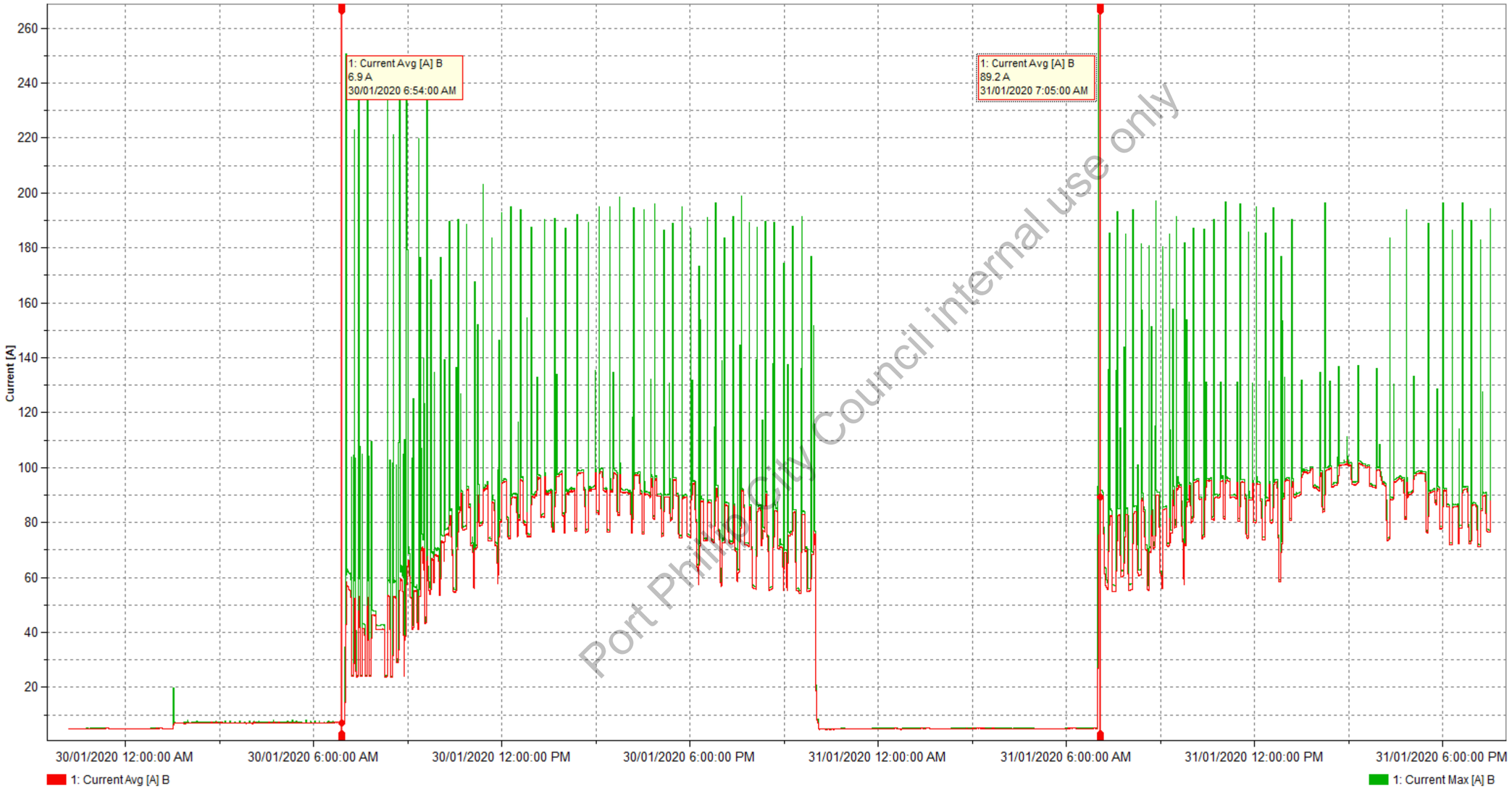
End 31/01/2020 7:32:00 PM

Working hours

Set working hours

Start 8:00 AM Span 08:00

Mon Tue Wed Thu Fri Sat Sun



Graph options

Session

1 MS800

Left scale options

Volt | Curr [A] | Freq | Unbal

A B C N

Max Min

Show Limit

0 A

Right scale options

V THD [%] | A THD | Aux

A B C

Max Min

Show Limit

0 %

Time range

1 Hour
1 Day
1 Week
Individual

Set time range

Begin 29/01/2020 10:12:00 PM

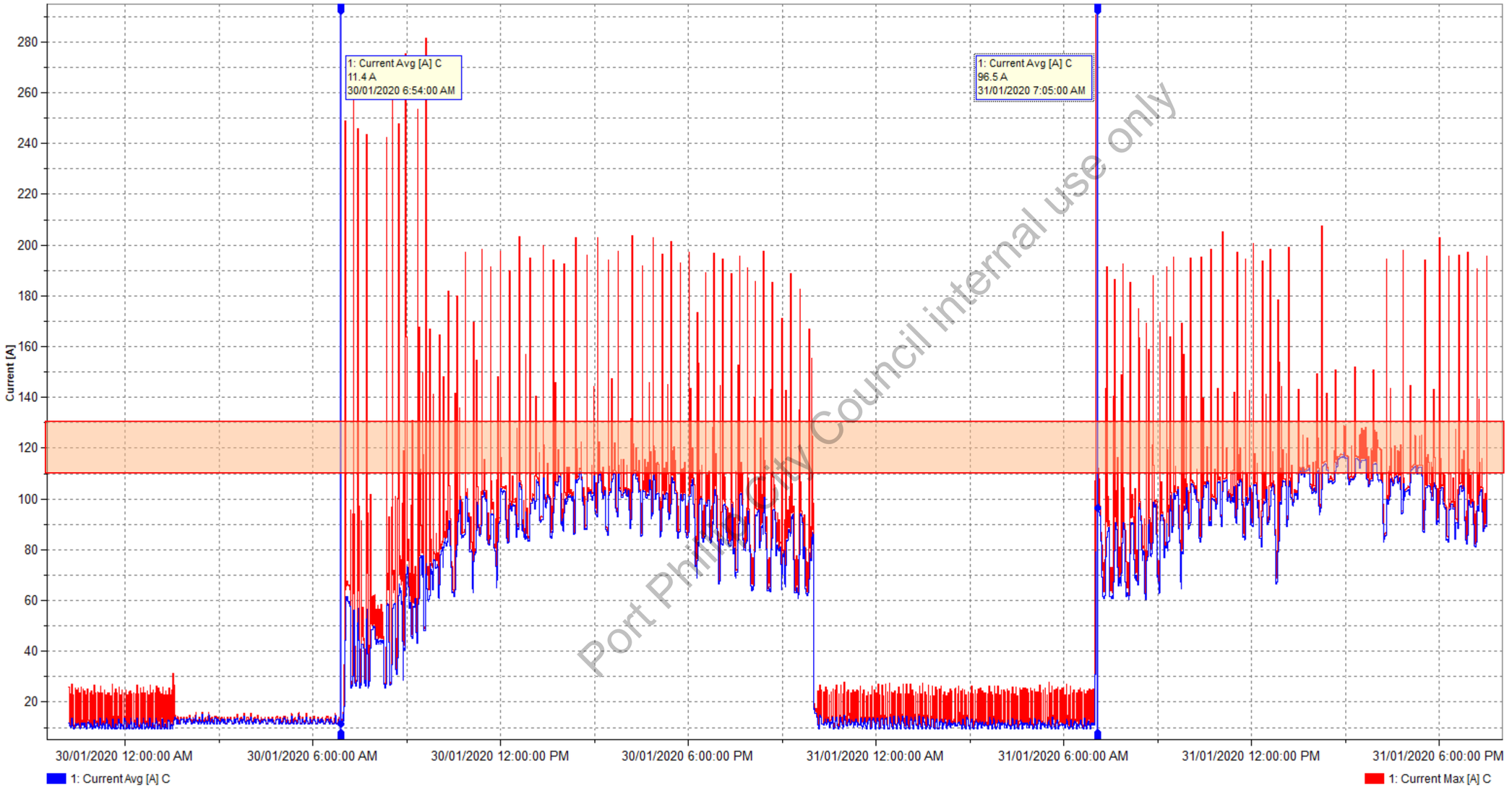
End 31/01/2020 7:32:00 PM

Working hours

Set working hours

Start 8:00 AM Span 08:00

Mon Tue Wed Thu Fri Sat Sun



Graph options

Session

1 MS800

Left scale options

Volt | Curr [A] | Freq | Unbal

A B C N

Max Min Show Limit 0 A

Right scale options

V THD [%] | A THD | Aux

A B C

Max Min Show Limit 0 %

Time range

1 Hour
1 Day
1 Week
Individual

Set time range

Begin 29/01/2020 10:12:00 PM

End 31/01/2020 7:32:00 PM

Working hours

Set working hours

Start 8:00 AM Span 08:00

Mon Tue Wed Thu Fri Sat Sun

BE Consulting Engineers

APPENDIX D – EXISTING ROOMS/AREAS INSTALLED WITH LED LIGHT FITTINGS

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BE Consulting Engineers

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South Melbourne

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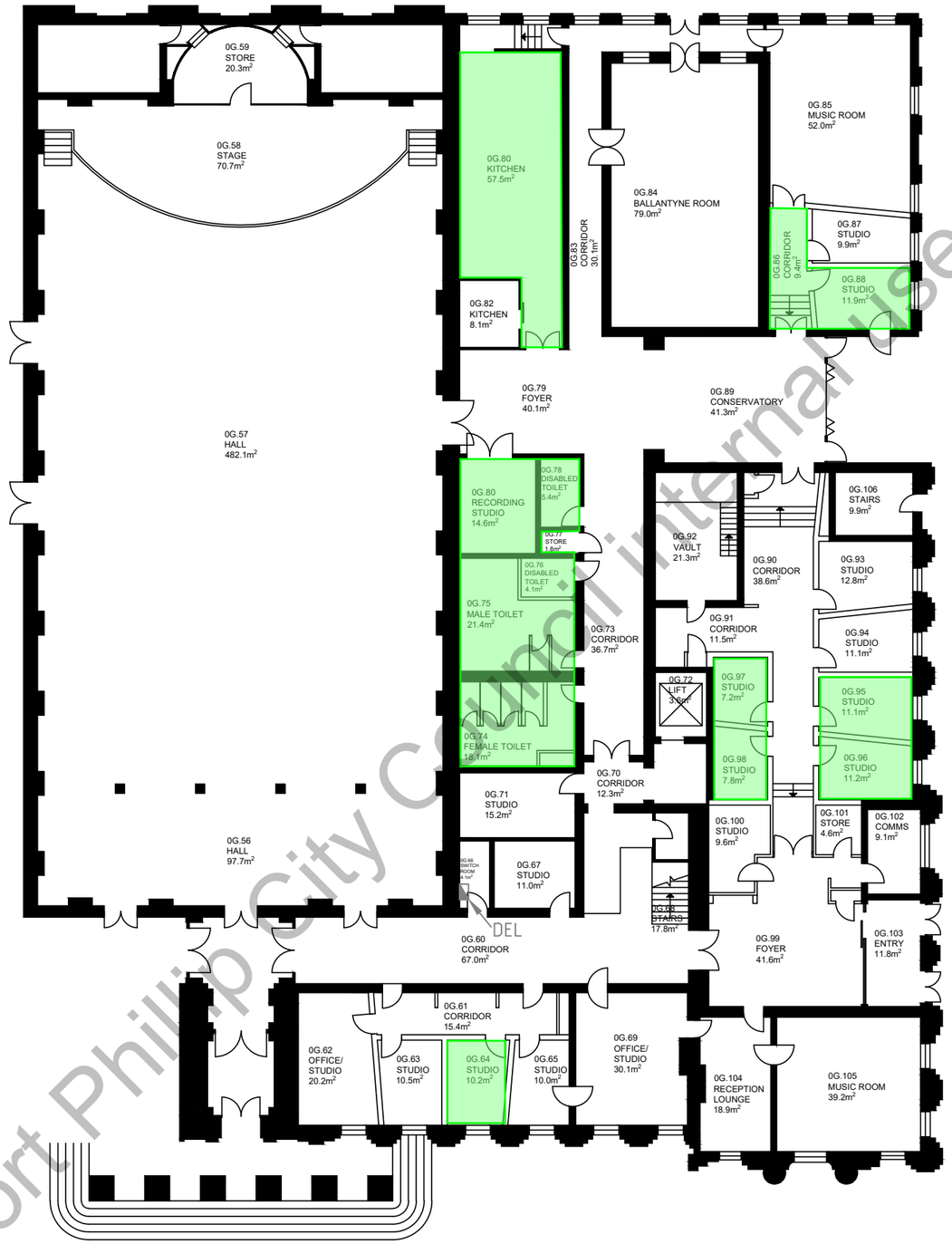

- Area identified as being installed with LED light fittings

* Note that not all areas were accessible during the site visit

EAST WING - GROUND FLOOR

EXISTING LED LIGHT FITTING INSTALLATION

BE Consulting Engineers

APPENDIX E – SINGLE LINE DIAGRAM OF THE EXISTING INDOOR SUBSTATION

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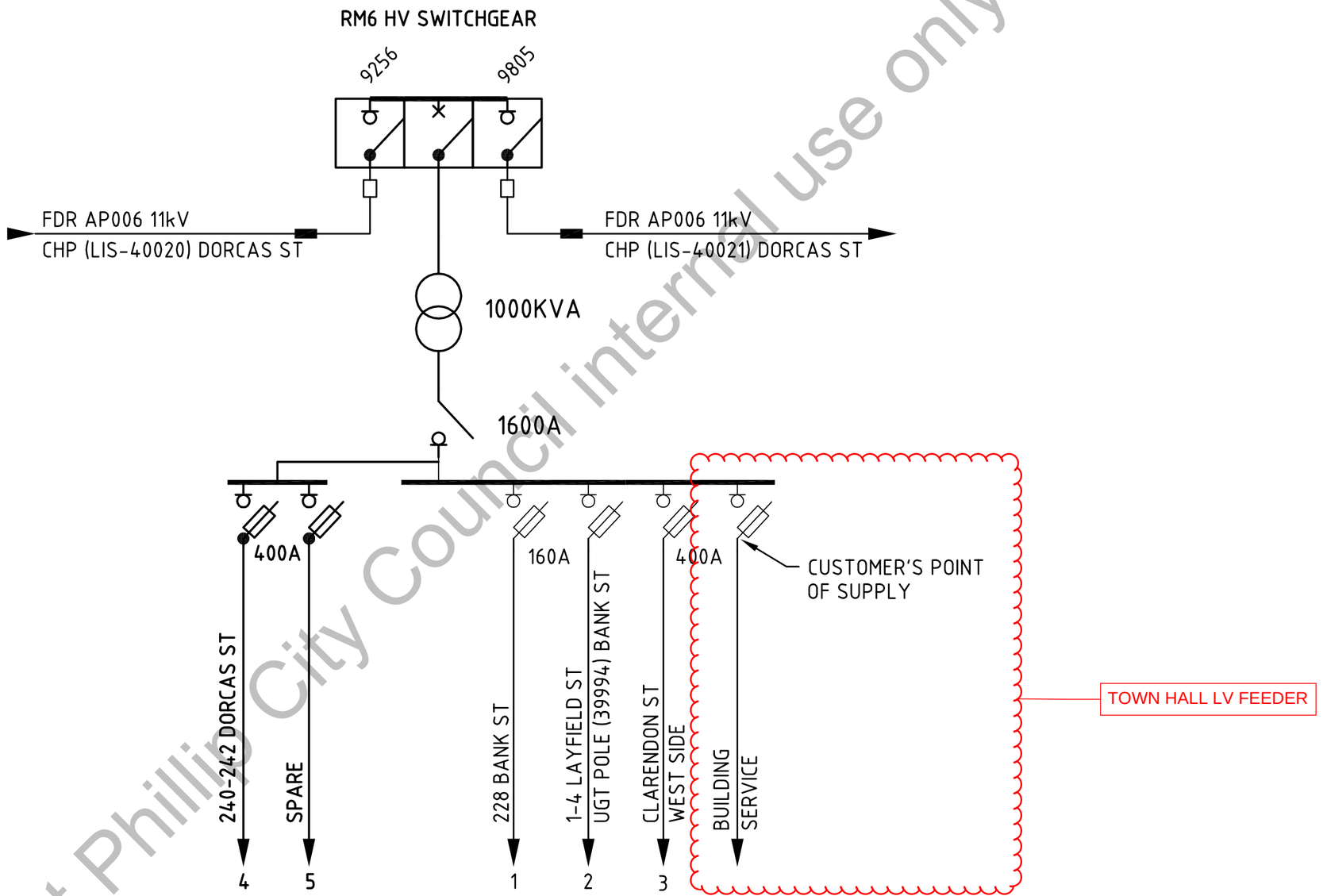

SINGLE LINE DIAGRAM OF THE EXISTING INDOOR SUBSTATION