Appendix D

ZEV INFRASTRUCTURE ASSESSMENT

PREPARED FOR

WHISTLER | Resort Municipality of Whistler

RESORT MUNICIPALITY OF WHISTLER

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PREPARED BY

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1 EXECUTIVE SUMMARY

The Resort Municipality of Whistler (RMOW) is transitioning its fleet from internal combustion engine (ICE) vehicles to zero emission vehicles (ZEVs). ChargeFWD was commissioned to conduct a ZEV Infrastructure Assessment of the facility to evaluate the existing electrical infrastructure, determine the maximum electrical demand that is available to support the electric vehicle (EV) charging, and identify any electrical modifications required to support an electric fleet.

The scope of the infrastructure assessment is based on the requirements outlined in the CleanBC Go Electric Fleets Program. A site visit was completed on Feb 17th, 2023, and information collected has been used to confirm or create a conceptual drawing for the electrical service and main distribution system. A high-level survey of the existing parking areas was completed, and each area was evaluated to determine the feasibility and effort required to electric vehicle charging infrastructure.

1.1 ELECTRICAL CAPACITY

The facility has sufficient electrical capacity to support the continued adoption of ZEVs. The site has two electrical services.

1.2 CHARGING SCHEDULES AND DEMAND INCREASE

For RMOW's battery electric vehicles (BEVs) to be effective and economical the vehicles need to be available during business hours. This means that charging should be scheduled while the vehicles are idle overnight. A depot charging approach can be achieved with the installation of level-2 charging stations. Overnight EV charging will also have a negligible effect on BC Hydro demand charges and load will be under daytime peaks.

1.3 ENERGY MANAGEMENT OPTIONS

At this point no energy management systems are being used at the facility. Networked charging stations are equipped with electric vehicle energy management systems (EVEMS). ChargeFWD recommend the deployment of a networked charging stations that makes use of load management features.

1.4 GAP ANALYSIS AND ELECTRICAL MODIFICATIONS

To support the fleets transition to ZEVs more charging stations are required. Currently only one dual level 2 charging station is available on site. We see the need for an additional 36 charging stations to support the RMOW transition of ZEVs.

1.5 ASSESSMENT LIMITATIONS AND COPYRIGHT

This assessment has been prepared by ChargeFWD for the exclusive use by The RMOW for the purposes of applying for the Go Electric Fleets rebate. The material in this assessment reflects the best judgment of ChargeFWD with the information made available to us at the time of preparation of this assessment. Any use a third party may make of this report, or any reliance on or decisions made based upon this assessment, is the responsibility of such third parties. ChargeFWD accepts no responsibility for damages suffered by a third party because of decisions made or actions taken based upon this assessment.

2 ELECTRICAL CAPACITY ASSESSMENT

The facility located at 8020 Nesters Rd, Whistler, BC V0N 1B8 has two electrical services.

Service 1 is the primary service and has a meter located in the transmission kiosk on the property line on the east side of the site. The meter number was recorded as 6200559s910 and was linked to BC Hydro Account number 016413330401. The service is 600a 600v 3φ fused at 600a.

Service 2 previously supported the Whistler Animals Galore (WAG) building. A meter is located in a power shed located in near the southeast corner of the site. The meter number was recored as 6216970p910 and was linked to BC Hydro Account number 016413300671. The service is 800a 208v 3φ fused at 400a.

This load calculation was conducted in accordance with CSA C22.1-18, Rule: 8-106(8).

Table 1. RMOW electrical capacity assessment

Service 1 (Main - 016413330401)

	Spare Capacity on Service (kW)
Current (Before any charging stations are installed)	330
After 3 charging stations on a single 40a circuit	324

Service Capacity (KVA)	De-rated Capacity (kW)	Historic Peak Load (kW)
624	499	168

Service 2 (WAG - 016413300671)

	Spare Capacity on Service (kW)
Current (Before any charging stations are installed)	94
After 27 charging stations on nine 40a circuits	34
After 6 charging stations on two 40a circuits	21

Service Capacity (KVA)	De-rated Capacity (kW)	Historic Peak Load (kW)
144	115	21

* A power factor of 100% was assumed for the electrical capacity assessment calculation

3 CHARGING SCHEDULES AND DEMAND INCREASE

RMOW operates a wide range of vehicles from light duty passenger vehicles to heavy duty work trucks. Of the vehicles in the fleet the light duty vehicles are the first to be electrified. The project focuses on making the site EV ready for two reasons. First it is more economical to perform the major civil works and electrical modifications required for EV charging at one time, rather than having to re-visit the site and perform re-work. Secondly, ZEV deliveries can have long lead times and unpredictable delivery dates, by having the site made EV ready charging infrastructure can quickly be installed as required.

ChargeFWD recommends RMOW, for the first phase of the project the scope of works includes all the civil and electrical work to make the site EV Ready. The second phase of the project is to install level-2 charging stations as required. The demand increase for a level-2 charging station would be 6.7 kW on a 40amp 208-volt circuit. If the level-2 charging stations are on a shared branch circuit, then the demand increase per station would be divided by the number of stations sharing that circuit.

The below table shows some of the different power outputs for level-2 and level-3 charging stations. The row highlighted in green is the suggested breaker sizing for this project.

Table 2. Charging station power

CHARGING LEVEL	BREAKER (A)	OUTPUT (A)	DEMAND (KW)
Level 2	100	80	19.2
Level 2	80	64	15.36
Level 2	60	48	11.52
Level 2	50	40	9.6
Level 2	**40**	**32**	**6.7***
Level 3	**200**	**153**	**120****

* Level 2 Assumes a 208-voltage and power factor of 100%

**Level 3 Assumes a 480-voltage and power factor of 100%

If the EV charging is scheduled to take place overnight during off peak times, it is not expected that RMOW will see any peak power demand increases from EV charging.

Fig 1: Example of power consumption over time (over night charging schedule)

4 ENERGY/LOAD MANAGEMENT OPTIONS

Load management systems represent a compromise between electrical infrastructure costs (e.g. wire and pipe) and charging performance.

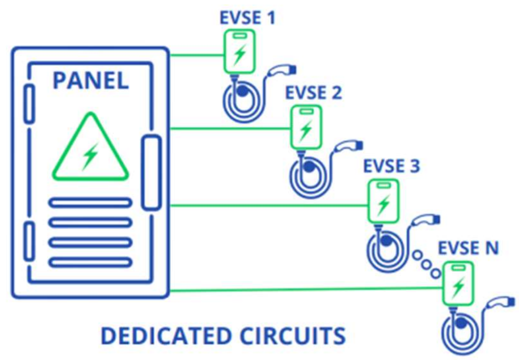


Figure 1: EVSE on dedicated service

Advantages include:

- Reduced electrical infrastructure costs.
- Greater utilization of electrical infrastructure.
- Reduced electrical demand and associated utility demand charges (where applicable).
- Integral power and energy metering.
- Improved monitoring features and network capabilities.
- Greater service support.

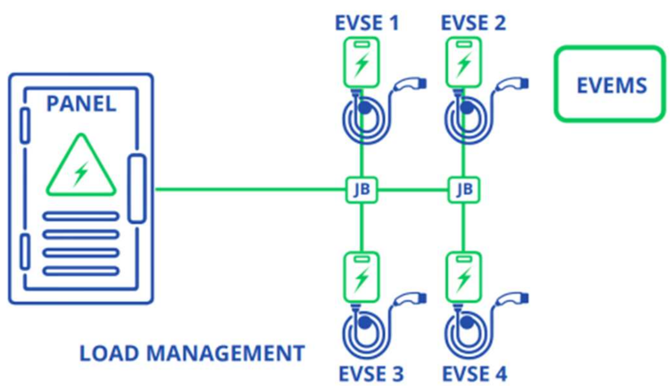


Figure 2: EVSE on shared branch

Disadvantages include:

- Reduced charging performance.
- Requirement to standardize on EVSE make.
- Reduced options of available EVSE.
- Increased EVSE cost and monthly fees.

An additional level of load management includes monitoring of the main electrical service. When it comes to networked charging stations, both hardware device manufacturer and backend networking software suppliers should be evaluated. Networked level 2 charging stations can be categorized in two groups: proprietary and non- proprietary hardware. The most common non-proprietary EVSEs operate on the Open Charge Point Protocol (OCPP). Some of the most installed networked charging makes / models include the FLO CoRe+, ChargePoint CT4000, ENEL-X Juicebox and Lite-On Platinum. In terms of proprietary networks FLO and ChargePoint hold the most market share. For non- proprietary networks there are many more options, however, Swtch and Chargelab are the most popular in Canada.

SERVICE MONITORING

Service monitoring, for the purpose of this report, is metering off the main electrical board of a building to instantaneously determine available spare capacity, and dynamically control charging accordingly. Such systems are particularly valuable where existing spare electrical capacity is extremely limited. Systems capable of service monitoring typically incorporate load management at the panel and circuit levels (circuit sharing).

The systems maximize power available for charging, as they are not restricted by the peak demand of the building. For new buildings this allows reduction of transformer sizes, and for existing buildings this means ability to accommodate charging that may not otherwise be possible without replacement of the utility service, high voltage transformer (where one exists), and main electrical board.

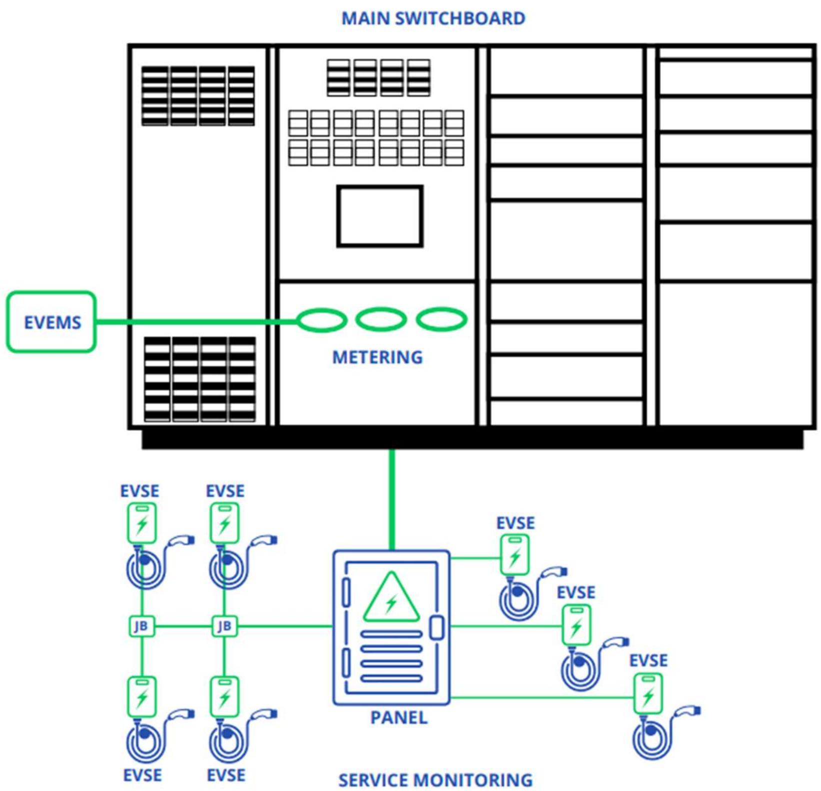


Figure 3: EVSE with service monitoring

Additional equipment over and above a typical load management system is minor and includes sensors (current transformers) installed on the main electrical board and connection to the management system. The major addition is in the software controls of the system to be able to utilize the data from the metering and apportion charging power accordingly.

Most existing buildings are not capable of accommodating EV charging with dedicated circuit solutions. Conversely, many existing buildings are capable of accommodating EV charging, provided load management solutions are deployed. Service monitoring systems are particularly valuable where spare electrical capacity is extremely limited, and unable to accommodate the required number of parking stalls, even with implementation of load managed solutions.

All configurations other than service monitoring systems are restricted to operate between peak demand and building capacity. While service monitoring systems are commercially available with solution providers such as Variablegrid and Unico Power, the technology is in relative infancy. The advantages of service monitoring systems are the ability to maximize utilization of spare capacity of building electrical systems and minimize peak demand. The disadvantages are reliability and durability risks and/or increased costs.

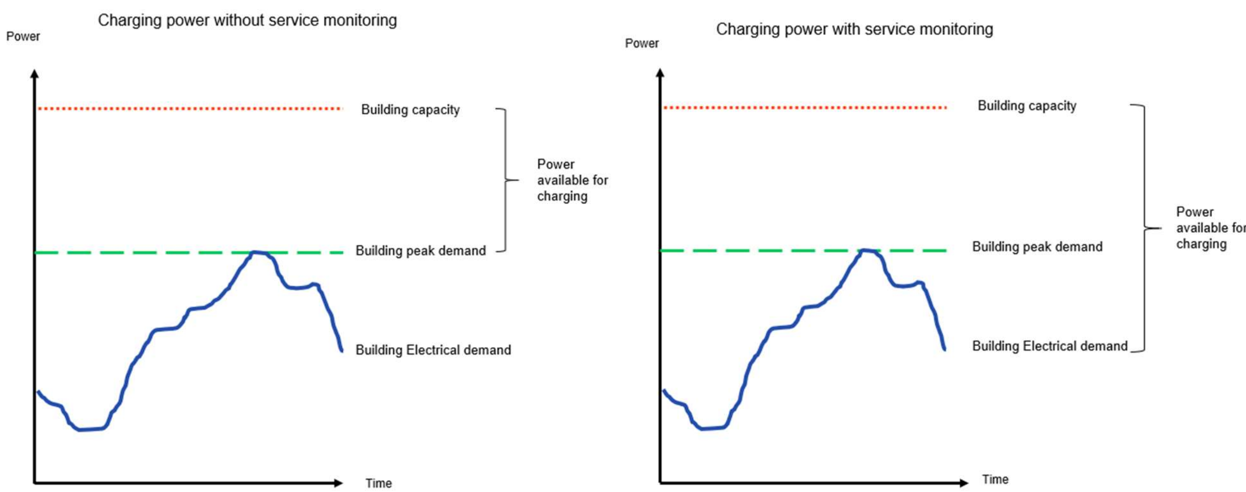


Figure 4: (left) Charging power without service monitoring vs (right) Charging power with service monitoring

There are no existing energy management systems implemented at the facility. After evaluating options for the RMOW, it is recommended that EVEMS (Electric Vehicle Energy Management system) should be installed at the facility to effectively manage the load of overall system.

5 GAP ANALYSIS

To support the fleets transition to ZEVs more charging stations are required. RMOW currently has 49 light duty vehicles that they eventually plan to transition to BEVs. Plans to transition their heavy-duty trucks to ZEVs are possible as well. Heavy-Duty ZEVs have bigger battery pack compared to light-duty battery electric vehicles (BEVs), therefore require a longer charge time or higher power levels. As these are work trucks, they need to be available for a demanding duty cycle and cannot sit idle for long periods of time while charging, therefore a faster charge rate is required.

It is recommended that the facility is first made EV ready, and then install **27 level-2 charging stations** on shared circuits. *See section 6 Conceptual Design for detailed analysis.*

6 CONCEPTUAL DESIGN

For this depot charging station installation there are several design variations available.

STEP 1: ELECTRICAL MODIFICATION (MAKE READY)

Phase 1: Make Ready Electrical Modifications

- **Installation of dedicated EV charging panels**
- **Coring**
- **Trenching and cabling from service to parking stall**
- **Installation twelve 40a / 208v branch circuits**
- **Installation of thirty-six energized outlets in stalls**

For this location ChargeFWD recommends to first make the site EV ready. Since the available capacity is sufficient, a BC Hydro will be installed on the existing services. This will provide a dedicated meter for EV charging. ChargeFWD recommends installing thirty-six (36) Level-2 charging stations on 40-amp 3-share circuits. Using a 3-share circuit will not only help to reduce the overall cost of the project but also reduce the utility bill in long run as the system will better utilize the available capacity. A new BC Hydro meter dedicated to EV charging will be installed. By having a dedicated meter, the municipality could take advantage of future EV charging electricity tariffs, in addition it will be much simpler to track and allocate electricity costs for fleet fueling if a separate meter is installed. ChargeFWD also recommends installing a new electrical panel that feeds to the EVSE. Since RMOW will gradually electrify its fleet over years, this modular installation is future proofed and expandable.

See appendix for detailed drawings.

STEP 2: CHARGING INFRASTRUCTURE

Phase 2: Level-2 Charging Stations

- **Installation of pedestals/ mounts for charging stations**
- **Installation of thirty-six level-2 charging stations on a 3-share circuit.**
- **Energizing and commissioning charging stations**

After the site is EV ready i.e., energized outlets in each stall, ChargeFWD recommends installing thirty-six level-2 charging stations on a 3-share circuit. Using a 3-share circuit will not only help to reduce the overall cost of the project but also reduce the utility bill in long run as the system will better utilize the available capacity. *See appendix for detailed drawings.*

CONSIDERATIONS SPECIFYING EVSE

PART A: EVSE HARDWARE

When selecting a EVSE proven reliability should be the top priority. There are over 10 DCFC manufactures that are certified in Canada. At first glance the equipment may seem interchangeable as all the units preform the same function, however, this is not the case. The key indicator of a good quality charging station is high up time. These stations are delivering high levels of power and generate a lot of heat. As such some manufactures have struggled to avoid burning out their power modals. This leads to equipment down time, and service calls.

ChargeFWD has been closely watching the roll out of DCFC by the biggest charging station operators in BC and North America. What we have seen is a consolidation in the types of equipment that is being installed. For example, when first installing DCFC equipment BC Hydro installed charging stations from various makes such as BTC power, Efacec, Tritium, ABB and FLO | AddEnergie. After years of lessons learned, BC Hydro has consolidated to only two units. One made by FLO | AddEnergie and the other by ABB. The same trend has occurred with other charging station operators such has Petro Canada and Electrify Canada who now only install BTC Power DCFCs.

DCFCs sold in the North American market tend to be based on the most common global distribution voltage which is 480 volts. Unfortunately, 480 volts is an uncommon electrical distribution voltage in the Canadian electrical grid. Typically, BC Hydro electrical grid connections are made to 208 volts and therefore the voltage for the DCFC will need to be stepped up with the use of a transformer. These transformers will need to be placed near by the DCFC on a concert slab.

Level 2 charging stations are essentially power delivery devices, similar to a on/off switch with electronics for communications with the vehicle to manage the charging process, and a connector cable. They do not include the actual “charger” which is onboard the vehicle and includes a rectifier to supply direct current (DC) to charge the battery. This is different to DC fast chargers which incorporate a rectifier and bypass the onboard charger. For this reason, charging power receivable from a Level 2 charger is limited by the onboard charger of the vehicle, which ranges from 3.3kW to 19.2 kW, depending on the vehicle make.

For this project, we have selected the **EVC10 from JoinTtech for Level-2 charging station** as our recommendation for EVSE. *See Appendix for specification documents*

PART B: EVSE SOFTWARE & INTEROPERABILITY

The most overlooked consideration in a EVSE project is the software. However, the software has a significant impact on the user experience and the operation of the station.
There are three types of charging stations. Non-networked stations that have zero connectivity and therefore lack many features but are more economical. Non-networked stations are suitable for applications in single family homes for fleet depo charging. Often non-network station do not have any screens or user interfaces. The two types of networked charging stations are closed and open networked charging stations. Closed network charging stations are offered by charging station manufactures that design both the charging station hardware and charging station management system software. In the early days of industry many customers preferred closed network charging station because the common standard and protocols were not yet widely supported. Selecting a closed networked charging station provider meant that one provider designed and managed the entire charging experience for end to end. ChargePoint would be an example of a closed network charging station provider.

As the common industry standards for charging station communication protocols developed, the **industry is now moving towards open networked charging stations**.

The open charge point protocol (OCPP) has been adopted as the worldwide industry standard for charging station interoperability.

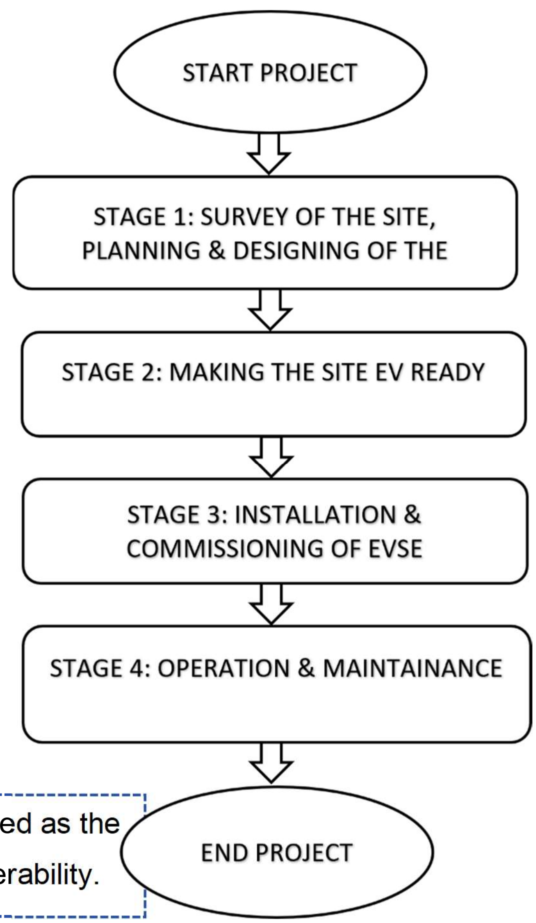


Figure 5: Typical flowchart to understand the project process flow

Open network charging station allow for various makes and models of charging station to operate on a single software platform. This is often referred to as interoperability, how this work is similar to the world of mobile phones. Various handset manufactures (e.g., Apple, Samsung) can be take across various mobility service providers (e.g., TELUS, Bell). By making use of open network charging stations operators will have the ability to choose amongst various charging station hardware manufactures and management platform service providers. This interoperability often results in lower costs for the operator.

The advantages of open standards-based charging networks are flexibility and choice. Open standards allow users to choose from many different hardware and network providers. When you install OCPP-compliant charging stations, end-users are free to select the charging network provider that meets your needs. Open systems offer the flexibility to mix and match charging hardware with the network management system on the back end. When user needs change or customer wants to scale its network, they can shop around for another OCPP-compliant network provider or can add charging stations from different OCPP-compliant manufacturers. This allows charging station owners to optimize the cost and risk of networked infrastructure investments.

Open networks enable interoperability, allowing the broadest possible set of products to work together. In turn, interoperability promotes the expansion of existing infrastructure. Open, universal standards make it easy to introduce new hardware options that connect to the existing network and are transparent to site hosts and EV drivers.

In a similar vein, utilities that invest in smart meter infrastructure based on open standards can add smart grid applications for outage management, demand response, thermostat integration, street light integration and more.

The Open Charge Alliance has developed a hardware certification process to ensure seamless integration between all OCPP-enabled devices and the back-end network management systems. Open standards vendors are investing significantly in building this technology.

Charging networks based on open communications standards stimulate technical innovation by allowing free-market competition to push down the costs of both charging station hardware and back-end software, while dramatically lowering the risks of hardware purchase for site hosts.

Beyond the benefits to the individual charging station owner, networks based on open standards represent the best path forward to large-scale transportation electrification. Drivers will certainly need more charging stations to relieve their range anxiety, and as more EVs hit the road, the most practical and convenient approach will be charging networks based on open standards.

PART C: COMMISSIONING & MAINTAINANCE

ChargeFWD will commission the full system; the EV chargers to ensure compliance with the manufacturers' specification; data communication system to optimise access the charging management system; load management system to maximise the power available to the EV chargers while protecting the electrical supply.

ChargeFWD offers a full call-fix and planned maintenance service to maximise the availability of your EV charging stations.

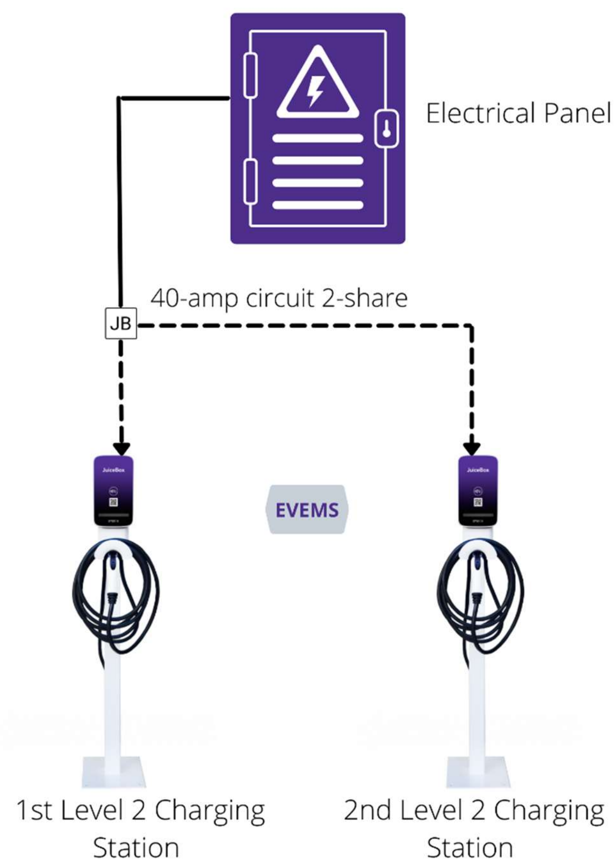
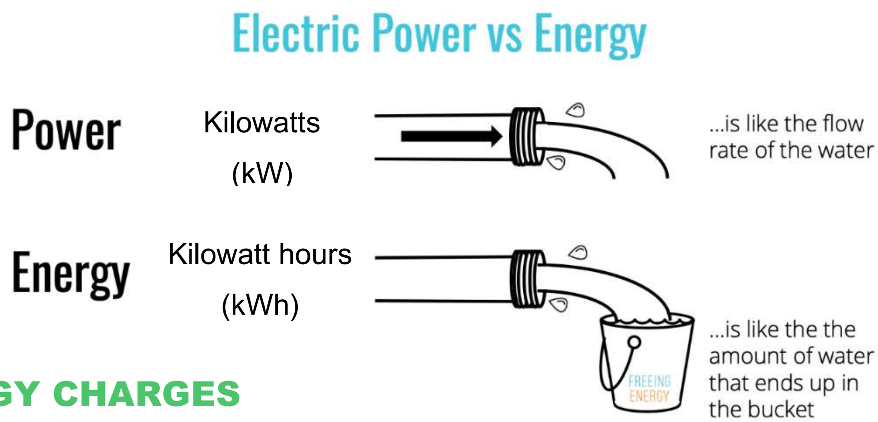


Figure 6: Typical Block Diagram (Level-2 Charging Station)

7 ENERGY BILL IMPACTS

The proposed new tariff plan for Superior City Services would be **"Medium General Service"**.

To understand electrical utility bills, it is important to understand the difference between power and energy.



7.1 ENERGY CHARGES

Fig 9. is the complete tariff rate plan under the Medium General Service Rate.

Basic Charge A small, daily amount that partially recovers fixed customer-related costs, including customer service channels, metering, billing, payment processing, collections, and distribution system costs that are customer-related (electrical lines and transformers).	$0.2672 per day.
Demand Charge Demand is the rate at which electricity is used and is typically measured in kilowatts (kW). Peak demand is the highest rate of electricity use during a period of time. Our smart meters measure demand using 15-minute intervals with three consecutive five-minute sub-intervals. The highest 15-minute demand average recorded in each billing period is used to calculate the demand charge on your bill.	$5.41 per kW.
Energy Charge	$0.0968 per kWh.

Minimum Charge A charge that covers the cost of maintaining our equipment year round for customers with high electricity usage in the winter but low electricity usage in the summer.	Equal to 50% of the highest Demand Charge during the previous November 1 to March 31 period. The Basic Charge, Energy Charge, and Demand Charge are replaced by the Minimum Charge if their sum is less than this amount.
Power Factor Surcharge A measure of efficiency, and the ratio of usable power (kW) to reactive power (kVar) in a circuit. It varies between 0 and 1, and is normally given as a percentage (1 to 100%). We apply a power factor surcharge to business customers whose power factor drops below 90%. Learn more about power factor.	Applicable if power factor is below 90%.
Discounts	1.5% on entire bill if electricity is metered at primary potential. $0.25 per kW if customer supplies transformation from a primary to a secondary potential. If eligible for both, the 1.5% discount is applied first.

Figure 7: Medium General Service Rate

7.2 DEMAND CHARGES

The demand charge, which is calculated for each billing period is based on the peak power demanded in the billing period.

- To understand the billing impact under this tariff plan, assuming a scenario where the Level-2 charging station (13.4 kW on a 3-share) is used is used 3 hrs/day, 5 days a week and the Level-3 charging station (120 kW) is used for 1 hr/day, 7 days a week. Taking a billing period of 8 weeks, the estimated **BC Hydro bill for EV charging will be around $1471.64 per month.**
- *Please note, these calculations are based on assumption that the peak demand will be lower than 150 kW (six level-2 charging station on a 3-share circuit and one 120 kW level-*

3 charging station). If in future, the peak demand increases more than 150kW then the tariff plan will change to "Large General Service"

8 TOTAL COST OF THE PROJECT

Total Cost of the Project = Capital Cost + Operational Cost

8.1 REBATES

As of Feb 2021, the rebate available in BC for EV Charging installation and upgradation work is Go Electric Fleets Program funded by Provincial government (CleanBC).

8.1.1 GO ELECTRIC FLEETS PROGRAM

1) **Financial Support for Electrical Modification and/or electrical service upgrade.**

   If electrical modification and/or electrical service upgrades are needed to support fleet electrification, the costs associated with such projects can be a barrier to ZEV adoption. To support the facilities of an organization to be ZEV fleet ready, the Go Electric Fleets Program provides financial support for the electrical work needed to provide enough energy to support a ZEV fleet. *This Program component will reimburse the costs of electrical work/service upgrades or modifications at the rate of 33% of total costs to a maximum rebate of $20,000.* Organizations can have separate applications for different sites but can only receive rebates for a maximum of four sites.

   Eligible costs include:

   • Engineering design services.
   • New panels and breakers.
   • New transformer.
   • Wiring and conduit additions
   • Upgrades to utility service.

2) **Charging Infrastructure Rebate.**

   Access to charging infrastructure will be necessary for any fleets choosing to adopt electric vehicles (EVs) such as battery-electric or plug-in hybrid electric vehicles. However, the costs associated with EV charging equipment can be a barrier to adoption. To help organizations address this barrier, the Go Electric Fleets Program provides financial assistance to customers to design, procure and install charging infrastructure, to be used by the fleet.

i) **Level 2 Charging Station**

This Program component will reimburse purchase and installation costs of eligible, new, Level 2 charging equipment at the rate of 50% of total costs, up to a maximum of $2,000 per station. Rebates will be capped at $25,000 per applicant. Single port stations count as one charging station, dual port stations count as two charging stations. As such, applicants who apply for a dual port station would receive up to $4,000 or 50% of total costs, whichever is lower.

ii) **DCFC**

Applicants are offered two tiers of rebates for DCFC stations, installed for use by fleet vehicles, as detailed in the table below.

Table 3. DCFC rebate levels

Charger Output	Maximum Rebate Amount	Maximum Rebate Amount for Indigenous Communities and Businesses
DCFC: 20kW to 49kW	50% of project costs up to $20,000	75% of costs up to a maximum of $35,000
DCFC: 50kW or higher	50% of project costs up to $50,000	75% of costs up to a maximum of $75,000

Eligible costs include:

• Purchase of the charging station.

• Labour and construction costs for the installation of the charging station, and associated conduit by a licensed electrical contractor.

• Electrical and other related permits.

• Parking and electrical design to accommodate the charging stations.

8.1.2 CLEANBC GO ELECTRIC REBATES FOR HOMES & WORKPLACES

Funded by the Government of B.C.'s Ministry of Energy, Mines and Low Carbon Innovation, and with financial support from the Government of Canada, BC Hydro administers the CleanBC Go Electric (EV) charger rebate program. The program provides rebates for the purchase and installation of electric vehicle (EV) chargers and infrastructure to get homes and workplaces across B.C. ready for EVs. Workplaces can get a rebate of up to *$5,000 per charger (limited-time increase, regularly $2,000) to purchase and install eligible Level 2 networked EV chargers for employee use, to a maximum of *$25,000 (limited-time increase, regularly $14,000). To be eligible, pre-approval from BC Hydro is required prior to purchasing and/or installing chargers.

Eligible workplace organizations can have separate applications for different locations, up to a maximum of four.

****** Rebates are subject to change and availability at the time of project kick off ******

8.2 CAPITAL COST

Phase 1: Make Ready Electrical Modifications

- **Installation of dedicated EV charging panels**
- **Coring**
- **Trenching and cabling from service to parking stall**
- **Installation twelve 40a / 208v branch circuits**
- **Installation of thirty-six energized outlets in stalls**

Table 4: Budgetary cost to make the facility EV ready.

BUDGETARY COST OVERVIEW			
ELECTRICAL MODIFICATIONS	CLEANBC REBATE	TOTAL AFTER REBATE & BEFORE TAXES	TOTAL AFTER REBATE & TAXES
$53,475	**$20,000**	**$33,475**	**$36,149**

Table 5: Breakdown of Electrical Modification Cost

BREAK DOWN OF ELECTRIC MODIFICATIONS COST		
ITEM	DESCRIPTION	UNIT
1	NEW 600 AMP PANEL	1
2	NEW 100 AMP PANEL	1
3	BRANCH CIRCUITS	12
4	BC HYDRO METER	2
5	NETWORKING HARDWARE	1
6	CIVIL WORKS: CORING, TRENCHING, PAVING	1
7	LABOR	1
8	15% CONTINGENCY	1
	TOTAL	$ 53,475

Phase 2: Level-2 Charging Stations

- **Installation of pedestals/ mounts for charging stations**
- **Installation of thirty-six level-2 charging stations on a 3-share circuit.**
- **Energizing and commissioning charging stations**

Table 6: Budgetary cost for installing EVSE

BUDGETARY COST OVERVIEW			
CHARGING INFRASTRUCTURE	CLEANBC REBATE	TOTAL AFTER REBATE & BEFORE TAXES	TOTAL AFTER REBATE & TAXES
$97,200	**$25,000**	**$72,200**	**$77,060**

Table 7: Breakdown of charging infrastructure cost

BREAK DOWN OF CHARGING INFRASTUCTURE COST		
ITEM	DESCRIPTION	UNIT
1	LEVEL-2 CHARGING STATION	36
2	CHARGING STATION COMMISSIONING	36
3	PEDESTALS & CABLE MANAGEMENT	18
	TOTAL	**$97,200**

Notes:

For budgeting purposes, it is assumed that all charging stations will be purchased and installed during a single site visit. If charging stations are installed over multiple appointments, then additional call out charges may apply.

Networked level 2 charging stations have an annual subscription fee of ~$250 annually per charging port for use of the EVEMS.

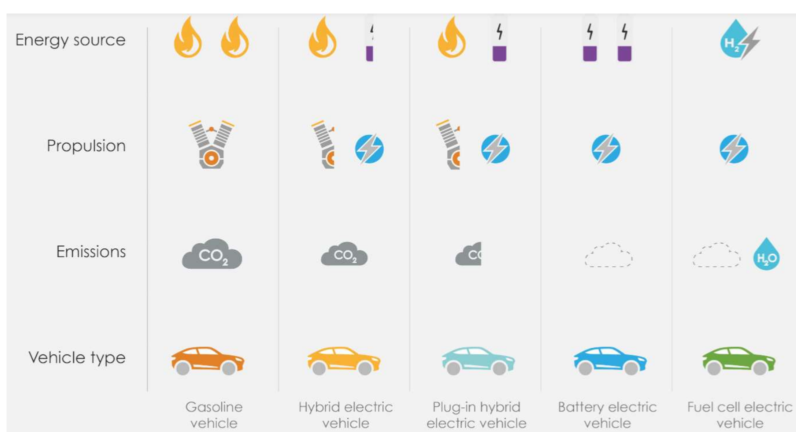
Rebate based on CleanBC Go Electric Rebates for Homes & Workplaces.

APPENDIX A: FUNDAMENTALS

ELECTRIC VEHICLE BASICS

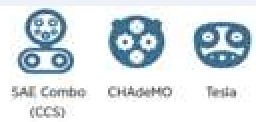
An electric vehicle (EV) is any vehicle with an electric drivetrain. The electric drivetrain is what differentiates an electric vehicle from a conventional fossil- fueled vehicle where the drivetrain is mechanical. What is interesting to note is that the first cars were electric way back at the end of the 19th and early 20th century. An intense competition then began between the two types of vehicles. Fossil- fueled cars became the clear winner over electric cars. As a result, the internal combustion engine car has dominated the market since then. However, decades of research and development into batteries, motors and power electronics technologies have helped bring electric vehicles back toward the forefront. We now have affordable EVs; the one you see in the picture here has a 380-KM range and can be charged in less than an hour. 5 million electric cars are already on the roads globally as of 2020 and this number is expected to dramatically rise in the future.

The table below shows the overview of all types of vehicles we see on roads. In the case of internal combustion engine (ICE) vehicles, they are solely powered by an internal combustion engine and have the most emissions. Hybrid Electric Vehicles (HEV) and Plug-In Hybrid Electric Vehicles (PHEV) are powered by both an internal combustion engine and an electric motor that uses energy stored in a battery. The battery is charged by the internal combustion engine in both cases. For a PHEV, the vehicle can be plugged into an electric power source to charge the battery. Battery Electric Vehicles (BEV) use no fossil fuel and have zero tail- pipe emissions. Like a PHEV, the EV batteries are charged by plugging the vehicle into an electric power source. Finally, a Full Cell Electric Vehicle (FCEV) uses fuel cells powered by hydrogen and a battery to power the vehicle using an electric drivetrain.



ELECTRIC VEHICLE CHARGING

Fast, reliable, and safe charging options are required for electric vehicles; not too long ago this problem was looking like a “chicken and the egg” scenario. Some drivers would not consider electric vehicles reliable and comfortable unless there were charging facilities in predictable ranges. In contrast, investors of charging infrastructure typically expected (and still do usually) quick and regular income after installations but the gap is lessening all the time now. It could be noted that this trend is also really like the relationship was between the roll- out of gasoline cars and gas stations from around a century ago.

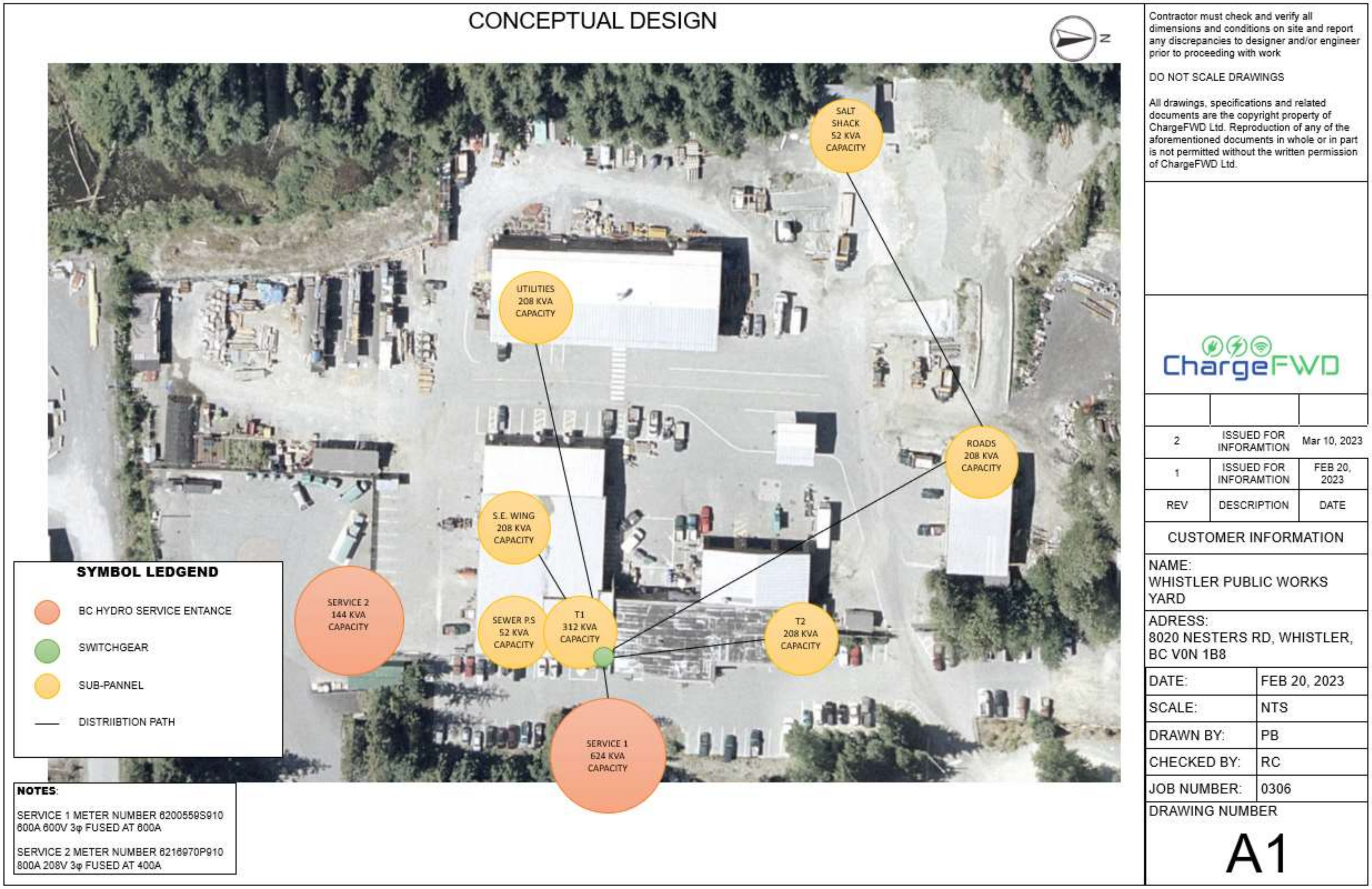
Type	KM Range Per Hour of Charging (RPH)	Time to Fully Charge	When to Use	Connector
Level 1, Standard Wall Outlet (AC)	4-8 RPH	14-25 hours	☐ Overnight	
Level 2 Charging Station (AC)	25-80 RPH	4-5 hours	☐ At Work ☐ Overnight	
Level 3 DC Fast Charging	100+ RPH	80% charge within 30 minutes	☐ Short stops ☐ Highway drives	

In the first column of the above table, you will see 3 levels of charging. These levels are categorized into alternating current (AC) and direct current (DC). AC and DC charging are characterized by the connector type and the charging power levels that can be reached. Car manufacturers have not agreed on a single connector; various connectors are used for AC and DC charging. Charging is typically split into three levels from 1 to 3.

Level 1 or “slow charging” refers to charging using a 120-volt, 15- or 20-amp circuit. The best practice for level 1 charging is to use a single dedicated 20-amp receptacle that is labelled for EV charging only. For level 2, the “Type 1” connector is commonly used in North America. The “Type 1” connector is commonly referred to as the J- plug, or the SAE J1772 plug or the universal connector. In terms of level 3 or “DC charging”, the CHAdeMO connector was used by Japanese car manufacturers, while the North American and European car manufacturers have adopted a combined AC/ DC connector called the CCS-COMBO. Recently the Japanese car manufacturers have begun to use the CCS1 connector in North America as well. Interestingly, Tesla vehicles use the same connector meant for AC charging for DC charging as well, which is their own proprietary design. However, with the use of adaptors, Tesla vehicles can also make use of the J-plug and CHAdeMO connector but not the CCS1 connector in North America.

The EV industry has not agreed on one specific connector, so depending on the car brand, country and whether it is AC or DC charging, the connector varies in shape, size and pin configuration.

APPENDIX B: CONCEPTUAL DRAWING



CONCEPTUAL DESIGN

SYMBOL LEDGEND

- EV READY JUNCTION BOX
- EV1 EV CHARGING PANNEL
- CONDUIT PATH
- EXISTING DUAL PORT EVSE

NOTES:

FINAL PLACEMENT OF EV READY JUNCTION BOXES SUBJECT TO CHANGE ON REQUEST

Contractor must check and verify all dimensions and conditions on site and report any discrepancies to designer and/or engineer prior to proceeding with work

DO NOT SCALE DRAWINGS

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ChargeFWD

REV	DESCRIPTION	DATE
2	ISSUED FOR INFORAMTION	Mar 10, 2023
1	ISSUED FOR INFORAMTION	FEB 20, 2023

CUSTOMER INFORMATION

NAME:
WHISTLER PUBLIC WORKS YARD

ADRESS:
8020 NESTERS RD, WHISTLER, BC V0N 1B8

DATE:	FEB 20, 2023
SCALE:	NTS
DRAWN BY:	PB
CHECKED BY:	RC
JOB NUMBER:	0306

DRAWING NUMBER

A2

LOAD CALCULATION

Service 1 (Main - 016413330401)

Spare Capacity on Service (kW)	
Current (Before any charging stations are installed)	330
After 3 charging stations on a single 40a circuit	324

Service Capacity (KVA)	De-rated Capacity (kW)	Historic Peak Load (kW)
624	499	168

Service 2 (WAG - 016413300671)

Spare Capacity on Service (kW)	
Current (Before any charging stations are installed)	94
After 27 charging stations on nine 40a circuits	34
After 6 charging stations on two 40a circuits	21

Service Capacity (KVA)	De-rated Capacity (kW)	Historic Peak Load (kW)
144	115	21

Assumptions for Main Service 1

Meter Number	6200559S910
Account Number	16413330401
3 Phase	1.7321
Amps	600
Voltage	600
Power Factor	1
W to kW conversion	1000
12 month Historic Peak Load (kW)	168.4

Assumptions for EVSE loads on Service 1

EVSE to Branch Circuit Ratio (# to 1)	3
Number of stations	3
Number of Branch Circuits	1
Breaker Size (A)	40
Max EVSE Output (A)	32
Min EVSE Output (A)	11
Peak EVSE Load	6.7

Assumptions for charging performance requirments

Range add per kWh charged (KM)	6.4
Charging Station Peak Load (kW)	6.7

Assumptions for WAG Service 2

Meter Number	6216970P910
Account Number	16413300671
3 Phase	1.7321
Amps	400
Voltage	208
Power Factor	1
W to kW conversion	1000
12 month Historic Peak Load (kW)	21.03

Assumptions for EVSE loads on Service 2

EVSE to Branch Circuit Ratio (# to 1)	3
Number of stations	27
Number of Branch Circuits	9
Breaker Size (A)	40
Max EVSE Output (A)	32
Min EVSE Output (A)	11
Peak EVSE Load	59.9

Assumptions for charging performance requirments

Range add per kWh charged (KM)	6.4
Charging Station Peak Load (kW)	6.7

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DRAWING NUMBER

E1