[redacted]

Current Electrical Infrastructure

[redacted] supplied from pad mounted substation located at the end of the driveway [redacted] and supports the local customer network and street lighting.

The incoming supply to [redacted] a 200Amps, 400 Volts 50Hz / Three Phase and Neutral connection which terminates into the Main Switch Board (MSB) located within the Switch Room within the basement off the common area car park.

Figure 1 – Main Switch Board (MSB) located within the switch room.

The MSB comprises of 3 main sections:

- House Supply (Common Area supplies),
- Essential Services (Common Area essential supplies), and
- the supplies to the Units.

[redacted]

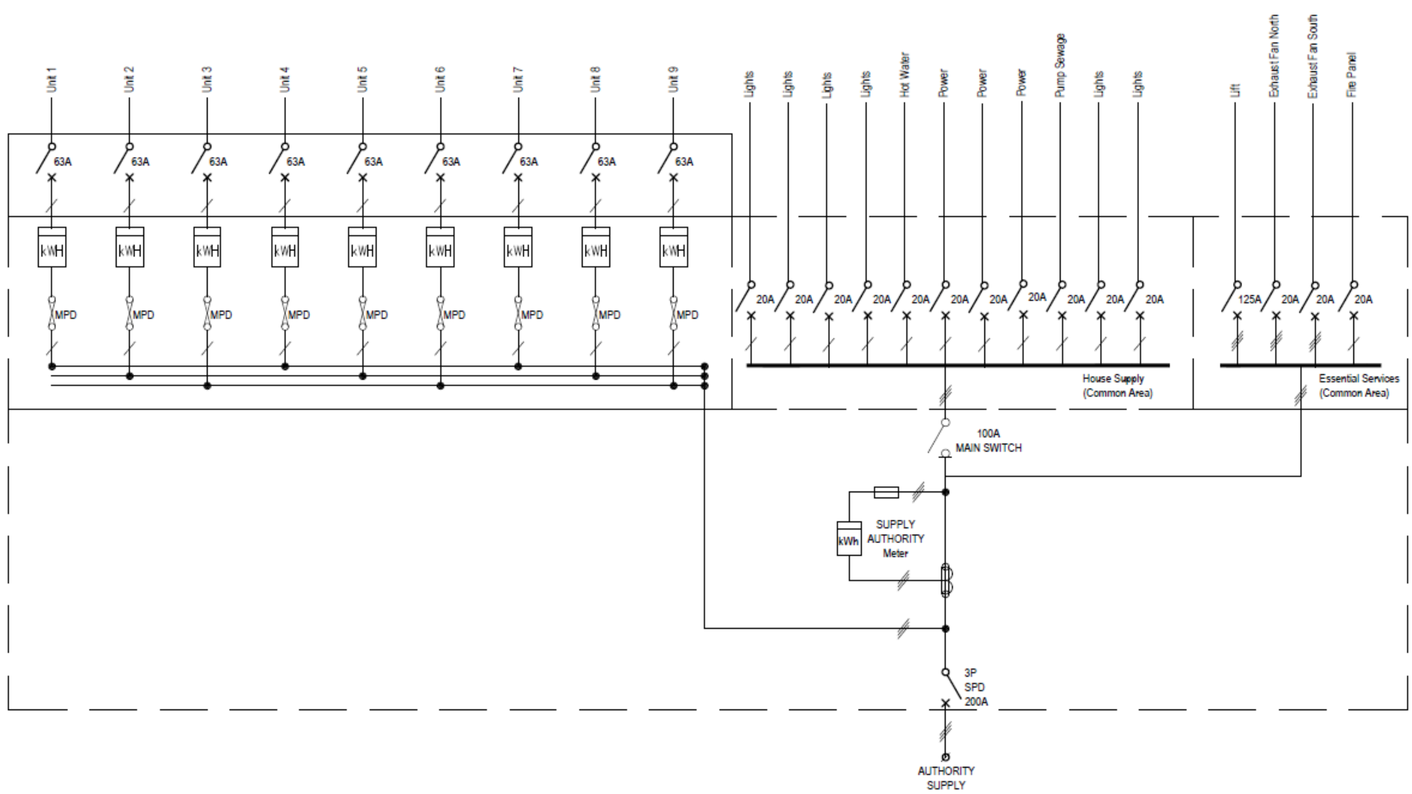
The House Supply section is controlled via a 100Amp 3 Pole Miniature Circuit Breaker (MCB), which in turn supplies several single phase (230 Volt) 20 Amp supplies to the common area lighting and power.

The Essential Services is a ‘uncontrolled’ supply i.e. is not isolated when the other common area supplies are isolated and it supplies the “essential” supplies, which consists of a number of three phase (400 Volt) supplies, including the car park exhaust fans (note that one is permanently isolated) and the lift, as well as a single-phase supply to the Fire Panel.

Both the “House Supply” and “Essential Services” sections are metered via a three phase Authority CT energy meter. This is billed to the Strata Scheme via their Energy Provider.

The supplies to the Units consist of single phase 63Amp rated Miniature Circuit Breakers, which are supplied via single phase Authority energy meters, which are billed direct to the Unit owners via their Energy Provider.

A simplified schematic diagram depicting the above is shown in figure 2:



<u>Figure 2 – Simplified schematic diagram of the Main Switch Board (MSB).</u>

[redacted]

Electric Vehicles and charging

As the Motor vehicle industry transition from traditional Internal Combustion Engine (ICE) vehicles to Plug-in Hybrid Electric Vehicles (PHEV) and Electric Vehicles (EV), there are several challenges for consumers, some of which revolve around how PHEV and EV's will be charged, which in turn also has a consequential effect on the electrical network.

There are a number of charging methods that are generally grouped in to three methods, referred to as Level 1, 2 and 3 charging.

Level 1 Charging
This uses existing power points (10-15 Amp, single phase), used in combination with a specialised cable which is typically supplied with the vehicle. They are typically used in standalone domestic homes and this method will add between **10 and 20km of range per hour** plugged in. It will top up daily use but will not fully recharge a typical pure electric vehicle overnight.

Level 2 Charging 22 Three **Wattblock Annotationn 5/1/2022**
This is a dedicated AC EV charger up to [redacted]kW (32 Amp, [redacted] phase). Typically installed in homes, apartment complexes, workplaces, shopping centres, hotels, etc – anywhere the vehicle will be parked for a while. This method will add up to **40km of range per hour** plugged in. It will top up average daily vehicle use in an hour or deliver a full recharge overnight.

Level 3 Charging
This is a dedicated DC EV charger at power levels from 25kW to 350kW (40 – 500 Amp, three phase). Typically used in commercial premises and road-side locations to provide for faster recharging than Level 1 and 2 can achieve. At the lower end, this method will add up to **150km of range per hour** plugged in and at the upper end, this method can fully recharge some electric vehicles in 10 to 15 minutes.

The average Kilometers driven per year in Australia is 13,300 km per year, or 36.4 km per day. Therefore, typically an EV will only be charging for circa 3 hours (Level 1 type charger) or 1 hour (Level 2 type charger) each day.

Where EV's are taken on longer journeys, generally EV's are only charged to 80% and are not driven to below 10-15% of the battery capacity, in which case an EV with a 450 km range would require circa 30 hours (Level 1 type charger) or 7.5 hours (Level 2 type charger).

Therefore, a Level 2 type charger is typically preferred.

[redacted], below is the available options for charging:

Output Power	Power Settings	Range added per hour* (km/h)		
Power (kW)	Phase + Amps	Model 3	Model S	Model X
16.5	3phase 24A	75	90	80
11	3phase 16A	75	60	54
7.4	Single phase 32A	50	38	34
3.7	Single phase 16A	25	19	17
2.3	Single phase 10A	15	13	11

[redacted]

[redacted]

EV Charging options [redacted]

Although there is a 3 Phase supply available at [redacted], utilizing a 3-phase supply would have a significant impact on the electrical supply, moreover the individual Unit supplies are all single phase.

Taking the [redacted] charging options, based on the above, there are two available options:

- A **Single phase 10Amp supply**, which is a level 1 type charger and involves the provision of a dedicated standard socket outlet to plug the on-board charger in to. This takes up to 2.3kW (which is similar to running say an Airconditioning unit) and charges at a rate of **15km/h** which will take between 3 and 30 hours to charge the car (as noted above) depending on the amount of charging required.

- A **Single phase 32Amp supply**, which is a level 2 type charger and involves the provision of a [redacted] wall charging unit. This takes up to 11kW and charges at a rate of **50km/h** which will take between 1 and 7 hours to charge the car (as noted above) depending on the amount of charging required.

With either option, a new dedicated supply would be required to be taken from the line side of the Unit's supply, meaning that any power consumed would be charged directly to the Unit owner. The EV should NOT be plugged in to the existing socket outlets located within the car park as this power is charged to the Strata Scheme. As an example, the supply for Unit 4 has been added to the previous schematic in red below, note that although the load is 32 Amps, it requires a 40 Amp MCB (due to the initial starting current):

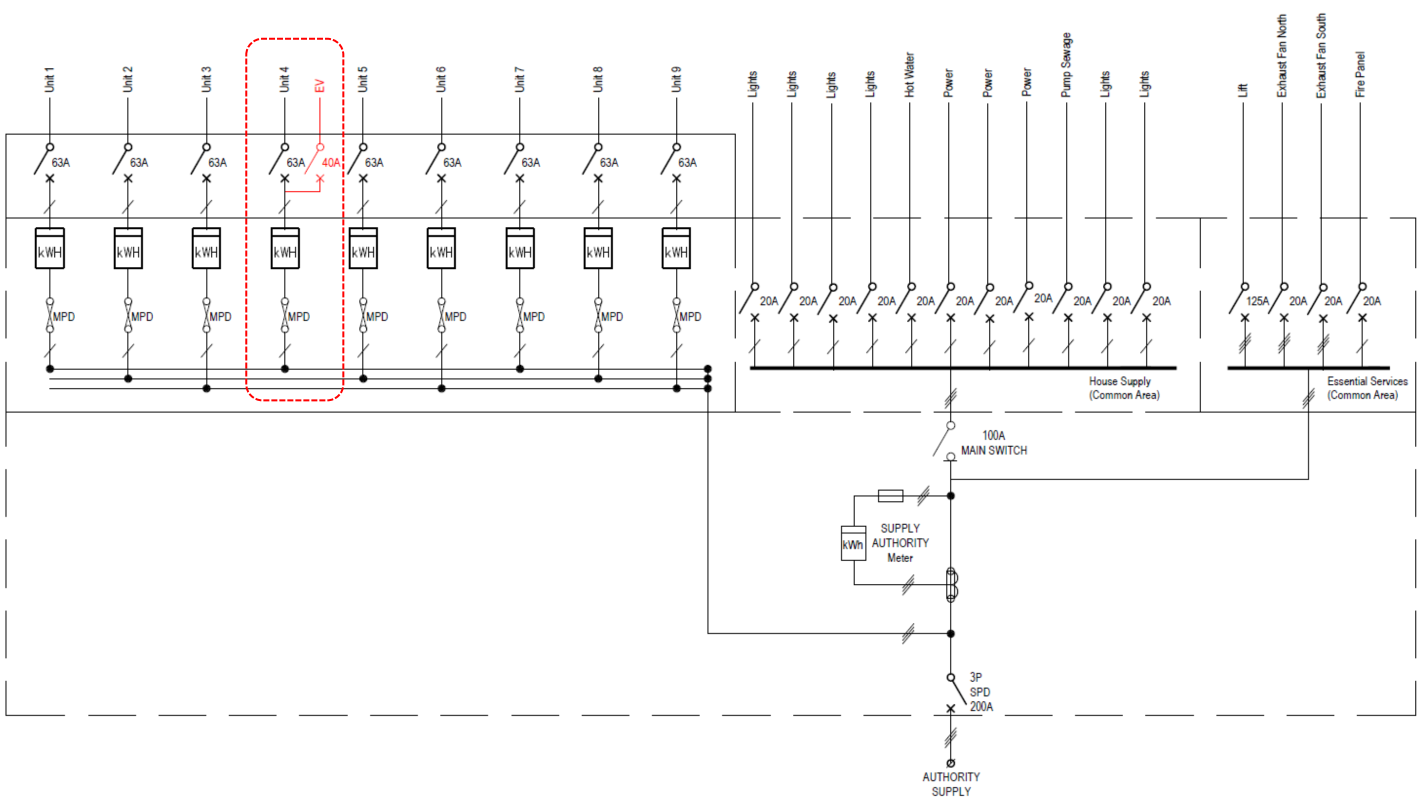


Figure 4 – Simplified schematic diagram of the Main Switch Board (MSB) with Unit 4 EV supply added.

[redacted] available capacity

The table below lists out the currently installed loads in the MSB, section 1 is the sum of the MCB ratings, which is the maximum that could be drawn, noting that this is approx. twice the incoming available supply, but doesn't account for the actual loads or the amount of diversity across the different loads:

	Phases	Rating (Amps)	1 - Based on 'Fuse' size			2 - Approx. Max Demand		
			Red Phase	White Phase	Blue Phase	Red Phase	White Phase	Blue Phase
Incoming Service	Three	200	200	200	200	200	200	200
Total Load			454	391	474	134	112	134.5
Diff (Amps / Phase)			-254	-191	-274	66	88	65.5
% of available capacity			227%	196%	237%	67%	56%	67%
Essentail Services								
Lift	Three	125	125	125	125	40	40	40
Exh Fan North (locked off)	Three	20	20	20	20	0	0	0
Exh Fan South	Three	20	20	20	20	2	2	2
Fire panel	Single	20			20			0.5
House Supply (common areas)								
Main Switch	Three	100	100	100	100	100	100	100
- Lights Garage	Single	20	20			2		
- Lights Garage	Single	20		20			2	
- Lights Plant	Single	20			20			2
- Lights Traffic	Single	20	20			0		
- Hot Water	Single	20		20			8	
- Power	Single	20			20			0
- Power	Single	20	20			0		
- Power	Single	20		20			0	
- Pump Sewage	Single	20			20			0
- Right Garden	Single	20	20			0		
- Sensor Garden (PE)	Single	20		20			0	
Unit 1	Single	63	63			30		
- EV								
- EV								
Unit 3	Single	63			63			30
Unit 4	Single	63	63			30		
Unit 5	Single	63		63			30	
Unit 6	Single	63			63			30
Unit 7	Single	63	63			30		
Unit 8	Single	63		63			30	
Unit 9	Single	63			63			30

Figure 5 – MSB load table.

[redacted]

Comments on the Common area loads.

Although there is a 100 Amp / Phase supply to the common area plus and 125 Amp 3 phase supply to the lift, the actual load usage of the common area is minimal i.e. only common area lighting, minor power usage of the available sockets and occasional hot water heating. The lift itself may require a 125 Amp MCB to handle the starting currents, but the running load will tend to be much less.

Comments on the Unit loads.

Although a 63Amp Single Phase supply is provided to each unit, the actual maximum load taken by any of the units is expected to be much less than this. Guidance published by the local supply Authority, based on meter readings of thousands of residential units, suggests that a typical small house (ie an apartment) has a After Diversity Maximum Demand (ADMD) of between 20-35 amps depending on the mix of gas and electrical appliances.

Therefore, section two of figure 5 is based on more representative loads, noting that without conducting detail calculations and / or load measurements, this is just an estimation but this indicates that there is potentially 65-90 Amps / Phase available.

Comments on time of use and diversity.

The above loads are based on a level of diversity being applied, i.e. not all the loads are being used at the same time and / or the peak loads are not occurring coincidentally. Another factor to consider is the time of day, which day and the season. There will be a large difference in the load taken between say the middle of a weekday night, where there may be only a few lights, standing loads and potentially air conditioning running, vs dinner time of Christmas day where there could potentially be a number of the Units with visitors, heavy cooking, air conditioning and other general uses all occurring simultaneously, therefore these factors need to be considered in respect to the available load for EV charging.

Single EV vs multiple EV's.

As noted, a Type 2 charger requires a 32Amps single phase supply and based on the available capacity of 65-90 Amps / Phase, a single EV would be able to be accommodated comfortably and potentially two.

It is also worth noting that the Unit's are balanced across the three incoming phases, this means that one EV connected to one phase of a three-phase supply, has the same impact as three EV's connected to each phase of the three phase supply, but having more than one EV connected to the same phase would directly impact that supply.

Scheduled charging

To make use of potentially lower energy rates, EV's typically have the ability to be able to schedule when they are to be charged. For example, the EV can be set to start charge at mid-night when the rates are lower, as well as the load on the MSB.

Impacts on the incoming supply [redacted]

Figure 6 (section 3) below shows the impact of adding three EV's, two of which are connected to the same phase. This results in minimal capacity being available during charging on the Red Phase.

Section 4 shows the potential impact of adding a EV supply to all nine Units, which may result in an overload of the supply at peak times.

Section 5 shows the same situation, but by implementing charging to be schedule at off-peak times, the charging of all nine EV's could be accommodated.

An additional way of accomodating nine electric vehicles is to implement an EV charging network where software is used to dynamically slow down and speed up charging at any time during the day across the network of chargers (rather than limiting charging to be scheduled at off-peak times). This could see variable charging speeds for the same electric vehicle during a single charging session e.g. 1/2 an hour at single phase 16amps, followed by 1/2 hour an hour at single phase 8amps, followed by 1/2 an hour at single phase 16amps. This is a functionality promised by a number of vendors entering the market. (Wattblock annotation 15/1/2022)

[redacted]

	Phases	Rating (Amps)	3 - With x3 EV Red Phase	3 - With x3 EV White Phase	3 - With x3 EV Blue Phase	4 - With x9 EV Red Phase	4 - With x9 EV White Phase	4 - With x9 EV Blue Phase	5 - With x9 EV Off Peak Red Phase	5 - With x9 EV Off Peak White Phase	5 - With x9 EV Off Peak Blue Phase
Incoming Service	Three	200	200	200	200	200	200	200	200	200	200
Total Load			198	142	134.5	230	238	198.5	155	163	123.5
Diff (Amps / Phase)			2	58	65.5	-30	-38	1.5	45	37	76.5
% of available capacity			99%	71%	67%	115%	119%	99%	78%	82%	62%
Essentail Services											
Lift	Three	125	40	40	40	40	40	40	40	40	40
Exh Fan North (locked off)	Three	20	0	0	0	0	0	0	0	0	0
Exh Fan South	Three	20	2	2	2	2	2	2	2	2	2
Fire panel	Single	20			0.5			0.5			0.5
House Supply (common areas)											
Main Switch	Three	100	100	100	100	100	100	100	100	100	100
- Lights Garage	Single	20	2			2			2		
- Lights Garage	Single	20		2			2			2	
- Lights Plant	Single	20			2			2			2
- Lights Traffic	Single	20	0			0			0		
- Hot Water	Single	20		8			8			8	
- Power	Single	20			0			0			0
- Power	Single	20	0			0			0		
- Power	Single	20		0			0			0	
- Pump Sewage	Single	20			0			0			0
- Right Garden	Single	20	0			0			0		
- Sensor Garden (PE)	Single	20		0			0			0	
Unit 1	Single	63	30			30			5		
- EV			32			32			32		
Unit 2	Single	63		30			30			5	
- EV							32			32	
Unit 3	Single	63			30			30			5
- EV								32			32
Unit 4	Single	63	30			30			5		
- EV			32			32			32		
Unit 5	Single	63		30			30			5	
- EV							32			32	
Unit 6	Single	63			30			30			5
- EV								32			32
Unit 7	Single	63	30			30			5		
- EV						32			32		
Unit 8	Single	63		30			30			5	
- EV							32			32	
Unit 9	Single	63			30			30			5
- EV					32			32			32

Figure 6 – MSB load table with EV charging.