Charging Station Installation Analysis

Tompkins County
Plug-in Electric Vehicle Infrastructure Plan

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Prepared by:

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Executive Summary

An electric vehicle (EV) charging station installation includes several components and choices that can vary by site location.

Charging stations provide various power levels to charge the EV at different rates. AC Level 1 stations use 120V to provide up to 2 kW of charging, resulting in 3-5 miles of electrical driving range per hour of charging. AC Level 2 stations use 240V to provide up to 19.2 kW, resulting in 10-20 miles of electrical driving range per hour of charging. Most commercial charging station models have the option to be networked. Networked stations use cellular communication to report and track the real-time status of the charging station. AC Level 1 and 2 charging stations cost between $500 and $5,000 per charging port depending on type and features.

The installation of a charging station includes something to mount it on and getting sufficient electrical power to the charging station. Typically, the station is mounted on a concrete base for a free-standing pedestal unit or a simple mount to an existing structure for a wall unit. The distance between the electrical panel and charging station will impact the cost, as well as the surface (e.g., pavement, concrete sidewalk, dirt) and structure (building envelop) that conduit must be routed through. Any required upgrades to the electrical service or panel if the existing infrastructure is not sufficient will also add cost to the installation. The installation costs for the potential charging station sites surveyed around Tompkins County ranged from $2,000 to $12,500, but could certainly be much higher in special circumstances.

Protecting the charging station from vehicular damage is important for preventing potentially high repair costs. In some situations an existing curb or mounting it elevated on a wall will be sufficient to avoid any accidental impacts. However, most sites should add a tire stop ($350 per space) or bollards ($1,000 each) in front of the charging station to protect it.

If the charging station is hard to find on the property, signage may be helpful to EV drivers, but most use mobile applications to locate the stations. Signage is critical to regulate how the charging stations are used (e.g., specifying that only charging EVs should be parked in these spaces), advertise who sponsored the station (most charging stations are put in to attract business from EV drivers or demonstrate corporate sustainability beliefs), and create EV awareness with non-EV drivers. Some sites have painted the charging station spaces green to further distinguish them from the other parking spaces. This signage might add $500 to the total station cost.

Networked stations cost more to purchase because they have cellular communication modules that allow it to send and receive information. They will also have additional installation costs of $1,000 for site validation (to verify that there is a sufficient cellular signal) and station activation (to initiate and verify proper communication).

Ongoing expenses for a charging station include networking fees, electricity, and maintenance. Networking fees around $300 per charging port per year cover the needed cellular data plan and the services to maintain the networking features. These features include monitoring, alerts, and reporting (transaction fees for billing EV drivers to charge are extra). While varying based on the battery capacity of an EV and its state of charge when plugging in, on average one charge event dispenses about $1.00 of electricity to an EV (~7.7 kWh at $0.13 per kWh). In New York State, the 700 charging ports currently being monitored by the New York State Energy Research and Development Authority average 2.5 charge events per week per port. Rounding this up to 150 charge events per year per port would cost the site $150 in

electricity. Maintenance costs will depend on the location and use, but a properly cared for charging station (ensuring the cords are coiled, occasionally wiping it clean, and clearing any snow or debris that might accumulate around it) should only have minor repairs ($1,000 or less) for parts that wear from use over 10 years.

A preliminary engineering and cost analysis for installing new EV charging stations was completed for seven different locations in Tompkins County that showed good potential from survey responses and answers to the Site Suitability Criteria Tool. In addition to preparing these seven sites for a charging station installation, these locations represent a range of site characteristics that should help other locations estimate the costs to install a charging station based on similarities to these locations. Table 1 summarizes the total first year cost for installing and operating a networked Level 2 charging station at these locations. Not included on Table 1 is the cost to install Level 1 charging stations for Cornell Cooperative Extension. That location has characteristics suitable for this lower-cost option, which is outlined later in this report. Some locations had multiple options for the charging station placement or mount which resulted in multiple entries on this summary table and are described in more detail through this report.

Table 1. Total charging station components and installation costs for selected sites in Tompkins County

Site Host	Station Description	Installation Description	Total Cost (first year)
Cornell Cooperative Extension	Level 2 (240V), wall mount, networked	Installed with **new** building, 30' wire run, 1 tire stop	$11,250
Cornell Cooperative Extension	Level 2 (240V), wall mount, networked	Installed on an **old** building, 30' wire run, 1 tire stop	$13,750
Seneca Street Parking Garage	Level 2 (240V), wall mount, networked	50' wire run 1 tire stop	$15,250
Sciencenter	Level 2 (240V), pedestal mount, networked	New sidewalk square, 50' wire run, 1 bollard	$18,900
Ithaca College U-Lot	Level 2 (240V), pedestal mount, networked	Installed with **new** parking lot, 1 bollard, 100' wire run (15' conduit)	$13,900
Ithaca College U-Lot	Level 2 (240V), pedestal mount, networked	Sidewalk cut and repair in **old** lot, 1 bollard, 100' wire run (15' conduit)	$17,900
Shops at Ithaca Mall	Level 2 (240V), wall mount, networked	120' wire run with high ceiling work, mounted on the building **wall**	$14,400
Shops at Ithaca Mall	Level 2 (240V), pedestal mount, networked	New **sidewalk** square, 1 bollard, 120' wire run (along high ceilings)	$19,400
Shops at Ithaca Mall	Level 2 (240V), pedestal mount, networked	Underground boring to **island**, 1 bollard, 50' wire run, mounting pier	$23,400
GreenStar Market on W. Court Street	Level 2 (240V), wall mount, networked	60' electrical run 2 bollards	$14,900
Taughannock Falls State Park	Level 2 (240V), pedestal mount, networked	New panel from transformer, Mounting pier, 1 bollard	$21,900

Introduction

The results of the site selection for new electric vehicle (EV) charging stations in Tompkins County were based on survey responses and answers to the Site Suitability Criteria Tool. The selection process and results are described in the previously published report titled Plug-in Electric Vehicle Infrastructure Plan in Tompkins County: New Charging Station Site Suitability and found on the Clean Communities of Central New York Webpage. The most suitable sites for new charging station installations are listed on Table 2 and geographically shown on the Figure 1 map along with the existing EV charging station in the county.

Table 2. Ranking of potential sites for EV charging stations based on site suitability criteria tool

Rank	Possible sites	Address	Venue
1	Cornell Cooperative Extension	615 Willow Avenue, Ithaca	Education
2	Seneca Street Parking Garage	215 N. Tioga Street, Ithaca	Multi-use Parking
3	Sciencenter	601 1st Street, Ithaca	Attraction
4	Ithaca College (U-lot)	953 Danby Road, Ithaca	Education
5	Shops at Ithaca Mall	40 Catherwood Road, Lansing	Retail
6	Dryden Road Parking Garage	120 Dryden Road, Ithaca	Multi-use Parking
7	Green Street Parking Garage	120-126 E. Green Street, Ithaca	Multi-use Parking
8	GreenStar Cooperative Market	301 W. Court Street, Ithaca	Retail
9	Taughannock Falls State Park	1740 Taughannock Blvd, Trumansburg	Parks/Recreation
10	All Pro Cayuga Street Garage	235 S. Cayuga Street, Ithaca	Multi-use Parking

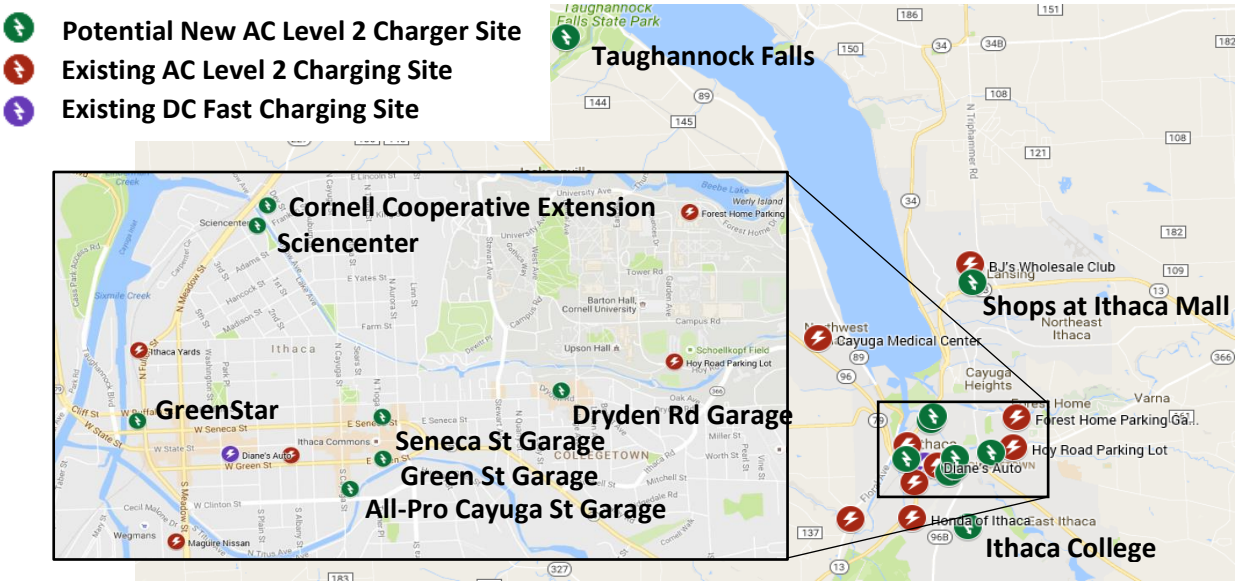

Figure 1. Existing and highly suitable new sites for EV chargers in Tompkins County

This report is a preliminary engineering and cost analysis for installing new EV charging stations at these sites. Specific recommendations and costs for seven different locations are included in this report (all four parking garages included in Table 2 have very similar characteristics so only Seneca Street Parking Garage was analyzed in detail). These analyses serve as case studies for which any other EV charging stations planned for Tompkins County would likely be similar to one of them. The other general installation information presented in this report is also applicable to any EV charging station project in the County.

Electric Vehicle Charging Stations

EV charging stations are classified by their approximate charge rates and the form of power delivered (alternating current [AC] or direct current [DC]). Charging times for each specific vehicle vary depending on power electronics, state of existing charge, battery capacity, and level of charging station used. These stations are technically referred to as electric vehicle supply equipment (EVSE). AC Level 1 EVSE (at 120 volts of alternating current [VAC] up to 2 kilowatts [kW]) and AC Level 2 EVSE (at 240 or 208 VAC up to 19.2 kW) provides power in the same capacity as it is supplied and the EV uses an onboard inverter to switch it to DC power that charges the batteries. DC EVSE uses an off-board inverter so it can supply DC power to the vehicle directly at higher amps for a faster charge.

Connectors, or plugs, for Level 1 and Level 2 charging stations have been standardized to allow owners of EV models to utilize the same charging infrastructure. This standard Society of Automotive Engineers (SAE) J1772 connector provides significant safety and shock-proof design elements. There are two different connectors used for DC fast charging, CHAdeMO and SAE J1772 Combo, which is why DC fast charge stations like the one at Diane's Downtown Automotive in Ithaca offers both. Tesla uses a different proprietary connector, but includes a SAE J1772 compliant adapter cable with each vehicle sold and offers adapters for CHAdeMO and SAE J1772 Combo connections for an additional price. Figure 2 shows the four common EV charging connectors.[1]

Figure 2: EV charging station connectors

The most common station ownership model is for the site host to own the station. However, third-party charging station service providers offer a different business model, in which they pay for the installation, operate the station, and share some of the profits with the site host. Some charging station manufacturers, third-party charging station service providers, and charging station network providers offer a lease option as well.

[1] Graphic sources: http://m.eet.com/media/1200053/sae-j1772c.jpg, http://m.eet.com/media/1200054/sae-combo.jpg, www.ryot.org/tesla-motors-releases-secrets-hopes-innovate/733589, and http://circarlife.com/sites/default/files/conector_chademo.png

The charging requirements at each location determine the type of charging station that should be installed. As illustrated by the charging pyramid in Figure 3, most EVs will charge at home (single- or multi-family) for the majority of the time. However, EV drivers also seek public charging infrastructure to use at work, around town, and on longer trips. Many of these chargers come with an option to purchase a subscription to a charging network that can collect payments from users and limits use of the station to charging network members. There is often no fee for EV drivers to become a member, and there is usually an option to activate the station using a toll-free number for anyone that does not have a network card. In addition to listing the station on its network maps for EV drivers, the network (for a subscription fee around $20 to $30 per month per charging outlet) will track station usage and enable the owner to bill for use.

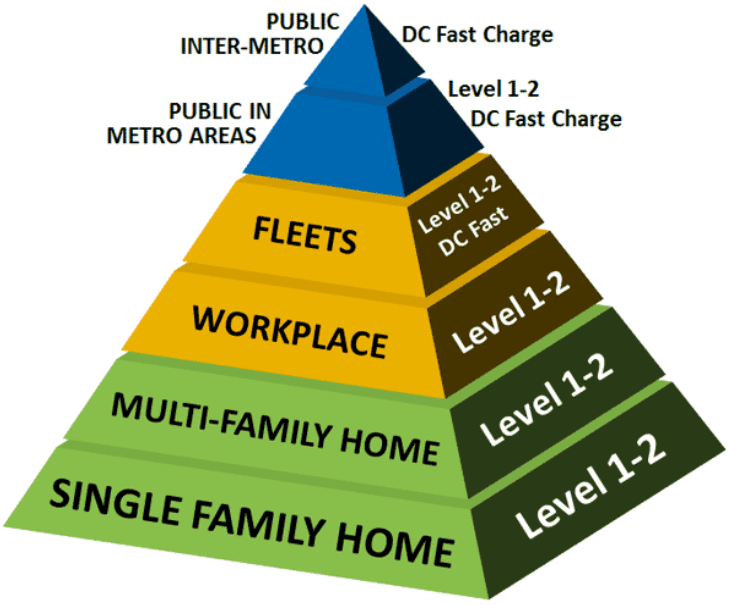

Figure 3: EV charging pyramid

Figure 4: EV charging station with cord management

Level 2 charging stations are a popular choice for commercial public installations because they typically offer better durability and more features, such as a cord management system that keeps the cord off the ground when not in use (Figure 4) and network connections for tracking use, establishing payments, or making reservations. Listed on Table 3 are networked Level 2 stations that offer valuable features, but the stations are more expensive because of this capability and require a subscription fee for the owner. There are non-networked Level 2 charging station models available as shown in Table 4, but they cannot collect payments from the users or monitor station activity. Most manufacturers offer charging stations that can be wall mounted or installed as a stand-alone pedestal. They often have models with either a single or double charging port per station. Level 2 charging stations provide 10 to 20 miles of range per hour of charging, a sufficient boost for EV drivers parked for a few hours.

In multifamily homes and workplaces (or longer term parking at airports and other transit hubs), EV drivers park for an extended period of time and may not require Level 2 charging. This is especially true for drivers of plug-in hybrid electric vehicles that have smaller battery packs or battery electric vehicle drivers that regularly charge at another location and don't require a full charge each time they park at these locations.

Table 3. Networked Level 2 EV charging stations

			
Blink	**Chargepoint**	**Delta**	**EVBox**
Level II Charger	CT4000	AC Charger	Business Line
30 Amp	16-30 Amp	30 Amp	30 Amp
25ft. Cable	18-23ft. Cable	18ft. Cable	20-26ft. Cable
1 Port	1-2 Ports	1 Port	1-2 Ports
Pedestal Mount	Wall/Pedestal Mount	Wall/Pedestal Mount	Wall/Pedestal Mount
$3,000-$4,000	$3,990 - $8,727	$9,995	
			
GE	**GE**	**Schneider Electric**	**Tellus Power**
DuraStation	WattStation	EV230	EVSE
30 Amp	30 Amp	30 Amp	30 Amp
22ft. Cable	15.5ft. Cable	18ft. Cable	18ft. Cable
1 Port	1 Port	2 Ports	1-2 Ports
Pedestal Mount	Wall/Pedestal Mount	Wall/Pedestal Mount	Wall/Pedestal Mount
$1,895-$2,095	$2,899-$5,307	$8,500	

Table 4. Non-networked Level 2 EV charging stations

			
Aerovironment	**Bosch**	**Clipper Creek**	**JuiceBox**
EVSE-RS	Power Xpress	Chargers	EVSE
30 Amp	12-32 Amp	20-48 Amp	40-75 Amp
15-25ft. Cable	18ft. Cable	25ft. Cable	24ft. Cable
1-2 Ports	1-2 Ports	1 Port	1 Port
Wall/Pedestal Mount	Wall/Pedestal Mount	Wall/Pedestal Mount	Wall Mount
$599 - $3,275	$999 - $3,395	$469 - $1,750	$499 - $899
			
Schneider Electric	**Siemens**	**Tesla**	**WattZilla**
EV230	VersiCharge	Charger	EV Chargers
30 Amp	30 Amp	48-72 Amp	40-80 Amp
18ft. Cable	14-20ft. Cable	8.5-24ft. Cable	25ft. Cable
1-2 Ports	1 Port	1 Port	1-4 Ports
Wall/Pedestal Mount	Wall Mount	Wall Mount	Wall/Pedestal Mount
$1,800-$4,600	$429-$775	$500 - $550	$699 - $7,795

To reduce the costs for the stations and their installation, Level 1 stations might be a better option. With the same electrical service and panel, two Level 1 stations (Figure 5) can be installed instead of one Level 2 station. Many EVs come with portable Level 1 cords that can be used as long as the parking lot provides a 120 volt outlet on a dedicated circuit for it to be plugged in. The power draw by Level 1 stations is much less, so there is less electrical expense to the host. However, because of their simplicity, most Level 1 stations do not have the option for a subscription on a charging network and cannot easily bill EV drivers for usage or track station activity. Examples of AC Level 1 charging products currently on the market are shown in Table 5.

Figure 5: AC Level 1 charging cords (left) are typically sold with an EV or an AC Level 1 charging station (right) can be mounted where an EV parks

Table 5. Non-networked Level 1 EV charging stations and cords

			
Aerovironment	**Aerovironment**	**Clipper Creek**	**Dostar**
TurboDock	TurboCord	Chargers	Charging Cord
16 Amp	16 Amp	12-20 Amp	16 Amp
20ft. Cable	20ft. Cable	25ft. Cable	24ft. Cable
1-4 Ports	1 Port	1 Port	1 Port
Wall/Pedestal Mount	Cord only	Wall/Pedestal Mount	Cord only
$1,798 - $5,695	$649	$379 - $469	$350

Figure 6: DC fast charge station at Diane's Automotive in downtown Ithaca

DC Fast Charging utilizes direct current energy transfer and a 480 volt of alternating current input to provide extremely rapid battery charging at heavily used public charging locations. DC fast charge stations can provide an 80% recharge in as little as 20 minutes if the EV comes with DC fast charge capability. With support from Nissan, Diane's Downtown Automotive installed a DC fast charge station (Figure 6). This is a great convenience for EV drivers and a valuable asset to have in Ithaca. There is a $10 per hour fee to use this charger due to the expense incurred to install it and for covering the electricity costs to operate it. Unless this station was always being used and EV drivers were often waiting in line to use it, there is little need to install another DC fast charge station in Tompkins County. Therefore, the additional public charging sites proposed in this report are Level 2 charging stations, typically used as secondary charging locations (with EV drivers primarily charging at home or work). These stations would enable plug-in hybrid electric vehicles with smaller battery packs to drive more on cleaner electric power rather than needing to switch over to its gasoline engine. These Level 2 charging stations also allow battery electric vehicles (which do not have any backup gasoline option) to extend their driving ranges for additional errands or activities, or in the winter time when the electric components are less efficient and also needed to heat the passenger area. A more comprehensive network of charging stations throughout Tompkins County increases the comfort level of EV drivers. Charging stations are needed when an EV driver unexpectedly finds themselves without enough battery capacity to reach their destination and need to stop for a charge.

Electric Vehicle Charging Station Protection and Signage

Most charging station repairs are due to damage from vehicles. Some form of charging station protection should be used to prevent cars, snow plows, or sweepers from hitting the station or snagging the charging cords. Mounting the station above the bumper level on a wall or behind a curb is helpful, but a tire stop or bollard would provide added protection (see Figure 7). A single tire stop is about $350 delivered to the installation site and a set of two bollards to protect the station can be constructed at the site for about $1,500 (or $1,000 if only one bollard is needed).

Figure 7: Bollards, tire stops, and sign posts used for charging station protection

It is also useful to install a post for signage while the station is being put in. If the location of the station on the property is not obvious to EV drivers, additional directional signage throughout the property can be useful, but will add additional cost. Typical signage and striping costs are around $500 per site. Parking garages with charging stations may want to place a sign outside the entrance and also have wayfinding signs or instructions just inside the gate. This will ensure EV drivers are aware of the charging station and are able to find it (see examples in Figure 8).

Figure 8. Signage at the entrance and inside a parking garage can be useful to EV drivers

Almost all EV drivers will be directed to a charging station location and find the charger itself by using applications that are available on websites, for mobile devices, and even in the vehicle dashboard. All networked stations will appear on their network's application and some of these might even pull data from other networks. Using the network application for the charging station an EV driver is targeting is advantageous because it enables the driver to access the real-time status of that charger. The application can indicate if someone is already plugged in or if it might be out of service. Some networks are enabling features that could reserve the charging station for an EV driver planning to park at that location.

The U.S. Department of Energy's Alternative Fuel Data Center and Plugshare (Figure 9) are two third-party charging station applications that pull data from multiple charging networks while also posting information about non-networked charging stations provided by site hosts or EV drivers. These third-party applications may have more details about the station from EV user experiences, but are not able to display any real-time information.

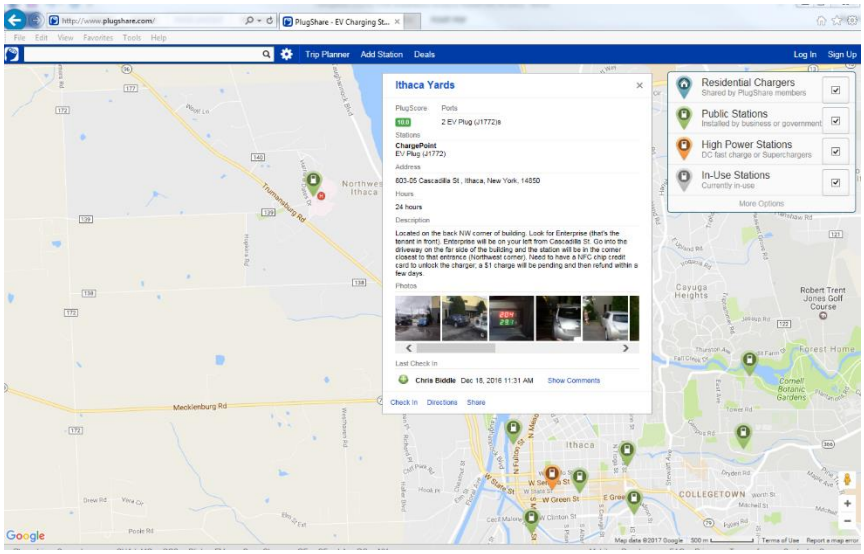

Figure 9. Plugshare's online charging station locator

The value in having signage at the charging station is to enforce charging policies (regulatory), advertise (trailblazing), and create EV awareness in non-EV drivers that might use the station in the future.

Regulatory Signs are required for enforcing what vehicles park in EV charging station parking spots, as well as the time duration that EVs are permitted to park and/or charge at public charging stations. Green/white

regulatory parking signs are considered *permissive* signs and are intended to provide motorists with the allowable time and days to park. Red/black/white regulatory parking signs are *prohibitive* and are intended to advise motorists of an action that shall not be taken.

The Federal Highway Administration (FHWA) regulates the nation's design and usage of traffic control devices using the Manual on Uniform Traffic Control Devices (MUTCD). The MUTCD approved signage only includes word legends, due to the lack of a symbol which can effectively convey regulations associated with EV charging stations and parking facilities. To be enforceable, Regulatory signs should be no smaller than 12" x 18" and placed immediately adjacent to the EVSE at a height of 7 feet as prescribed in Part 2, Chapter 2A.18 of the federal MUTCD. Permissive signs may be used in combination with a prohibitive sign, as long as they are installed below or to the right of the prohibitive sign. However, this can be confusing and should be avoided if possible. The example signs shown in Figure 10 are the FHWA recommended MUTCD compliant EV charging station signage. Signs in private parking facilities for public use are not required to meet MUTCD standards, but owners and operators are encouraged to do so. Signs with different shapes, colors, and messages than those listed in the MUTCD may be posted in private facilities, but cannot be legally enforceable.

Figure 10: MUTCD recommended regulatory signage

Parking spot stencils are not enforceable, but painting an EV charging station symbol or using a solid color on the parking surface as shown in Figure 11 can help to clearly identify EV charging station spaces more visibly.

Figure 11. EV charging station space painting for easy identification

Trailblazing (Special) Signs are used at the EVSE or host facility to provide additional information for drivers and visitors (sustainability benefits, funding source, tourism or economic development info, sponsorship, etc.). These do not follow MUTCD design standards and are not intended to be enforceable. As a result, they may include other logos, shapes, and colors as part of the signage theme at the site. Special signs must not be prominent, and should be placed to the side or below the regulatory signs. Examples of Special Signs are pictured in Figure 12.

Figure 12. Examples of trailblazing (special) signage

Installation Considerations

A number of factors influence charging station installation costs, which can often exceed the cost of the hardware itself. These factors should be considered when determining site viability and the ideal location to install the charging station on the property. The largest factor is usually the currently available electrical service. All new charging station installations should have a load analysis performed on the facility's electrical demand to determine if there is capacity to add EV charging stations. Each Level 2 charging port will need a dedicated 240-volt (40 amp) circuit. If a site has to upgrade electrical service, this adds significant cost to the installation. The condition of the electrical panel can be observed. Older or outdated panels (see Figure 13) may need to be replaced and updated before a charger can be safely added to the system.

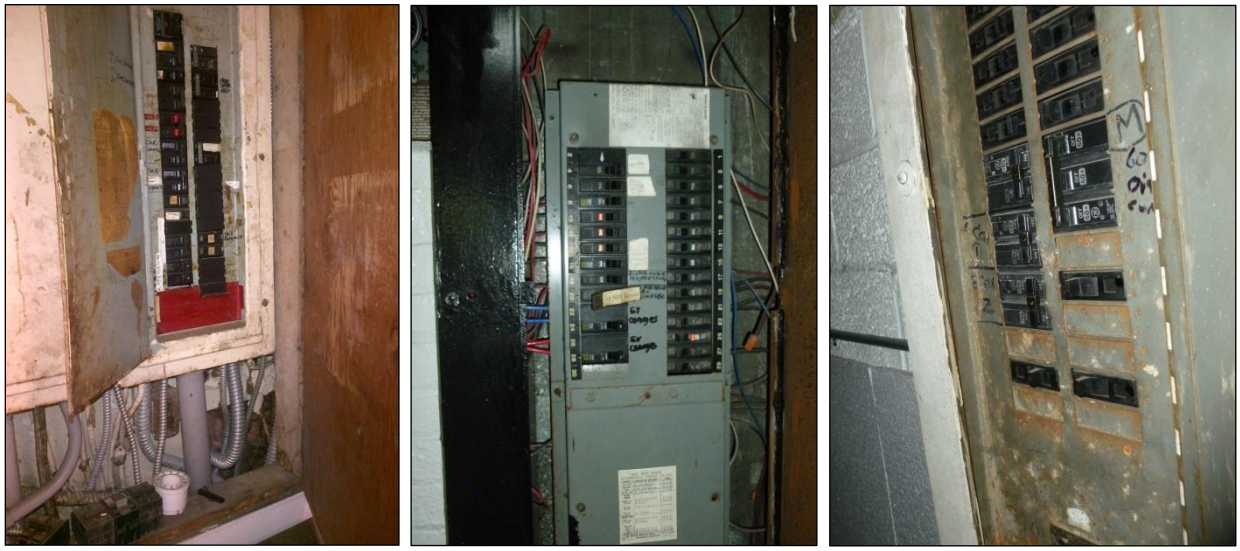

Figure 13: Older electrical panels may require upgrades to bring up to modern codes

It is also good to note whether the electrical panel has available breaker slots (see Figure 14) or some marked as spares that could be used for the charging stations. A single port Level 2 charging station will require two breaker slots for its 240V circuit and a dual port charging station will need four (see Figure 14). Each Level 1 charging station will only require a single breaker slot for a 120V circuit.

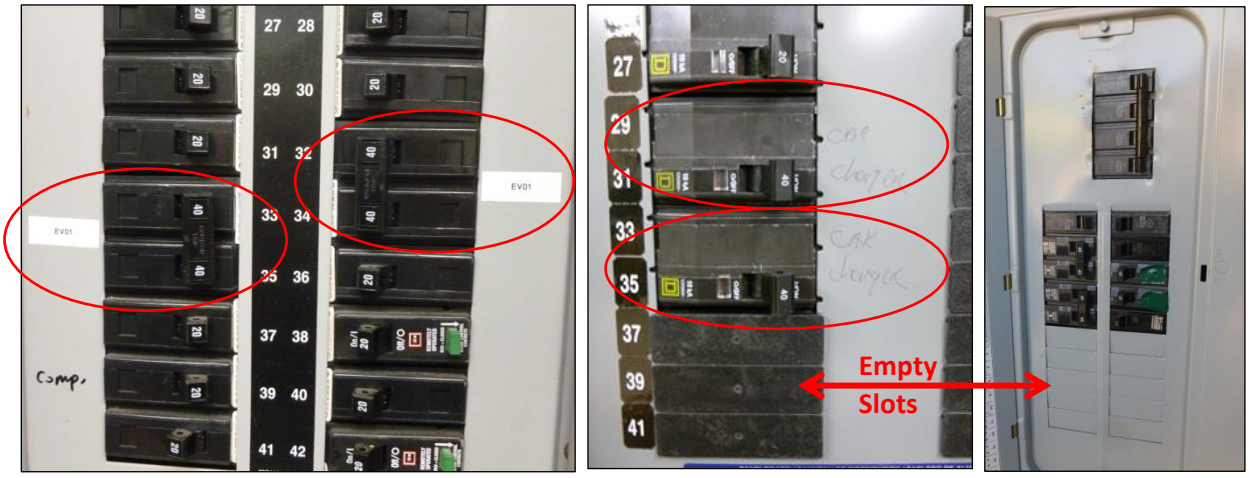

Figure 14: Level 2 charging station 240V-40A circuits breakers and examples of empty breaker slots

Available space in the electrical panel can indicate, but does not necessarily guarantee, whether there is sufficient capacity with the current electrical service to add the charging station(s) without requiring an upgrade from the utility. The electrical contractor will determine the available electrical capacity with a load calculation or reviewing the as-built electrical drawings and schedules. It is possible to simply add a small subpanel (see Figure 15) for the charging station circuit(s) if there is sufficient capacity with the existing service but no space in the main panel. In general, expect more complications and higher costs (ranging from $500 to $2,500, or possibly even higher) when installing charging stations at a facility that has an older and/or fully packed electrical panel, and if there is the option to select between two different locations or facilities, the one with a newer electrical panel is likely a better option.

Figure 15: Added subpanel for charging station circuits

Identifying all electrical panels at the facility will help with planning the installation. These panels come in many shapes and sizes and can be tied directly to the grid or used as sub-panels to further distribute power from larger panels. The electrician may determine that one panel is better to work with than another, or one may offer a shorter electrical run to a good charging station location, reducing costs.

A longer distance between the electrical panel and the EV charging station means increased installation costs because it increases the amount of necessary trenching (and repair), conduit, and wire. Example installations are shown in Figure 16 and Figure 17.

Figure 16: Charging station installations sited in convenient, but not prime parking spaces that minimize conduit runs to reduce costs

Figure 17: Charging stations at parking spaces away from a building require longer trenching through pavement and could disrupt traffic flow during construction

Although it is desirable to minimize the distance between the electrical panel and EV charging station as much as possible, where a charging station is located on a property can impact how it is used. For example, placing charging station parking spaces in the back of a building might discourage their use, but other customers may be upset if a charging station is installed in prime parking spaces that often remain vacant because there are few EV drivers. Charging stations in prime parking spaces are also more likely to be occupied by non-EVs, as shown in Figure 18.

Figure 18: Charging stations installed in prime parking spaces may be used by non-EV Drivers who have traditionally used these spaces

All externally run and most internally run electrical wire will have conduit for protection. It will be routed along ceilings and walls inside, pass through the building foundation or walls, and be buried underground until it reaches the station. Inside the facility, the length of the run, obstacles (e.g., concrete walls, metal I-beams, lights, or fire suppression systems), and accessibility should be noted. For outdoor routing, the length of the run, immovable objects (e.g., landscaping, tree roots, ponds, or buildings), manmade surfaces (e.g., concrete or pavement), utility lines (e.g., electrical, water, or gas), and any other obstacles that may complicate trenching should also be noted as best as possible. Trenching through grass, dirt, or gravel is easy to dig and repair. Most contractors will tunnel under a short concrete sidewalk, but some will cut into and repair it. Wire runs across parking lot pavement are typically longer and could be accomplished by tunneling under or cutting and repairing. Samples of trenching work are shown in Figure 19 for dirt, Figure 20 for concrete walkways, and Figure 21 for pavement.

Figure 19: Examples of trenching through dirt (easiest outdoor installations)

Figure 20: Concrete walkway examples of cut/repair (left and center) and tunneling under (right)

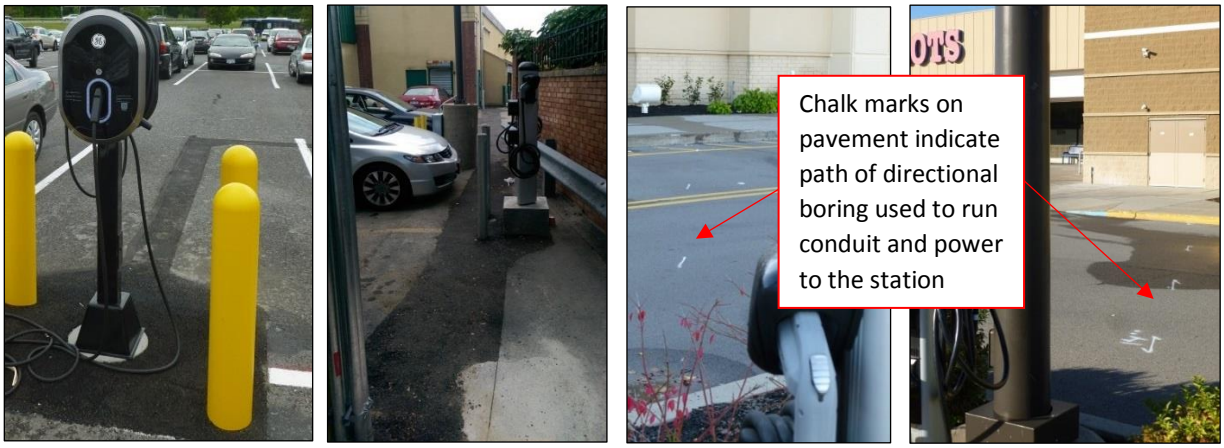

Figure 21: Parking lot pavement examples of cut/repair (left) and tunneling under (right)

Cellular signal strength is an important factor for networked EV charging station installations. Key features on a networked station (e.g., fault notifications, in-use status, user authentication, payments, or reservations) will not be available if the station cannot communicate with the central network via cellular signals. When considering where to place the station on the property, use a cell phone to test the available strength and determine if an alternative location might have a better signal. Charging station installations in remote locations or in underground garages may have more difficulty acquiring a good cellular connection. If the charging station cannot be moved into a place with a better cellular signal, some charging manufacturers offer equipment with alternative cellular providers that may have better strength at that location. Extended antennae or cell signal boosters can also be used, but these will add to the cost of the station installation.

Other considerations have less impact on installation costs, but are important to ensure that the charging station is well integrated into the parking lot. When selecting a site, be sure to think about the path of the charging cord when in use, so it is not a tripping hazard. Also consider your parking lot management practices: will the charging station get in the way of pavement cleaning or snow plowing (see Figure 22), is it a space where snow is piled in the winter, or is equipment stored nearby that might block access to it?

Figure 22: Snow management practices may impede EV charging

Operating Expenses

The higher end (more expensive) commercial Level 2 charging stations have shown to be very durable in various environments and have very few manufacturer issues. The most common issue with these is wear on the pins in the connector due to frequent use which may eventually not make a good connection and need to be replaced. Some less expensive Level 2 charging stations have occasionally failed because most are not designed to be directly impacted by weather (they are better suited for installation in a garage or covered parking location). Most manufacturers have a 1-3 year warrantee on their product and several offer extended warrantees for additional cost as well.

Most charging station repairs are due to damage from vehicles that hit them, which is why some level of protection is highly recommended. Another issue is the charging cords being caught by a plow in winter because they were not coiled up after use and ended up getting buried by snow (Figure 23). Charging stations with cord retraction systems help alleviate this issue. All charging stations require occasional cleaning and should have the cords inspected once a month and everything wiped down quarterly or monthly depending on use. Snow should be cleared from around the charging station so it can vent properly and be easily accessed.

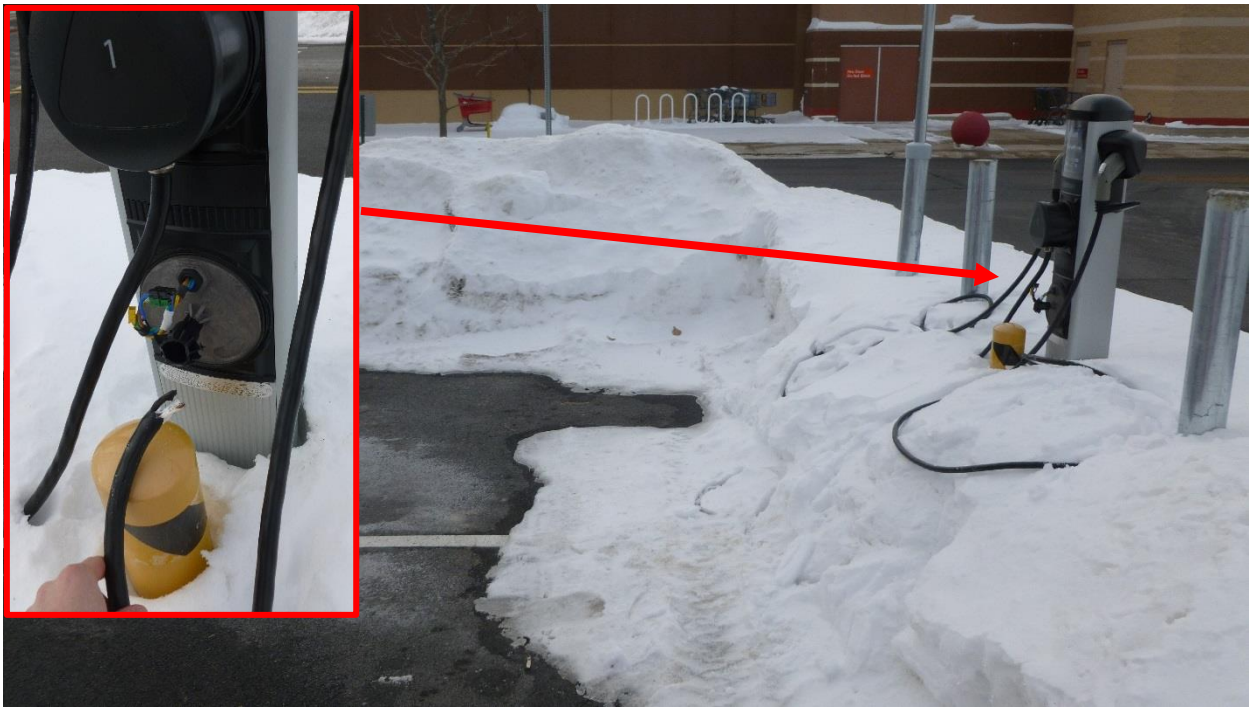

Figure 23. Charging cords not coiled up in the winter can be covered with snow and caught by a plow

Public access Level 2 charging stations rarely serve as an EV driver's primary source of electricity as this is done at home or work. Thus, while electric vehicle battery capacities can be as high as 20 kWh or even 60 kWh or higher for the newest 200-mile range EVs, the average energy dispensed per charge event for public stations in New York is only 6.6 kWh. At $0.13 per kWh which is a typical electrical energy rate in Tompkins County, this is a cost of only $0.86 per charge event. On average across New York State, public charging ports experience 2.5 charge events per week, so the average monthly electricity cost to operate a charging port is less than $10. The average use for charging ports at three Level 2 public charging stations in Ithaca (Cayuga Medical Center, Taitem Engineering, and Ithaca Yards/Enterprise) in 2015 was 11 kWh

per charge event for 1.9 charge events per week. These charging ports each dispensed about $10.50 per month in electricity which is similar to the state average. Charging stations at a popular and convenient location may see higher usage, while others might be used very infrequently as shown with the distribution of costs per month in Figure 24 for stations in NYSERDA's EVSE deployment program.

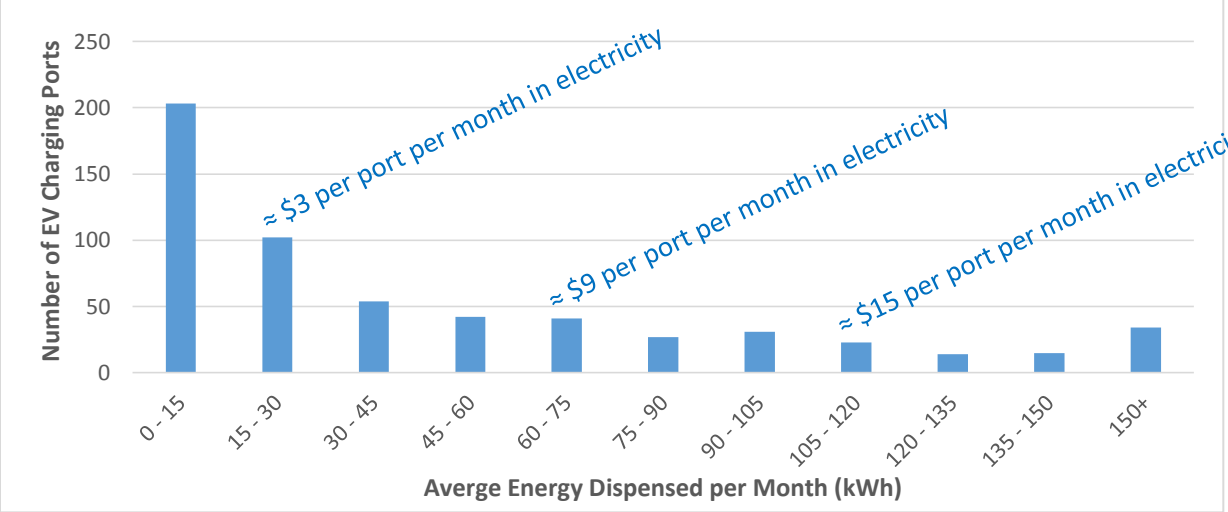

Figure 24. Electricity costs per charging port in 2015 for the stations in the NYSERDA Deployment Program

While minimal, a site owner may want to recoup the costs to supply electricity and maintain the station. Establishing a fee for the use of the charging station may depend in part on the venue where it is operating. Site owners should weigh whether their clientele would be willing to pay extra for EV charging and whether they need to generate revenue from use or if the charging station creates value in other ways. Most stations must be networked and have an active subscription, at an additional operating cost, for a site owner to impose a fee for use. If the site owner intends to share the networking costs with the EV drivers, the cost per charge event to recover all of the site owner's expenses might be higher than many EV drivers would pay for unless it was an emergency. Since network subscriptions costs would be challenging to get back through station use fees, networked stations should not be used solely to generate revenue. The primary purpose of maintaining an active network subscription should be for tracking usage, real-time notification of issues, listing its current status on charging maps, and other available benefits.

Charging station fees can be per hour, per session, or per unit of electricity. If charging per hour, the cost of energy may vary widely by charging session because different EVs receive electricity at different rates. Charging per session is usually more appropriate for workplace charging or charging stations that have very short, regular sessions. Charging by unit of energy (usually kilowatt-hour [kWh]) accurately accounts for the true cost of electricity for the charging station owner, but does not give an incentive for a car that is fully charged to leave the space. Some site owners have tried combinations of these approaches, such as charging a flat rate for the first two hours, then an increasing rate for longer sessions. Some locations might prefer to offer free charging, either as an additional draw or to lower operating expenses by not needing to join a charging station network.

Charging stations offer a number of ways to generate value beyond just charging for use. Installing charging stations can attract EV drivers who then patronize your business, retain valuable employees, and provide a sense of your environmental stewardship.

Installation Costs for Potential New Charging Stations in Tompkins County

Cornell Cooperative Extension of Tompkins County

Cornell Cooperative Extension of Tompkins County has an Education Center at 615 Willow Avenue in Ithaca which is just north of downtown off Route 13. This is the base location for extension staff where they provide educational activities and workshops while hosting various meetings throughout the week. Community members regularly visit this facility to gather information about commercial and consumer agriculture; nutrition and health; youth and families; finances; energy efficiency; economic and community development; and sustainable natural resources. Providing a charging opportunity for staff or community members that visit this facility would likely be beneficial to EV drivers and it would also serve as a good demonstration to promote this technology, as it aligns with the mission of Cornell Cooperative Extension to share information about sustainable technologies.

Cornell Cooperative Extension of Tompkins County is planning to construct an expansion of this facility that would include the addition of office space above the existing parking lot. The plan is to build with shipping containers that are supported by several concrete columns. The proposed location for the charging station, shown in Figure 25, is on one of these columns between parking spaces with electric power run down from the mechanical room in this newly constructed expansion. Figure 26 and Figure 27 show the placement of the charging station on the property and the routing of electrical power.

Figure 25. Proposed location for a charging station at Cornell Cooperative Extension's planned expansion

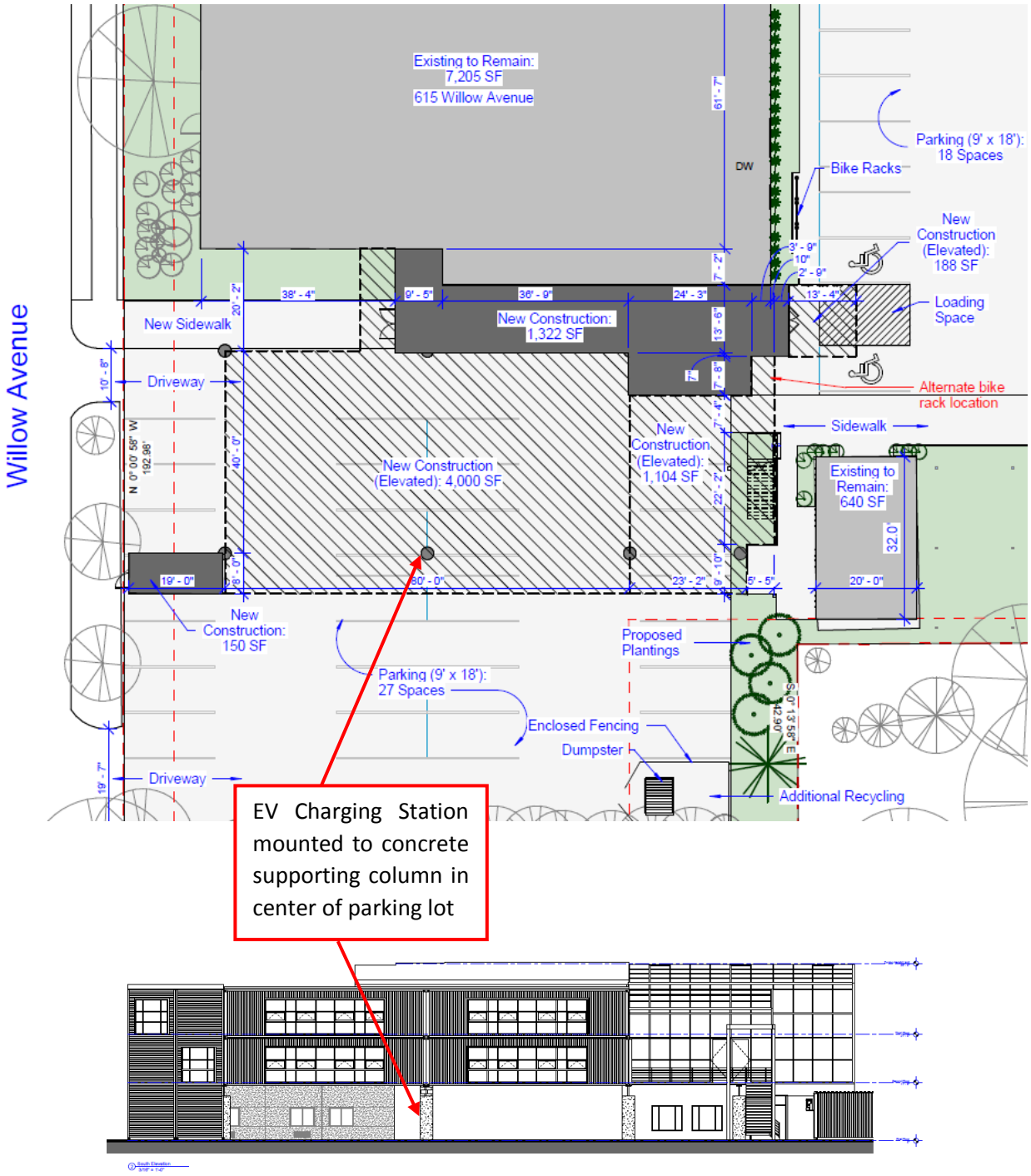

Figure 26. Schematic of proposed location for a new charging station at Cornell Cooperative Extension's planned expansion

Figure 27. Electrical wiring run for the proposed location for a new charging station at Cornell Cooperative Extension's planned expansion

Several charging stations in New York City garages have been mounted to a parking facility column as proposed for the Cornell Cooperative Extension. Figure 28 shows one such installation at a large apartment rental property in downtown Manhattan. This is an older ChargePoint model station that does not include a retraction system which would extend above the unit in this picture. Also, the column in this picture is in between car parking spaces and has a curb preventing cars from driving towards it. At the Cornell Cooperative Extension location, either a tire stop or other form of protection is recommended to prevent vehicles from damaging it.

Figure 28. Charging station mounted on a structural column at a rental property in New York City

These charging station installations in New York City garages are similarly mounted as is being proposed for the Cornell Cooperative Extension, but those installations were not done during the construction of those facilities. With an installation being done during new construction as is proposed at Cornell Cooperative Extension, the costs are significantly lower because the work can be done at the same time and practically eliminate any excavation work or challenging conduit routing that can occur when working on existing facilities. The new electrical panel can be designed to include capacity for these charging station breakers which should be minimal, if any, additional cost to what is already being planned. Installing the required conduit during building construction should be very simple with the personnel and tools already onsite for other projects. Thus, the majority of the cost for an installation of a charging station at a new facility would be materials (e.g., conduit, wiring, and breakers) and a few hours of labor to mount and connect up the charging station. For this location, a wall mounted unit does not require an additional foundation and a low-cost tire stop could be used because it is a covered parking lot that should not have significant plowing requirements.

If this installation was performed for an existing structure with the same factors, the installation cost would be about $4,500. When incorporated into new construction, the general contractor can run two 240 lines for the charging station during other electrical work and install the mounting bracket in the column while it is being poured at minimal additional costs to the project. Then the effort to install the charging station is significantly easier and would be able to be installed for around $2,000.

These installation costs are a portion of the total cost for a charging station. The total cost would include any initial costs for the station hardware, protection, signage, and network activation, as well as the additional ongoing costs for being on a charging network, electricity use, and maintenance. Costs will vary based on the choices of the host site, but the recommended configuration would have a total cost of $11,250 if installed at the same time as the new building or $13,750 to install this on an existing building with similar conditions. A breakdown of the total charging station costs can be found at the end of this report on Table 6 and is compared to other Tompkins County sites in the Conclusions section.

If the Cornell Cooperative Extension was considering charging stations for staff that park here most of the day, this would be a good place to install non-networked Level 1 stations. The covered protection provided

by the new addition permits the use of Level 1 stations that are not typically recommended for open lot locations. The power draw from Level 1 stations is half that of Level 2 stations which saves on electrical wiring and electrical operating costs. Since Level 1 stations provide lower charging power, these would not be practical for EV drivers that needed a significant charge and would only be used by staff or visitors parking here all day long. Therefore, it might be reasonable to not have networking capability on these for a very low overall cost to install the charging stations of $5,150 as shown on Table 6 at the end of this report.

Seneca Street Parking Garage

The City of Ithaca's Seneca Street Parking Garage located at 215 North Tioga Street is open 24 hours daily and is a short walk from the Ithaca Commons with its many shops and restaurants. Other destinations near this garage include: Town Hall, Hilton Garden Inn (25% of this garage is reserved for the Hotel), and TC3 Ithaca Extension Center. Several other parking garages in the City of Ithaca would have similar EV charging station installation configurations and expenses because they share similar characteristics as the Seneca Street Parking Garage. The Green Street Parking Garage and the All-Pro managed Cayuga Street Garage are near Ithaca Commons. The recently opened Marriot Hotel utilizes a quarter of the Green Street Parking Garage. The Dryden Street Parking Garage in Collegetown is predominantly used by Cornell students and staff, but there are also several restaurants in the area along with Cornell's Schwartz Center for the Performing Arts.

The proposed charging station placement in the garage would be along the center column of the garage directly above the electrical room to minimize the distance of the wires. The second level of parking is reserved for hotel guests, so the charging station would be placed on the 3rd floor where parking by the general public is available. It would be mounted on a column that is directly between two parking spaces so it can be easily accessed by both (Figure 29). The elevated placement of the charging station with the wall mounted option and the curb would protect the station from accidental damage by vehicles. Figure 30 and Figure 31 show the electrical panel from where power would be drawn and the routing of electrical conduit.

Figure 29. Proposed 3rd floor location for a charging station at the Seneca Street Parking Garage

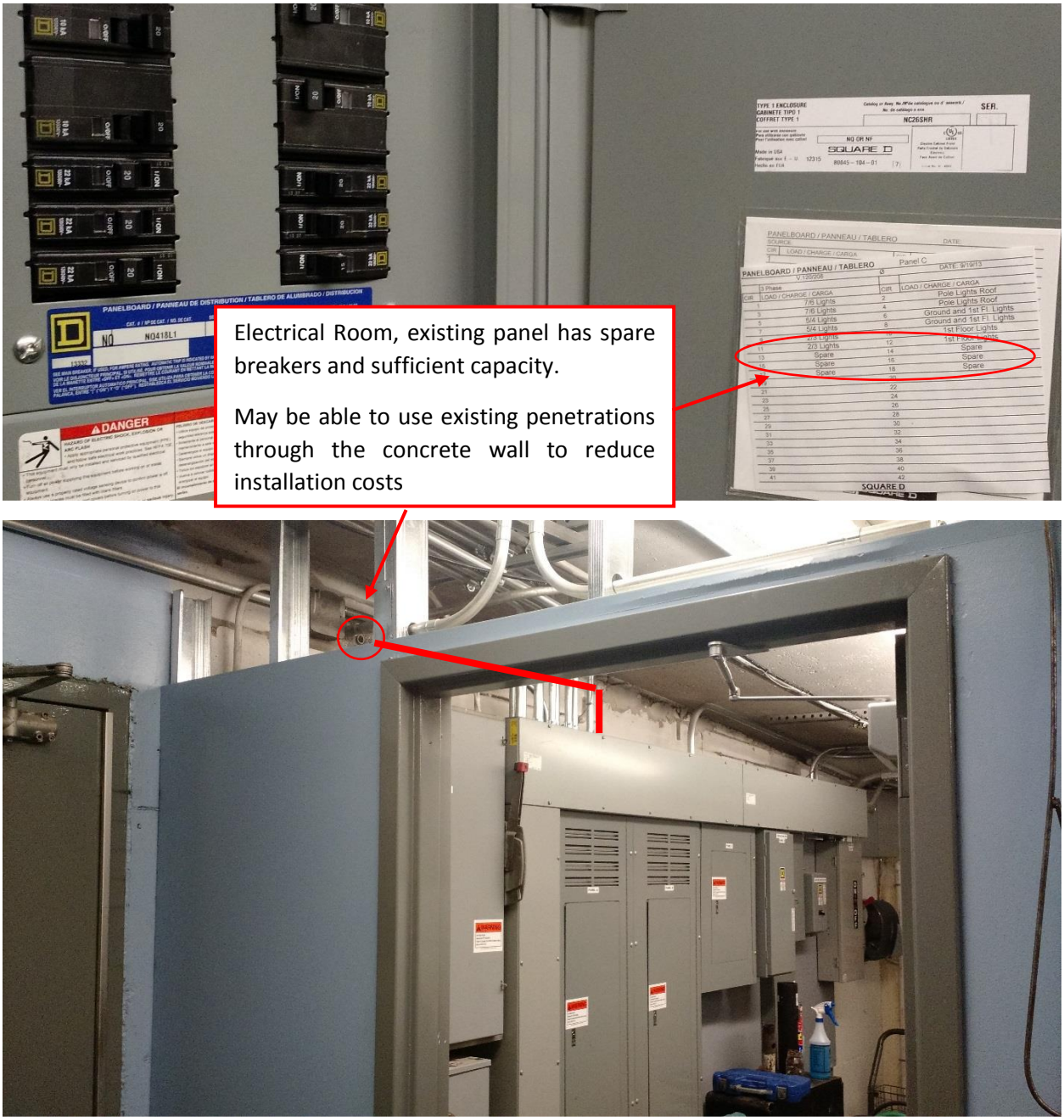

Figure 30. Electrical room and panel for the proposed location for a new charging station at Seneca Street Garage

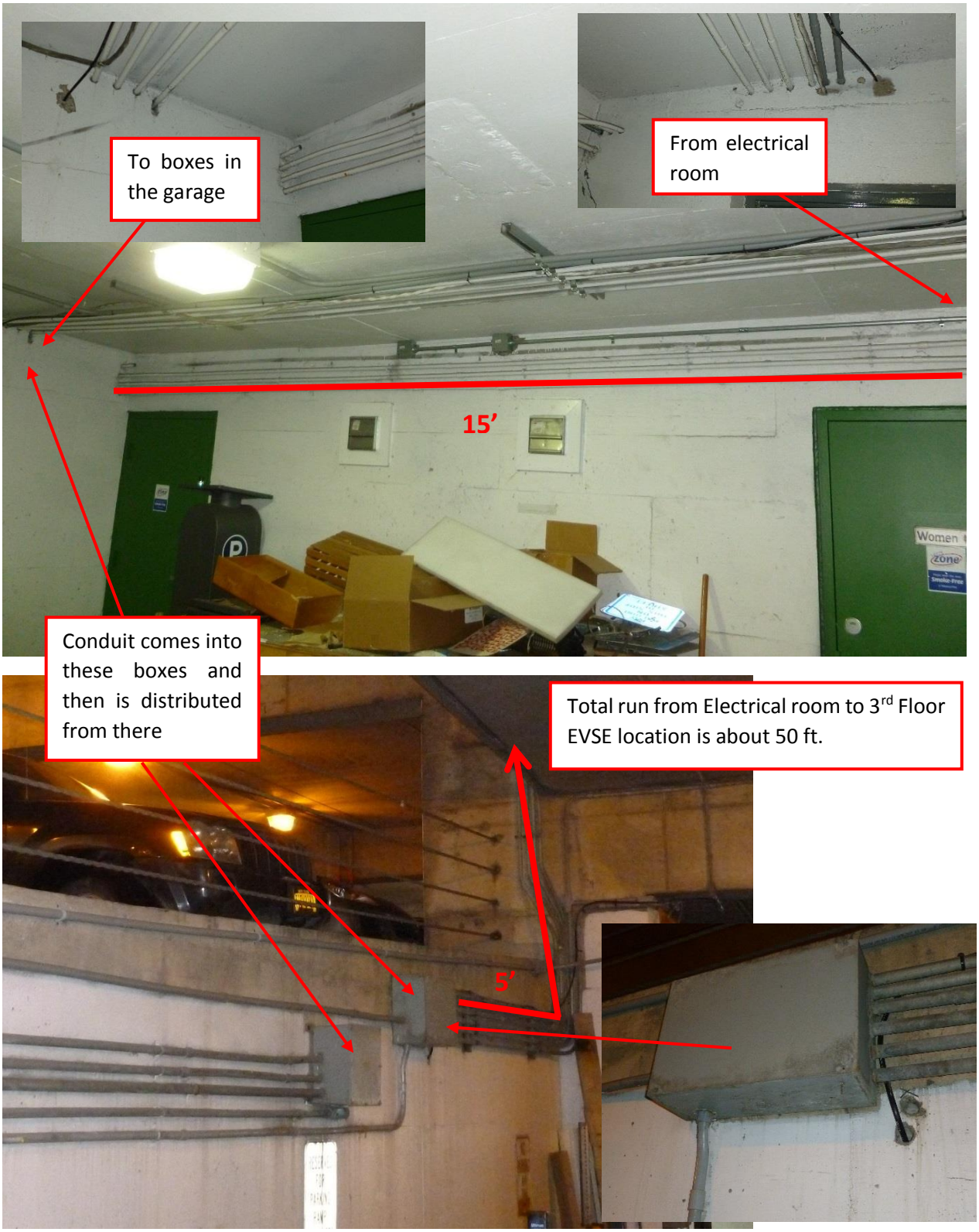

Figure 31. Electrical wiring run for the proposed location for a new charging station at Seneca Street Garage

The City of Rochester installed several charging stations in their City garages similarly as proposed for the Seneca Street Garage. Figure 32 shows one of these charging stations at the Sister Cities Garage that was mounted right next to a structural column in the garage. This ChargePoint station came with a light that is really not necessary in a lit garage which made it difficult to mount directly on the column. The proposed station for the Seneca Street Garage would not have a light so it could be a wall mounted directly to the column. This would elevate it slightly and keep it back from the curb which should provide sufficient protection from vehicles and not require the bollards shown in this example.

Figure 32. Charging station installed in a City of Rochester Garage

The electrical run in the Seneca Street Garage is slightly longer than for the Cornell Cooperative Extension and there may be more wall penetrations if existing holes cannot be used. Therefore the installation cost is slightly higher at around $5,000.

This installation cost is a portion of the total cost for a charging station. The total cost would include any initial costs for the station hardware, protection, signage, and network activation, as well as the additional ongoing costs for being on a charging network, electricity use, and maintenance. Costs will vary based on the choices of the host site, but the recommended configuration would have a total cost of $15,250. A breakdown of the total charging station costs can be found at the end of this report on Table 6 and is compared to other Tompkins County sites in the Conclusions section.

Sciencenter

The Sciencenter is a hands-on, children's science museum located in downtown Ithaca that has a number of educational programs with over 250 exhibits. The museum is open daily except for Mondays and regularly hosts groups of students from local schools.

Figure 33. Proposed EV charging station location as you enter the Sciencenter parking lot

The proposed placement for the charging station is along the row of parking that all visitors pass when entering the property (Figure 33). There is a brick handicap ramp that was previously used when the entrance was along this side of the building, but a recent renovation has moved the entrance around the side of the building and this is no longer used. Placing the charging station within the brick ramp would make excavation much easier, but to properly replace the brick afterwards could be challenging and there is no curb to help protect the station. It is easier and less costly for the installer to tear up and re-pour a concrete sidewalk square (Figure 34). If placed on the sidewalk rather than the brick, the charging station would likely need to be placed close to the curb in order to maintain a sidewalk width of at least 32 inches to meet ADA requirements. Figure 35 and Figure 36 show the location of the electrical panel from where power would be drawn and the routing of electrical conduit.

Figure 34. Proposed placement for a charging station at the Sciencenter

Figure 35. Electrical room location and indoor conduit routing options for a new charging station at the Sciencenter

Figure 36. Electrical wiring run for the proposed placement of a new charging station at the Sciencenter

The Empire State College for Distance Learning in Saratoga Springs installed a charging station in a similar manner as planned for the Sciencenter as shown in Figure 37. This installation had a short outside electrical run because of the parking space's proximity to the building and it was mounted into the sidewalk. Along with the curb, a small bollard was used to protect the station from being hit by a vehicle.

Figure 37. Charging station installed at the Empire State College for Distance Learning

The estimated cost to install a charging station at the Sciencenter is $8,000 because of the additional excavation and concrete repair work that is necessary to place it in one of the sidewalk squares.

This installation cost is a portion of the total cost for a charging station. The total cost would include any initial costs for the station hardware, protection, signage, and network activation, as well as the additional ongoing costs for being on a charging network, electricity use, and maintenance. Costs will vary based on the choices of the host site, but the recommended configuration would have a total cost of $18,900. A breakdown of the total charging station costs can be found at the end of this report on Table 6 and is compared to other Tompkins County sites in the Conclusions section.

Ithaca College

Ithaca College installed a charging station by some residential units several years ago, but due to complications with the equipment this station is no longer activated. The selected campus location proposed for a new charging station is the current lot "U" near the "Campus Center" which is scheduled to be reconfigured in May 2017. This reconfiguration might be able to incorporate the excavation and repair work for this charging station installation, but it was analyzed for this case study as being incorporated into the existing infrastructure.

The proposed placement of this charging station would be by the Hammond Health Center building where there are parking spaces adjacent to the paved sidewalk. This sidewalk is currently quite wide (8.5 feet) so there will be plenty of room to install the charging station and still have a sidewalk width of at least 32 inches to meet ADA requirements. Access to electrical power would come from an old light pole that is no longer being used. It might be possible to use the existing wires, but more likely that new wires would be pulled from the indoor panel using the existing conduit. A short run of 15 feet is all the additional conduit that would be needed. The installation would cut through and then repair the paved sidewalk. This location should have plenty of sufficient power for the new charging station. Figure 39 shows how power would be routed to the proposed station location using existing and new electrical conduit.

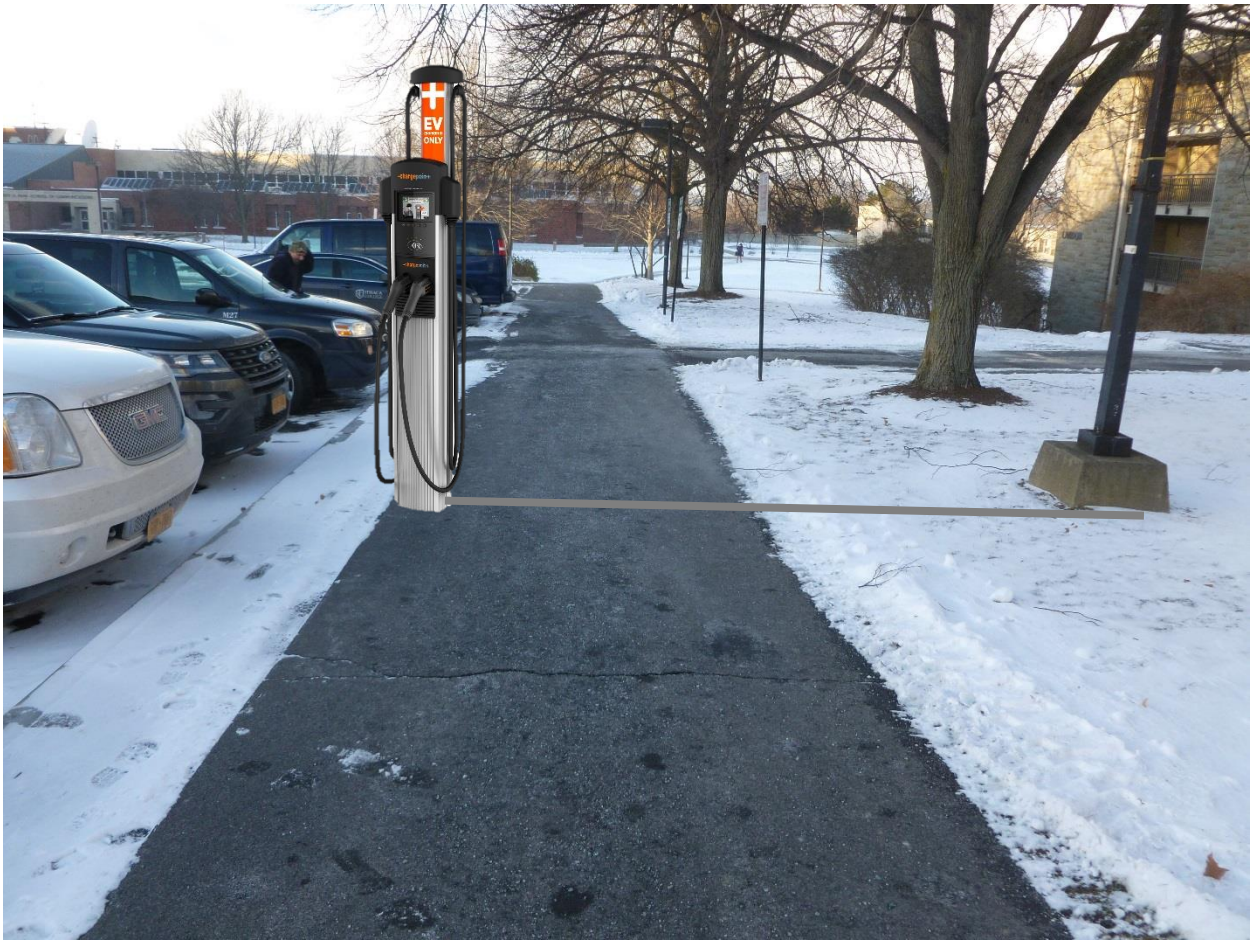

Figure 38. Proposed placement for a charging station in Ithaca College's U-Lot

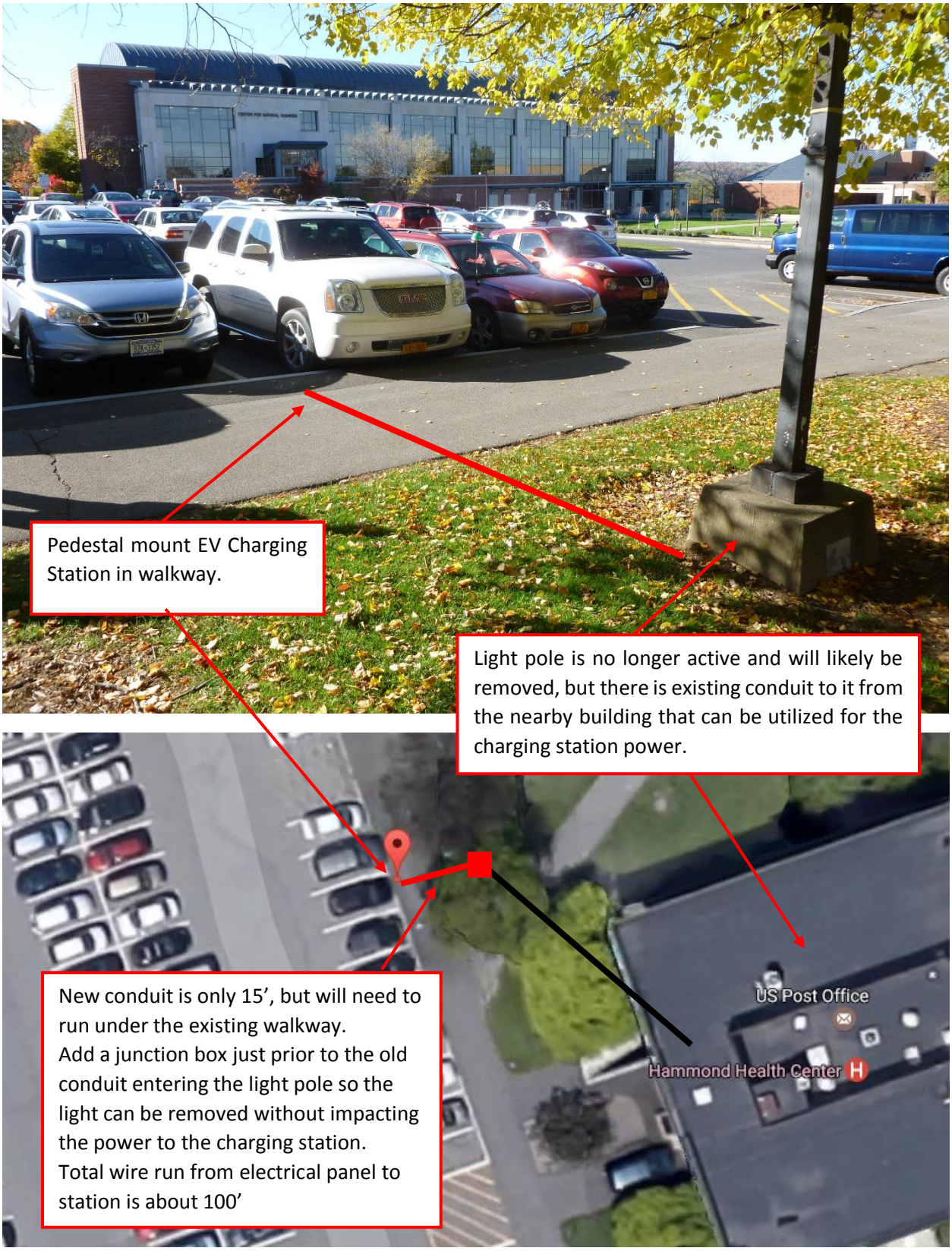

Figure 39. Electrical wiring run for the proposed placement of a new charging station at Ithaca College U-Lot

The charging station installation at Ithaca College U-Lot will be similar to the one at the Sciencenter that is a pedestal mounted station in a sidewalk. Another example of one of these is shown in Figure 40 at the University of Buffalo. Installation costs will be reduced by utilizing the existing conduit to the old light pole. The costs could be reduced further if the parking lot re-configurations will involve new sidewalks and this installation can be properly coordinated with that work.

Figure 40. Charging station installation at the University of Buffalo

The estimated cost to install a charging station at the Ithaca College U-Lot is $7,000. This still involves some sidewalk cutting and repair work, but it is lower than the Sciencenter because there is existing conduit most of the way to the charging station location. This cost could be reduced by about $4,000 if the construction work could coincide with the reconfiguration of the parking lot if that does involve sidewalk work.

This installation cost is a portion of the total cost for a charging station. The total cost would include any initial costs for the station hardware, protection, signage, and network activation, as well as the additional ongoing costs for being on a charging network, electricity use, and maintenance. Costs will vary based on the choices of the host site, but the recommended configuration would have a total cost of $17,900 if done independently of any construction work for the parking lot. A breakdown of the total charging station costs can be found at the end of this report on Table 6 and is compared to other Tompkins County sites in the Conclusions section.

Shops at Ithaca Mall

The Shops at Ithaca Mall, previously known as Pyramid Mall Ithaca, is located north of Ithaca at the intersection of NY Route 13 and N Triphammer Road. The mall's largest tenants currently include Target, Bon Ton, Best Buy, Dick's Sporting Goods, Regal Theater, and a couple of fitness centers. The nearby BJ's Wholesale Club has a charging station, but the high number of visitors to the mall easily justify another one.

Figure 41. Charging station placement option #1 at Ithaca Mall

There are two proposed placements for the charging station. The first option is at a small group of parking spaces that are adjacent to the building shown in Figure 41 by the entrance near Dick's Sporting Goods. The lowest installation cost here would be a wall mounted unit, but that would create a pedestrian tripping hazard when EVs are charging. Alternatively, similar to the proposed installations at the Sciencenter and Ithaca College, one of the concrete sidewalk squares could be torn up and re-poured for a pedestal mounted charging station out towards the parking spaces so that pedestrians can walk behind it. The charging station would likely need to be placed close to the curb in order to maintain a sidewalk width of at least 32 inches to meet ADA requirements. The second option to place this station is on a parking lot island shown in Figure 42 which would require either directional boring under the roadway or cutting through the pavement then patching for the electrical conduit run. The routing of electrical power to each of these locations is shown in Figure 43.

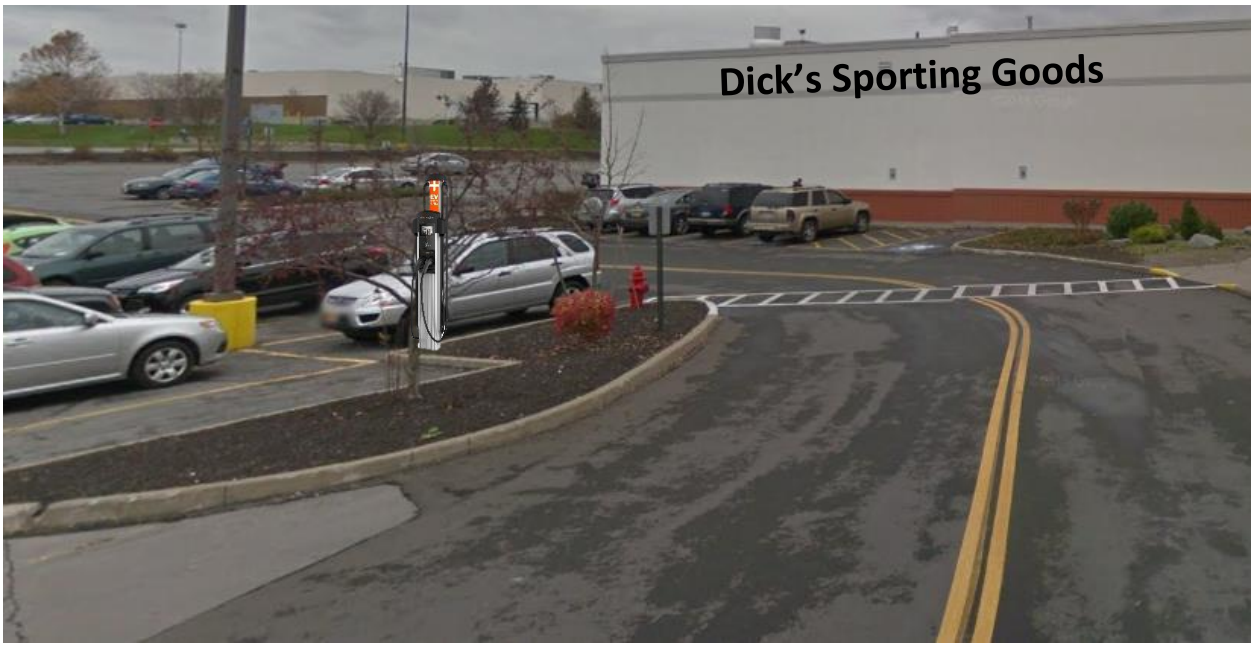

Figure 42. Charging station placement option #2 at Ithaca Mall

Figure 43. Electrical wiring run for the proposed placement options for a new charging station at Ithaca Mall

The first optional placement for the charging station at Ithaca Mall would be similar to the one at the Sciencenter and Ithaca College. Cayuga Medical Campus placed a charging station out on an island in a parking lot as well as several Kohl's locations around the state as shown in Figure 44. In addition to the expense of running conduit under a roadway to get the power to a parking lot island, a footing for the charging station is needed which also adds to the expense of this installation option. Note that the sign in Figure 44 helps to identify these spaces for EV charging, but it creates an obstacle in winter for plowing that prevents proper clearing of this space when it snows.

Figure 44. Charging station installation a Kohl's in Amherst

The cost to install the charging station for the parking spaces adjacent to the Mall building (Option #1) would cost an estimated $8,500 if planning on a pedestal mount that requires tearing up and replacing a sidewalk square. While similar to the installation at the Sciencenter and Ithaca College, this installation has a slightly longer run than either of those sites and would require a lift to install the conduit inside the building because the Mall has high ceilings. If the Mall has a way to deter people from using this sidewalk when EVs are charging and therefore can have the charging station mounted on the side of the building, the installation cost would be about $5,500.

The second optional placement for the charging station in the parking lot island would cost around $12,500 because of the directional boring that is required. This also requires a lot more preparation to ensure that nothing would obstruct or be damaged by the boring. If properly done, cutting through the pavement and repairing it after the conduit was laid in would be a similar price. It is probably possible to find a contractor to do this pavement repair work at a lower cost, but over time the patch might become less even with the existing pavement and cause issues. Unless there are plans to resurface the parking lot in the near future, directional boring is often a better option.

The installation cost is a portion of the total cost for a charging station. The total cost would include any initial costs for the station hardware, protection, signage, and network activation, as well as the additional ongoing costs for being on a charging network, electricity use, and maintenance. Costs will vary based on the choices of the host site, but the recommended configuration would have a total cost ranging from $14,400 to $23,400 depending on the chosen installation configuration and location. A breakdown of the total charging station costs can be found at the end of this report on Table 6 and is compared to other Tompkins County sites in the Conclusions section.

GreenStar Cooperative Market

The GreenStar Cooperative Market is located near downtown Ithaca where NY Routes 13 and 79 intersect. GreenStar is a natural foods and fair trade market that prioritizes the purchase of local and organic goods. They cater to environmentally conscious people that are also more likely to drive EVs. This site is one of three GreenStar locations throughout Ithaca. The retail market building off Route 13 was not a good candidate for installing a charging station because there was no parking by the building (so it would have to be run out to a parking space) and the typical length of stay for visitors was an hour or less. GreenStar also leases this property.

The proposed placement of the charging station was at the GreenStar Classroom across the street from the GreenStar market. GreenStar owns this building and it is also next to their distribution warehouse so many employees use parking spaces in this lot. The electrical room is in the middle of the building, but directly out from that is the air-conditioning unit which would prevent the charging station from being placed there. Thus, conduit would need to be run toward the corner of the building and wall mounted between two parking spaces. The most visible placement for the charging station is on the outside corner (Figure 45). Figure 46 shows the electrical panel from where power would be drawn and the routing of electrical conduit.

Figure 45. Proposed placement for a charging station at GreenStar's Classroom

Figure 46. Electrical room and wiring run for the proposed placement of a new charging station at GreenStar

There are no example installations from NYSERDA's EVSE Deployment Program that show a ChargePoint charging station wall-mounted to the exterior of a building as proposed for GreenStar. However, the configuration would be very similar to pedestal mounted stations that were installed right next to a building as shown by the example in Figure 47 at Nichols Market in Liverpool. The older ChargePoint charging station model used for this installation did not accommodate wall-mounting, but their new models can be. This installation example has a guard rail to protect the station and it is highly recommended that some form of protection is used at GreenStar since it would be vulnerable to vehicle impacts.

Figure 47. Charging station installation at Nichols Supermarket

The installation of the charging station at GreenStar Classroom is fairly simple and relatively low cost at $4,500. However, this site would likely require two bollards to protect the station because there is no curb and it is on the corner of the building where it could be struck from multiple directions.

This installation cost is a portion of the total cost for a charging station. The total cost would include any initial costs for the station hardware, protection, signage, and network activation, as well as the additional ongoing costs for being on a charging network, electricity use, and maintenance. Costs will vary based on the choices of the host site, but the recommended configuration would have a total cost of $14,900. A breakdown of the total charging station costs can be found at the end of this report on Table 6 and is compared to other Tompkins County sites in the Conclusions section.

Taughannock Falls State Park

Taughannock Falls State Park's namesake waterfall is one of the outstanding natural attractions of the Northeast. Gorge and rim trails offer spectacular views from above the falls and from below at the end of the gorge trail. Campsites and cabins overlook Cayuga Lake, with marina, boat launch and beach nearby. A multi-use trail--hiking, cross-country skiing--winds past sledding slopes and natural skating ponds.

The proposed placement of the charging station is in the parking lot by the beach access. There is a building near this parking lot with bathrooms, but it has a very small electrical service (125A) and is a relatively long distance from the parking lot (150 feet). A better option was to place the charging station at the other end of the parking lot where the utility power comes into a transformer (Figure 48). Through discussions with the Park electrician, it was determined that adequate power could be brought out from this electrical equipment. However, a new outdoor panel for the charging station breakers would be needed, along with a structure to mount it on. The station itself would also require a foundation for mounting upon. Otherwise, the electrical runs should be relatively short as shown in Figure 49.

Figure 48. Proposed placement for a charging station at Taughannock Falls State Park

Figure 49. Electrical equipment and conduit run for the proposed placement of a new charging station at Taughannock Falls State Park

A charging station at Bronx Zoo (Figure 50) was installed from a transformer and outdoor panel similarly as proposed for Taughannock Falls State Park. The outdoor panel already existed at the Bronx Zoo, so the installation was fairly easy. This is not the case at Taughannock Falls State Park and the electrical upgrades for this installation might be quite extensive. This is still feasible because the State has their own electricians that can do this work.

Figure 50. Charging station installation at Bronx Zoo

The installation costs for this situation that requires more extensive electrical work will be significantly higher than many other sites at around $11,000. Drawing power from an existing panel with sufficient power will almost always be less expensive than putting in a new panel, even if the distance to get that power to the station is significantly longer. In this case, there was concern over drawing a potential 80A for the dual-port station from the 125A panel in the building. Some companies offer lower power drawing stations or even a power management system that might be a less costly option than putting in a new outdoor panel.

The installation cost is a portion of the total cost for a charging station. The total cost would include any initial costs for the station hardware, protection, signage, and network activation, as well as the additional ongoing costs for being on a charging network, electricity use, and maintenance. Costs will vary based on the choices of the host site, but the recommended configuration would have a total cost of $21,900. A breakdown of the total charging station costs can be found at the end of this report on Table 6 and is compared to other Tompkins County sites in the Conclusions section.

Conclusions

The two highest cost components of a charging station installation are the station hardware and the installation work (which is largely influenced by labor hours for the construction aspects and not the electrical work or supplies). The average cost and range of costs for charging station equipment described in an earlier section of this report are summarized in Figure 51. The cost difference between a wall mounted unit and a pedestal mounted unit is about $500. Prices from individual charging station manufacturers indicate a slight savings in a double port unit (a dual-port wall mounted unit is about 10% less than purchasing two single-port wall mounted units and a dual-port pedestal mounted unit is about 20% less than purchasing two single-port pedestal mounted units). However, when averaging across all manufacturer prices as shown in Figure 51 the dual port unit averages are more than twice the cost for single port units because several more expensive product manufacturers only offer dual port units. A networked charging station costs about 60% more than a non-networked station in each configuration.

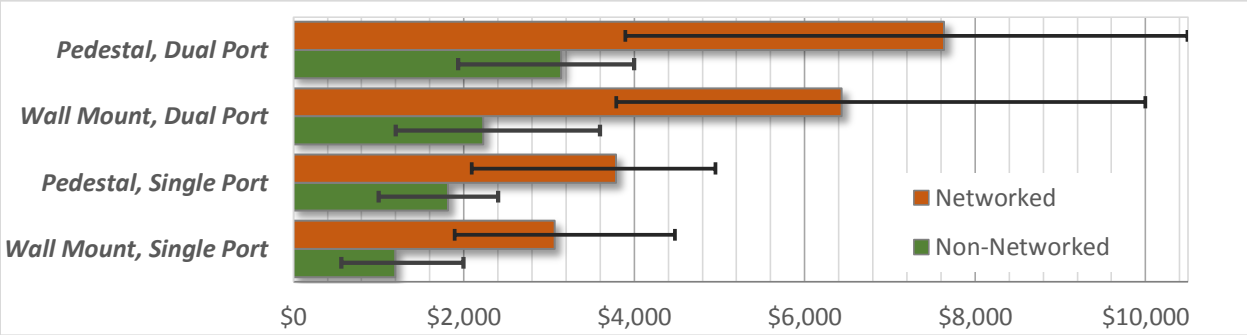

Figure 51. Average cost and range of costs for various charging station types

The total installation costs for a dual port station at the seven selected sites in Tompkins County are shown on Table 6 (next page) and summarized in Figure 52 below. The only additional cost a site host might consider is an extended manufacturer warrantee. Some selected sites have multiple total installation costs based on installation variables noted in parenthesis that correspond to highlighted characteristics on Table 6 found on the next page. Networking costs are for the first year after installation and would be an ongoing expense if the site host chooses this service. Electrical costs and maintenance is also not included as this will vary with use. The charging stations for staff use at Cornell Cooperative Extension are by far the lowest cost because they are Level 1 non-networked stations installed during the construction of a new building. For all the other dual port Level 2 networked stations, the total costs range from $11,000 to $23,000 and cover a wide range of site characteristics found throughout Tompkins County. Charging station installations during new construction projects save on costs. Wall mounted configurations that don't require excavation and concrete repair are about $5,000 less than pedestal configurations. Any major electrical upgrades or the use of directional boring also increases installation costs significantly.

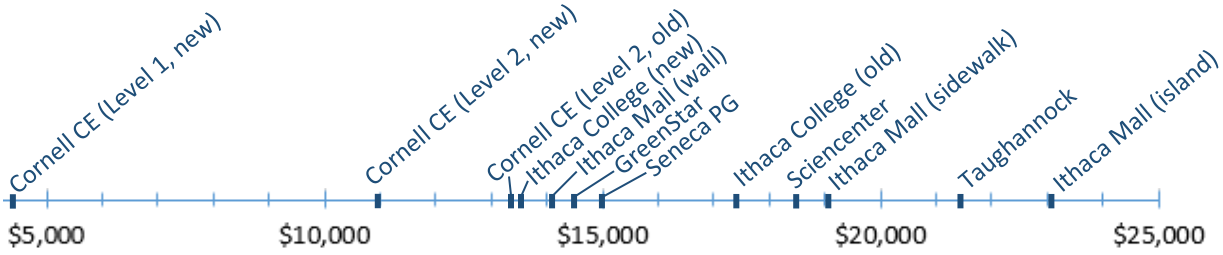

Figure 52. Comparison of total installed charging station costs for sites in Tompkins County

Table 6. Total charging station components and installation costs for selected sites in Tompkins County

Site Host	Station Description	Installation Description	Dual Port Station Cost	Install-ation Cost	Tire stop or bollard Cost	Signage Cost	Activa-tion Cost	Net-work Cost (1 year)	Average Electricity Cost (1 year)	Total Cost (first year)
Cornell CE	**Level 1** (120V), wall mount, **not networked**	Installed with **new** building, 30' wire run, 1 tire stop	$2,500	$2,000	$350				$300	$5,150
Cornell CE	Level 2 (240V), wall mount, networked	Installed with **new** building, 30' wire run, 1 tire stop	$6,500	$2,000	$350	$500	$1,000	$600	$300	$11,250
Cornell CE	Level 2 (240V), wall mount, networked	Installed on an **old** building, 30' wire run, 1 tire stop	$6,500	$4,500	$350	$500	$1,000	$600	$300	$13,750
Seneca PG	Level 2 (240V), wall mount, networked	50' wire run 1 tire stop	$7,500	$5,000	$350	$500	$1,000	$600	$300	$15,250
Sciencenter	Level 2 (240V), pedestal mount, networked	New sidewalk square, 50' wire run, 1 bollard	$7,500	$8,000	$1,000	$500	$1,000	$600	$300	$18,900
Ithaca College	Level 2 (240V), pedestal mount, networked	Installed with **new** parking lot, 1 bollard, 100' wire run (15' conduit)	$7,500	$3,000	$1,000	$500	$1,000	$600	$300	$13,900
Ithaca College	Level 2 (240V), pedestal mount, networked	Sidewalk cut and repair in **old** lot, 1 bollard, 100' wire run (15' conduit)	$7,500	$7,000	$1,000	$500	$1,000	$600	$300	$17,900
Ithaca Mall	Level 2 (240V), wall mount, networked	120' wire run with high ceiling work, mounted on the building **wall**	$6,500	$5,500		$500	$1,000	$600	$300	$14,400
Ithaca Mall	Level 2 (240V), pedestal mount, networked	New **sidewalk** square, 1 bollard, 120' wire run (along high ceilings)	$7,500	$8,500	$1,000	$500	$1,000	$600	$300	$19,400
Ithaca Mall	Level 2 (240V), pedestal mount, networked	Underground boring to **island**, 1 bollard, 50' wire run, mounting pier	$7,500	$12,500	$1,000	$500	$1,000	$600	$300	$23,400
GreenStar	Level 2 (240V), wall mount, networked	60' electrical run 2 bollards	$6,500	$4,500	$1,500	$500	$1,000	$600	$300	$14,900
Taughannock	Level 2 (240V), pedestal mount, networked	New panel from transformer, Mounting pier, 1 bollard	$7,500	$11,000	$1,000	$500	$1,000	$600	$300	$21,900