BEB Transportation Facility Electrification Transition Plan

CEC issued under GFO-20-601

Prepared by
Center for Transportation and the Environment
for City of Culver City

cte | Culver CITY

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Zero Emission Bus Transition Blueprint

Prepared for City of Culver City

August 31, 2023

Executive Summary

The zero-emission bus market, which includes both battery electric and fuel cell electric buses, is rapidly developing. While electric bus technology is becoming increasingly commercially viable, there remains a number of barriers that transit agencies. cities, and counties, such as the City of Culver City (Culver City). face when it comes to adoption of zero emission technologies, including:

- Understanding charging infrastructure and utility requirements;
- Clearly defining responsibilities for upgrading utility services to support charging power requirements;
- Understanding charger requirements and impact to facility throughout the transition period;
- Large capital expenses for grid infrastructure;
- Lack of space and land to install additional fueling infrastructure; and,
- High cost of fuel (electricity and hydrogen) as compared to internal combustion engine fuels (i.e., gasoline, diesel, and CNG/RNG).

However, addressing both bus and infrastructure requirements by creating a robust, holistic zero-emission transition plan for an entire fleet, transit properties such as Culver City will be in a much better position for the successful transition to electric vehicle technology. Culver City created a plan for transitioning its entire fleet to zero-emission technology that took the agency from a pilot battery electric bus (BEB) deployment through to completely transitioned BEB fleet.

Based on this experience, Culver City developed the following recommendations:

- Deploy infrastructure as part of a fleet transition plan based on sound analysis that determines the feasibility of BEB technology
- Determine an infrastructure deployment timeline that meets the fleet's transition schedule with adequately sized equipment
- Consider the amount of infrastructure required at the end of the transition period to determine the optimal layout for the equipment through partnerships with industry experts
- Revisit the transition plan every year or two to assess if the path forward requires reevaluation

Introduction

Project Overview

Electrification Goals

Widespread adoption of zero-emission bus technology has the potential to significantly reduce greenhouse gas (GHG) emissions resulting from the transportation sector. Culver City is wholeheartedly committed to implementing environmentally-friendly policies and reducing its carbon footprint; therefore, the City has committed to full CityBus fleet electrification by the year 2028. With this goal in mind, Culver City has worked diligently with the State of California to order buses off of the statewide Department of General Services (DGS) contract and execute a purchase order with New Flyer of America for the purchase of battery electric buses (BEBs) and associated charging infrastructure. The first four BEBs were delivered in Fall 2021.

Feasibility assessment and determining Culver City's transition strategy

To ensure that Culver City's electrification strategy would be feasible, the agency began the transition planning effort by conducting a Service Assessment with the Center for Transportation and the Environment (CTE). This assessment analyzes the feasibility of maintaining Culver City's current level of service with BEBs. The main focus of the Service Assessment is the block analysis, which determines if BEBs could meet the service requirements of the current service blocks throughout the transition period based on bus endurance, range limitations, weather conditions, battery degradation and route topography. The energy needed to complete a block is compared to the available energy for the respective bus type to determine if a BEB can successfully operate on that block. In the event that a BEB cannot feasibly operate on a given block, the assessment also estimates the timeline for when blocks become feasible for zero-emission buses based on assumptions of technology improvement over time. The timing of block feasibility as well as the fleet replacement schedule is then used to develop a BEB procurement schedule in the Fleet Assessment.

The analysis assumes a 5% improvement in battery capacity every other year and a starting battery capacity of 660 kWh, which is used to determine the timeline for when blocks become achievable for BEBs to replace fossil-fuel buses in a one-for-one ratio. The results from the analysis are used to determine when, or if, a full transition to BEBs may be feasible. Results from this analysis are also used to determine the specific energy requirements for the agency and develop the estimated costs to operate the BEBs in the Fuel Assessment. This modeling analysis also assumes blocks will maintain a similar distribution of distance, relative speeds, and elevation changes as exists at the time of the study since bus service will continue to serve similar locations within the city and use similar roads to reach these destinations even if specific routes and schedules change. This core assumption affects energy use estimates and block achievability in each year.

CTE's route modeling estimates the impact of varying passenger load, accessory load, and battery degradation on real-world bus performance, fuel efficiency, and range. CTE ran models with varying loads to represent “nominal” and “strenuous” loading conditions. Nominal loading conditions assume average passenger loads and moderate temperature over the course of the day, which places marginal demands on the motor and heating, ventilation, and air conditioning (HVAC) system. Strenuous loading conditions assume high or maximum passenger loading and near maximum output of the HVAC system. This nominal/strenuous approach offers a range of operating efficiencies to use for estimating average annual energy use (nominal) or planning minimum service demands (strenuous). Route modeling ultimately provides an average energy use per mile (kilowatt-hour/mile [kWh/mi]) associated with each route, bus size, and load case. System-wide energy use is estimated in subsequent assessments.

Figure 1 shows the outputs of this analysis, which determined that by 2028 nearly all Culver City blocks can be completed by BEBs. Battery capacity may improve more quickly than by the assumed 5% every two years, which means that it is possible that all of Culver City’s blocks will be achievable by that time. If batteries do not improve at the modeled rate, the range gap can be remedied through re-blocking.

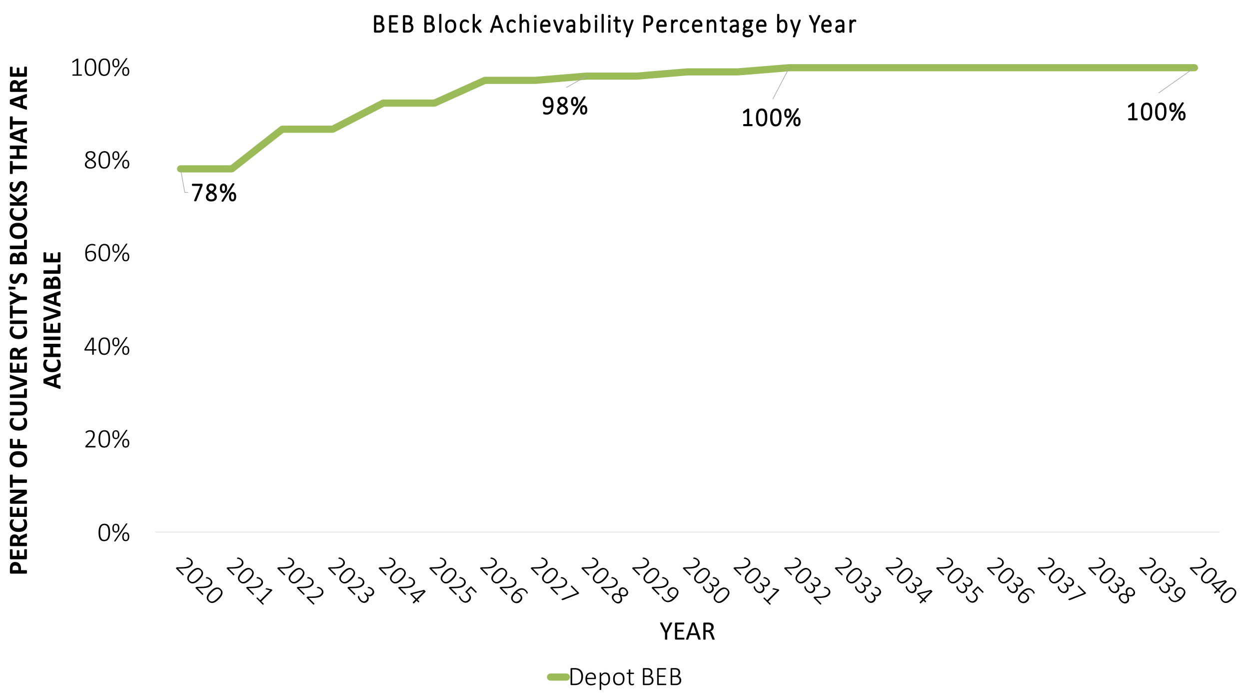


Figure 1 – BEB Block Achievability Percentage by Year

Culver City’s Current Plan for Pilot Deployment

Culver City’s transition plans to begin with a pilot deployment of ten buses, split into two phases. In Phase I, Culver City will receive four BEBs with a 439kWh battery capacity and in Phase II, the agency will receive six buses with 527 kWh batteries. CTE has assessed Culver City’s blocks and determined that these battery capacities will be sufficient for many of the agency’s blocks and that putting a higher capacity bus on these blocks would not be necessary and would only incur increased cost and weight. By beginning with lower capacity battery BEBs, Culver City is also familiarizing themselves with the technology while allowing the industry time to develop before committing to higher capacity battery buses. CTE anticipates that batteries will continue to increase in energy density, while maintaining, or even decreasing, in battery weight, which means that when Culver City is ready to transition the remainder of the fleet beyond the pilot, the buses will not be heavier than the buses in the pilot deployment, but will be able to travel further on a single overnight depot charge.

Conclusion

Assuming a 5% improvement in battery capacity every other year and considering that current battery technology allows for a battery capacity of 660kWh, CTE concludes that Culver City may achieve a full battery electric fleet by 2028 since all blocks are estimated to be achievable with current and anticipated battery electric technologies. CTE recommends that Culver City reassess their transition plan on an annual basis to take into account any changes in assumptions, service, technology and costs.

Project Partners

The Culver City Department of Transportation collaborated with New Flyer, Southern California Edison (SCE), AECOM, and CTE to plan the deployment of these ten buses and, in addition, prepared a transition study to plan for a full fleet conversion to battery electric buses by 2028.

Objective – Overcome Challenges Faced by Transit Agency

Challenges Faced by Transit Agency

Although BEB deployments are becoming increasingly common, there are still several challenges that agencies often face in transitioning to this technology, that ICE deployments do not face. Culver City also faced several challenges before and during its first BEB deployment and in developing a transition plan to convert the entire fleet to BEB technology. The primary challenges Culver City anticipated as well as the solution the agency identified are summarized below:

Challenge	Solution
Defining current and future Charging Infrastructure Requirements	Culver City partnered with industry experts CTE and AECOM to help the agency understand charger options and selecting the correct charger power and quantity.
Clearly defining responsibilities for upgrading utility services to support charging power requirements	Culver City partnered with SCE to take advantage of their Charge Ready Program to ensure that the scope of work was clearly defined, the responsibilities between the agency and the utility were clear, ensure that the utility understood the power requirements of the agency over time and ensure there were no gaps or overlaps between the two parties.
Understanding charger requirements and impact to facility throughout the transition period	Culver City partnered with industry experts CTE and AECOM to help the agency understand the agency's requirements for charger performance to ensure that the chargers would meet the agency's needs. Culver City also partnered with New Flyer to purchase the pilot charger through their bus OEM to ensure that the charger would be compatible with their buses.
Large capital expenses for BEB Transition	Culver City partnered with CTE to create a full fleet BEB Transition Plan to define total capital requirements for BEBs and charging infrastructure. Culver City's grants team is proactively looking for and securing funding opportunities for BEB infrastructure and vehicle purchases.
Lack of Space and Land to Install Charging Infrastructure	Culver City partnered with AECOM to create 30% drawings (Appendix) to help the agency understand the space required to implement the necessary charging infrastructure in the space constrained yard. The analysis looked at several alternatives including ground-mounted plug-in chargers, overhead gantry mounted plug-in chargers, and a new bus parking garage with chargers. This proactive planning confirmed that the existing yard would not have sufficient space to install the necessary number of chargers in the existing bus yard. Culver City and AECOM worked to identify a solution – building an overhead space frame for plug-in chargers in the yard and rebuilding a

	neighboring garage to accommodate bus parking on the bottom floor.

An overview of the Infrastructure Assessment conducted by Culver City, CTE, and AECOM is provided in the following section.

Finance and Budget – Methodology for Determining Cost Estimates

Scaling to a fleetwide BEB deployment requires substantial infrastructure upgrades and a significantly different approach to charging compared to smaller pilot deployments. With pilot deployments, charging requirements are met relatively easily with a handful of plug-in pedestal chargers and minimal infrastructure investment.

Full fleet BEB deployments, however, require installation of charging stations and improvements to existing electrical infrastructure. These improvements may include upgrades to switchgear, transformers, or service connections. Planning and design work, including development of detailed electrical and construction drawings required for permitting, is also necessary once charging equipment has been selected.

Culver City operates their transit service from a space constrained yard. The current fleet of 54 buses, combined with other city vehicles that park in the yard at night, exceeds the available parking and vehicles are currently accommodated in maintenance bays and around the perimeter of the yard in order to fit all vehicles in the space at night. This creates an issue for the agency in considering moving to a BEB fleet since being able to fully charge the fleet overnight will require that all buses are able to park in defined charging locations with dedicated chargers.

Figure 2 below shows the layout of the existing yard that is constrained on all four sides by existing structures and infrastructure. In creating a plan for building out infrastructure to support their transition, Culver City wanted to explore their infrastructure options both from the perspective of minimizing loss of parking space and cost. Culver City, CTE, and AECOM therefore worked together to investigate four charger styles to determine if/how they could be accommodated in the current yard and the relative cost of the option.

The four charger styles investigated were:

A. Plug-in dispensers with ground-mounted pedestal chargers
B. Plug-in dispensers suspended from overhead gantry with pedestal ground-mounted chargers
C. Pantograph dispensers suspended from overhead gantry
D. In-ground inductive charging systems

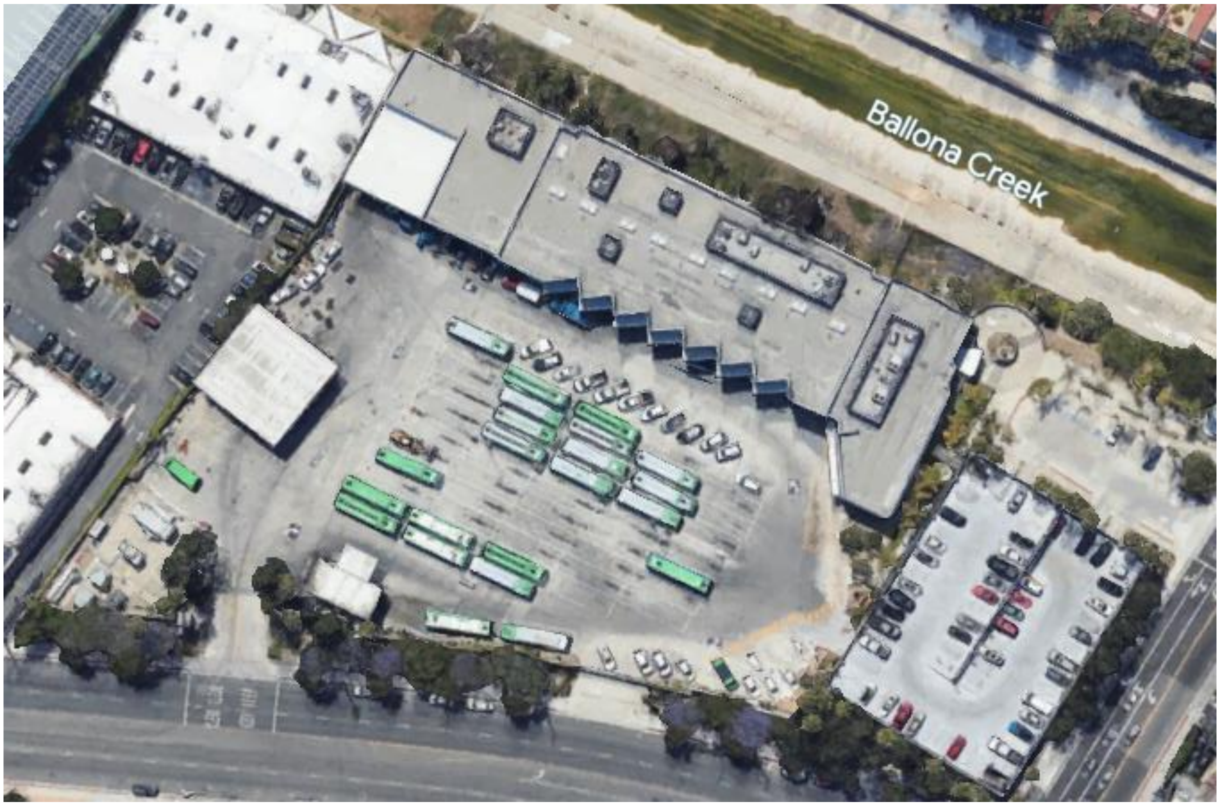


Figure 2 – Culver City's Current Yard Parking

In **Figure 2,** a parking garage can be seen in the bottom right-hand corner. This parking garage is owned by the City and Culver City identified that a possible solution to increase the space available for bus parking would be to remove the existing parking structure and rebuild a taller structure that could accommodate bus parking on the bottom with the same footprint as the existing structure or to build a new garage that would cover the entire yard. With these additional options in mind, Culver City, CTE, and AECOM also worked together to investigate the cost of pursuing the three following options for increasing the parking space available:

1. No additional space – buses and charging infrastructure only accommodated in current yard space
2. New garage over current yard – the buses and infrastructure can be accommodated in a space under a new garage that is equal to most of the current yard's footprint
3. Replacing the current parking garage's footprint – buses and infrastructure accommodated outdoors in the current yard footprint with some additional space available under a new garage that has the same footprint as the current garage

The project team agreed that investigating each combination of the four charger styles with each of the three-yard layouts would provide Culver City with a complete picture of their options. Each charger type was therefore iterated for yard layout, so that a total of 12 infrastructure scenarios were examined. See **Table 1** for a summary of these scenarios.

Table 1 - Infrastructure Scenario Summary

	A. Pedestal with plug-in dispensers	B. Gantry with suspended plug-in dispensers	C. In-Ground Inductive Charging	D. Gantry with Pantograph Chargers
1. Existing Yard Only	1A	1B	1C	1D
2. New Garage in existing Yard	2A	2B	2C	2D
3. New Parking Garage Replacing Existing Parking Garage	3A	3B	3C	3D

Through discussions with Culver City and AECOM, the *existing yard only* (1A through 1D) and the New *garage over existing yard* (2A through 2D) options were found to be non-viable. The *existing yard only* layouts were eliminated because the required charging infrastructure would cause a loss of parking spaces and the required number of buses and support vehicles could not be accommodated. The New *garage over existing yard* option was eliminated because of insufficient spacing for the required quantity of buses, the inconvenience to other activity in the yard, the awkwardness of the structure design, and the close proximity to the main facility.

The third layout considered, replacing the existing parking garage, using the same footprint, but designed with higher ceilings to accommodate transit buses and more floors to accommodate more parking with additional parking still available in the yard was found to be the best option. The benefits of raising the first floor to 20 feet, would accommodate parking for up to 9 40' buses – providing access from the yard and exit through Duquesne Avenue. The second-floor entry and exit would come from Duquesne and be 12 feet high to accommodate electric mini-buses, shuttles and city vehicles. A third and fourth floor would be added to expand parking for our city employees, expanding the capacity from 132 to 202 vehicles.

Scenarios 3C and 3D were additionally ruled out due to the incremental capital cost of inductive chargers and pantographs respectively. The remaining options, 3A and 3B only differed in cost by 7.5%, so the final selection came down to the convenience that the light gantry structure in 3B would be able to provide over the 3A option. Therefore, the following discussion focuses on scenario 3B, which combines rebuilding the garage higher and adding a gantry structure to the yard to allow dispensers to be suspended from the structure. Most of the buses would be accommodated under the gantry in the yard with up to nine additional buses being housed under the garage.

CTE and AECOM developed estimates for the components of each project type to build up a total cost estimate by project type. **Table 2** below shows the assumptions used for BEB infrastructure costs. Conceptual layouts for the selected scenario, prepared by AECOM, are provided in the Error! R eference source not found. chapter.

Methodology

Infrastructure Project Phasing

The infrastructure deployment was broken into a pilot and 5 main phases that was structured to add infrastructure to meet the needs of the agency's growing BEB fleet. The infrastructure phasing is therefore structured around the agency's fleet procurement plans as shown below:

Figure 3 – Culver City's Fleet Procurement Timeline

Although these phases are expected to occur in designated years, they are modular, which means that the phases can occur in any order if the agency's plans or priorities changed.

Pilot Phase: Involves the deployment of a single 150 kW charger that will be used to charge the first four buses that will be delivered. Nominal demand for this charger is 198A at 480V, three-phase power with a maximum power dissipation of 170 kVA. SCE's analysis of the electrical demand data shows that the single charger load can be added on to the facility's main building transformer via a small, separately metered service panel installed by SCE as part of the Charge Ready program.

Phase 1a: All the major trenching and electrical work should be completed to avoid needing to repeatedly disrupt the yard as the BEB transition moves forward. The transformer should be upgraded, trenching and boring to install conduit from distribution panel to charging island should be completed, and the charger stub out should be accomplished. Additionally, the existing 4' RCNG fuel island should be expanded into a 6' island to accommodate the chargers and gantry structure that will be built out in the coming years. This is expected to occur in 2021/2022.

Phase 1b: Five chargers (750kW total) will be needed to charge the first 10 buses delivered by 2022. These chargers have a maximum demand of 150kW each, with two gantry mounted dispensers per charging cabinet. Given that the current transformer is already reaching capacity, a 1500 kVA transformer will be needed to serve the existing building and the 10 buses, if the loads are combined as recommended by SCE. This upgrade is expected to be done by SCE as part of the Charge Ready program. SCE has yet to confirm what portion of the total project costs they will be willing to cover at this stage, but Culver City expects to cover the difference. This cost assumption should be updated when the terms are finalized. The first 5 gantries are also expected to be installed this year.

Phase 2: This phase accommodates the delivery of the next 10 BEBs, which will require an additional 5 chargers and 10 gantry mounted dispensers to be added to the existing gantry structure deployed in Phase 1b

Phase 3: This phase is largely the garage construction phase, which involves tearing down the existing garage and constructing a new one in its place that is planned to be one and a half stories higher than the current parking garage. Five (5) chargers and ten (10) ceiling mounted dispensers will be installed on the first floor of the new garage. The second floor is devoted to electric charging of mini-buses, shuttles and City vehicles, which will allow for twice as many vehicles as the current garage.

Phase 4: Expected in 2026, this phase sees the next and last stage of gantry construction with 5 more gantries being built on the eastern half of the yard. 3 more chargers and 6 gantry mounted dispensers will also be added.

Phase 5: Expected in early 2028, this phase is designed to accommodate the final 18 buses. The remaining 6 chargers and 18 gantry mounted dispensers are expected to be installed.

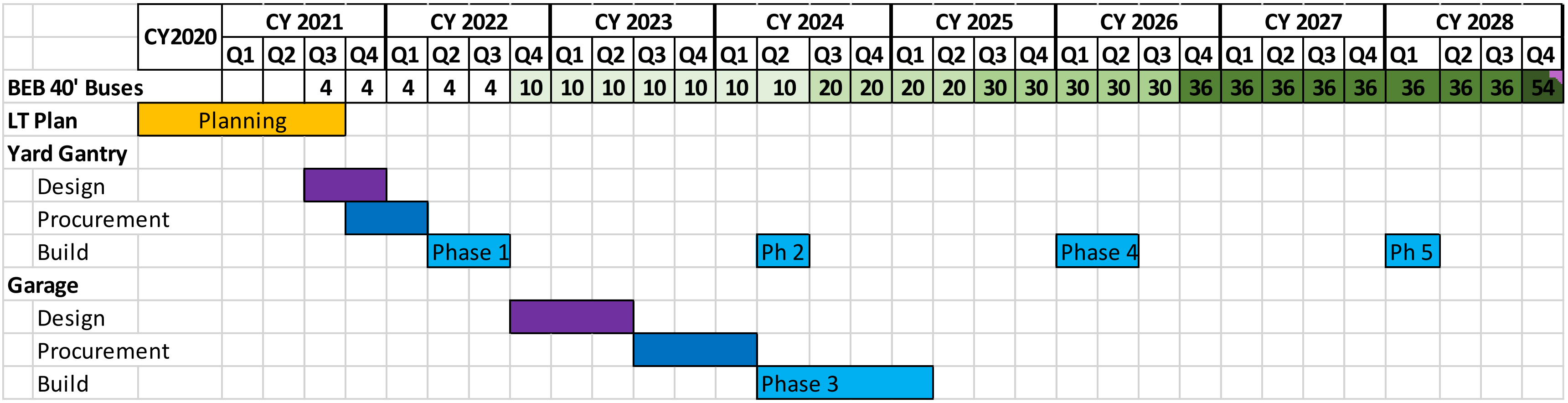


Figure 4 – Project Phasing Timeline

Facilities Assessment Projects

To determine the installation timeline and costs for charging equipment, this assessment breaks the infrastructure scope of work into four key project types: planning, structural, power upgrades, and charger installation - sized and scheduled to meet charging requirements over time. We assume that infrastructure will be built in stages to coincide with the introduction of new BEBs rather than immediately building out all necessary infrastructure for a full fleet transition in a single project.

The following section introduces the timeline and cost estimates for the Project Planning, Structural Projects, Power Upgrade Projects, Charger Installation Projects, and Garage Construction/Deconstruction costs associated with the four infrastructure scenarios being explored. An overview of the assumptions used for this analysis can be found below in **Table 2**.

Table 2 – BEB Infrastructure Project Cost Assumptions

Project	Cost Estimate Metrics	Source
Infrastructure Planning	$200k per project	Engineer's estimate
Structural Projects (Gantries/Islands, Conduit, duct banks, etc.)	Design/Construction: variable by scenario	Engineer's estimate, includes 20% contingency
Power Upgrade Projects	Design, Construction, & Equip: $96k per MW	Engineer's estimate, includes 20% contingency
Charging Projects	Charging Equipment & Installation: variable by scenario	Quotes and estimates, includes 20% contingency

Key assumptions applied in Culver City's Facilities Assessment are as follows:

- One plug-in dispenser and cord reel per bus;
- Two buses per 150 kW charger (with the exception of the inductive charger scenarios);
- Two charge windows, i.e., no more than half the buses charge at any given moment;
- Off-peak, overnight charging with automated charge management software; and
- Dispenser capacity to serve up to 80% of the fleet at a time; no movement of buses overnight.

Depot Planning Projects

A&E Planning at the depot is estimated to cost $200,000 before each Power Upgrade project. Three $200,000 projects are therefore planned for Culver City over the transition period to precede the years when power upgrades are expected as shown in **Table 5** below.

Depot Structural Projects

Structural projects include (1) trenching and building out duct banks from the switchgear to the charger pads, (2) construction of charger pads (i.e., foundation for charging equipment), (3) construction of gantry foundations and overhead gantry structures that hold the dispensers (for applicable scenarios), and (4) installation of conduit from switchgear to charger pads. **Table 3** shows the detailed cost assumptions for structural projects. These cost assumptions also apply to other projection scenarios. Duct bank cost is incurred only once per depot, other costs are on a per gantry basis.

Table 3 – Scenario 3B: Structural Project Cost Assumptions

Item	Cost	Unit
Initial Duct/Bank	$ 300,000	per Division
Island	$ 45	per square foot
Gantry & Foundation	$ 150,000	per gantry (light load)
Incremental Duct Bank/Conduit	$ 300	per Lineal Foot
Charger Pads	$ 50	per square foot
Contingency	20%	on project costs
Design Engineering	6%	on project costs and contingency

Depot Power Upgrade Projects

Power upgrade projects include construction of transformer foundations and installation of transformers. This study assumes that transformers are modular and that incremental power requirements are met over time. **Table 4** shows the estimated costs for depot power upgrade projects.

Table 4 – Depot Power Upgrade Cost Assumptions

Transformer/Switchback Pad	Cost	Unit
Transformer	$ 350,000	Per Division
Construction, Equipment (1 MW)	$ 200,000	per project
Construction, Equipment (2 MW)	$ 300,000	per project
Contingency	20%	on project costs
Design Engineering	6%	on project costs and contingency

Figure 5 shows total required electrical demand, in megawatts, for each depot over time. Each entry indicates the minimum amount of power that must be added in a given year to meet the growing demand at a given facility as more BEBs are purchased.

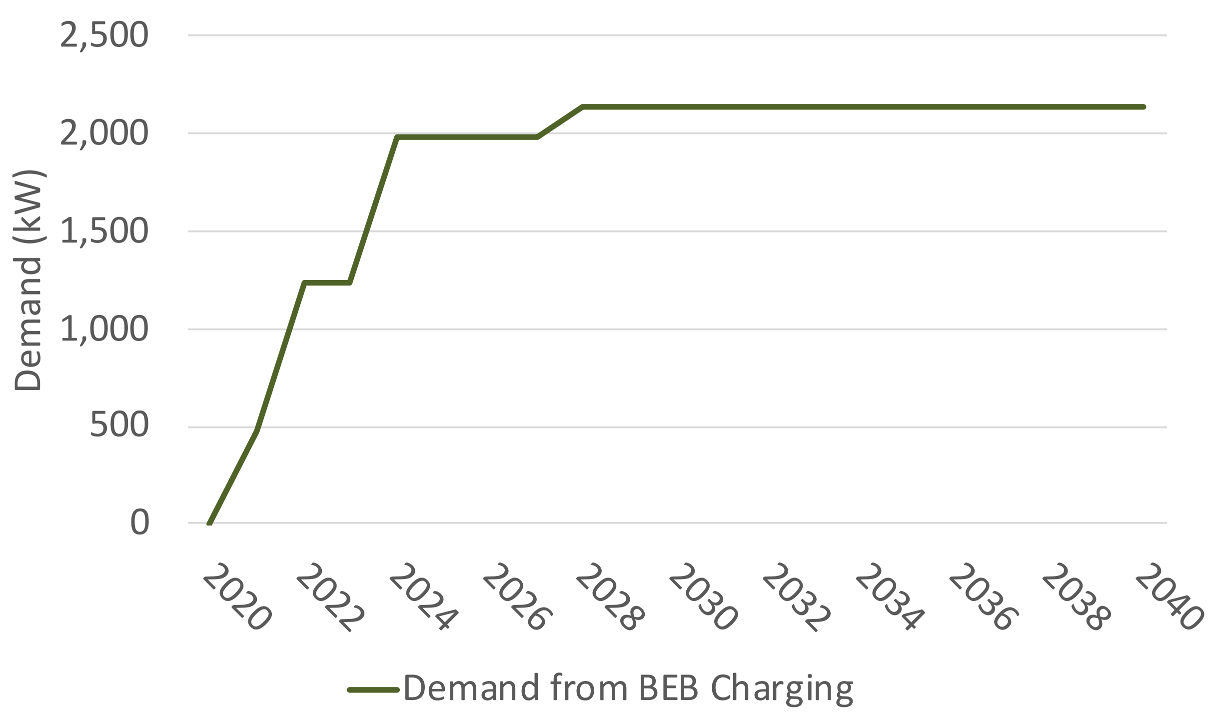


Figure 5 – Incremental Depot Electrical Demand (MW)

Power upgrades are consolidated to occur in selected years, in accordance with the required demand in **Figure 5.** These recommended upgrades are expected to occur in the years outlined in

Table 5 below. Due to the chargers gradually being introduced to different meters, multiple meters will require upgrading, resulting in one more MW being added than would seem apparent based on the projected demand above.

Table 5 - Depot Recommended Power Upgrade Projects (MW)

Year	Upgrade Required (MW)
2022	2
2024	1
2028	1

Total estimated power upgrade costs over the project life are approximately $1.3 million, although around $700,000 would likely be covered by SCE as part of the Charge Ready Program.

Depot Charger Installation Projects

Charging projects include purchase and installation of 150 kW chargers and dispensers. Each bus will require one dispenser. Every two buses will require one charger, with the exception of the inductive scenario, which would require one charger per bus. The dispenser type depends on the scenario, with 3B requiring plug-in dispensers. provides the costs assumed for charger and dispenser installs.

Table 6 – 3B Dispenser and Charger Project Cost Assumptions

Item	Cost	Unit
Charger	$ 100,000	per 150 kW charger
Charger Installation	$ 10,000	per 150 kW charger
Dispenser/Pantograph	$ 10,000	per dispenser
Dispenser Installation	$ 5,000	per dispenser
Contingency	20%	on project costs

Garage Construction Costs

In scenarios 3B, the current light-duty parking structure on Culver City's property would be torn down and replaced with a new, taller garage that would allow for additional bus parking on the ground level and would increase the light-duty parking availability in the structure by 50%. The garage deconstruction and construction are both part of Phase 5, which is shown in 2024, but the timing of this construction project may be adjusted as needed. The cost of removing the existing structure is estimated at $1.8 million, and the cost of reconstruction is estimated at $9.9 million. Upon approval of the plan, a full site survey and independent costing would be done as this is a high-cost infrastructure item. The Culver City team is concerned that these costs could be much higher and thus have asked for a $5M contingency for the garage replacement. The garage construction costs will need to be revisited and revised as plans for this large construction project solidify. It is staff's intention to contract with a third-party firm to provide construction cost estimating services as the date of construction approaches. This will verify the initial cost estimates of the conceptual design, thus ensuring the viability of the design and whether it needs to be refined any further prior to commencing the construction phase.

Additionally, there are zoning restrictions with regards to building height that need to be worked through with the City. For general industrial zoning the maximum building height is set at 43', however the current design as laid out in this plan has the parking structure at a height of 59', which is inclusive of a parapet. However, Section 17.300.025 - Height Measurement and Height Limit Exceptions of the Culver City Municipal Code (CMMC) allows a number of exceptions. Staff are currently working on conducting a site survey, the results of which will allow the Community Development Director to determine an alternative basis for measurement per the CMMC, thus allowing the required clearance for the new parking structure to be built as designed or to expand the footprint. Expanding the footprint, however, would cost more and would interfere with the view of the transportation building from the street.

Outputs

Table 7 summarizes all costs for charging infrastructure for all of the selected scenario. The estimated total infrastructure costs are approximately $20 million. This total cost includes all gantry projects (including the duct, bank, charger pad etc. costs required to support the chargers that will be installed along with the gantry), all power upgrade projects, all charger and dispenser installations, all planning projects, design engineering costs, the added 20% contingency on all costs, and 1.5% annual inflation. Culver City's Zero-Emission Bus Transition Plan Design Package developed by AECOM follows this cost summary.

Table 7 - Depot Only Cumulative Costs, Infrastructure Scenario 3B

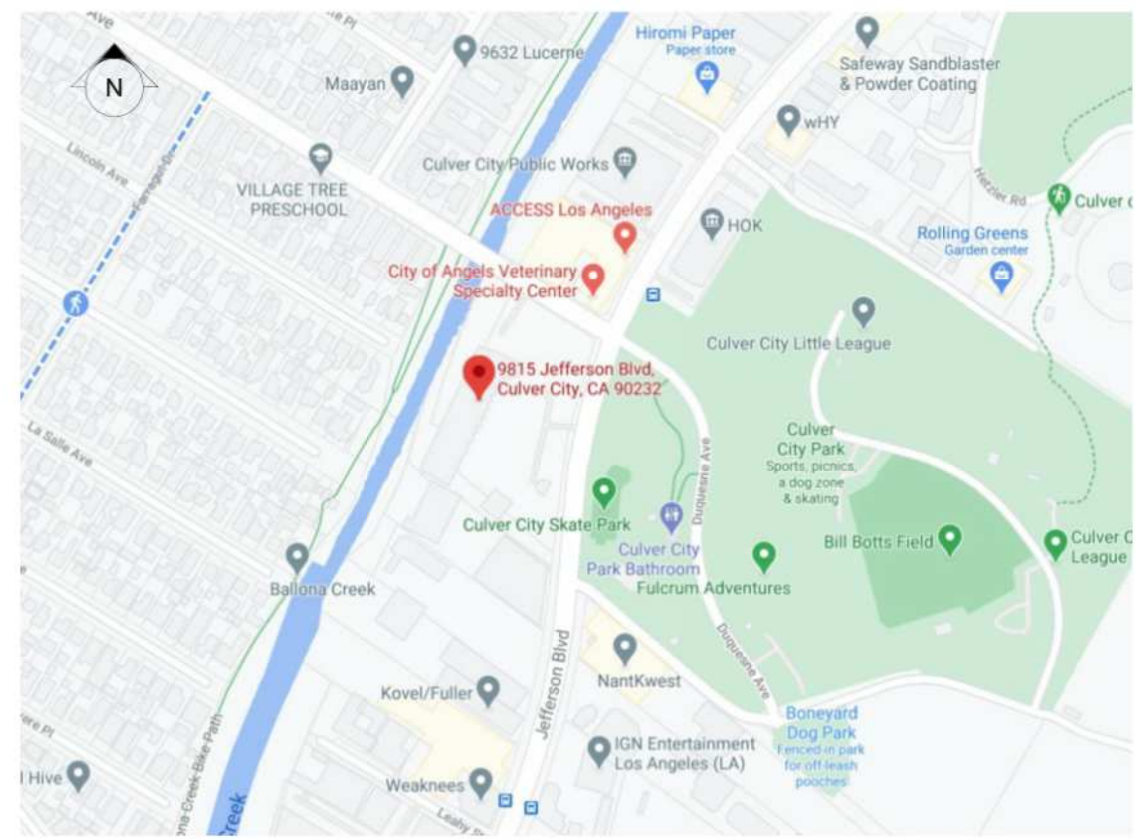
Project Requirements								
	Buses Added	A&E Planning	Charger Islands/ Gantries Added	Chargers Added	Dispensers Added	Power Upgrades	Garage Deconstruction	Garage Construction
2020								
2021	4	$206,000						
2022	6		$1,325,877	$679,949	$222,529	$863,496		
2023								
2024	10			$700,500	$229,255			$11,935,113
2025	10	$231,855	$1,386,441	$711,007	$232,693			
2026	6			$433,004	$141,710	$303,767		
2027		$245,975						
2028	18			$594,788	$218,990	$322,266		
Total	**54**	**$683,830**	**$2,712,317**	**$3,119,248**	**$1,045,177**	**$1,489,529**		**$11,935,113**

Culver City's Zero-Emission Bus Transition Plan Design Package Developed by AECOM

CULVER CITY

ZERO-EMISSION BUS TRANSITION PLAN

INDEX OF DRAWINGS



VICINITY MAP

Drawing: T-1

TITLE SHEET

CULVER CITY ZERO-EMISSIONBUS TRANSITION PLAN
CULVER CITYBUS
9815 JEFFERSON BLVD., CULVER CITY, CA
Project No.: 60650368
Date: 2021-09-08

Project Management Initials: Designer: EPB Checked: TB Approved: BRF ANSI B 11" x 17"
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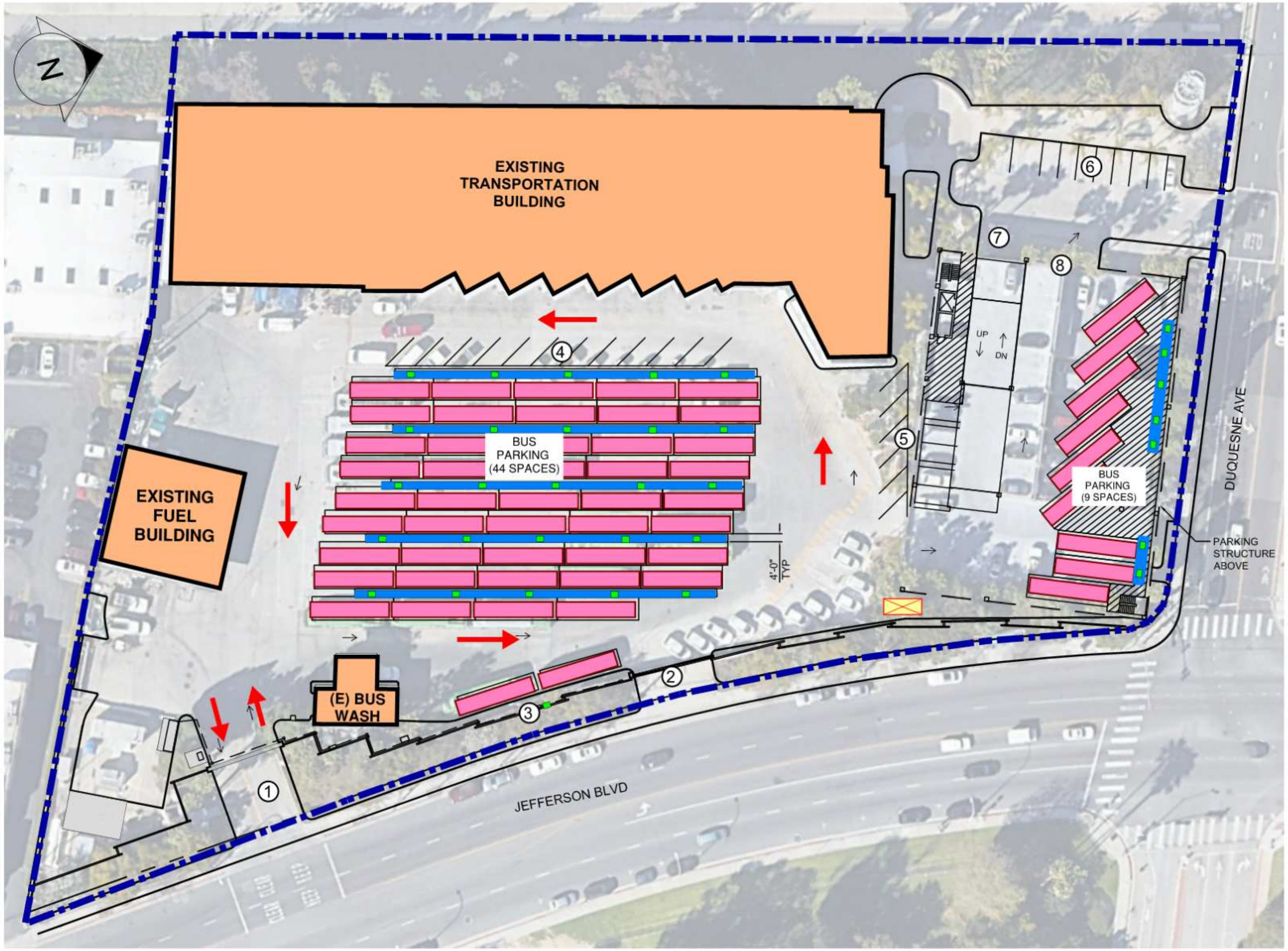


SITE PLAN w/ PLUG-IN CHARGERS
OPTION 3A (55 BUSES)

SCALE: 1" = 60'

KEYNOTES

1. BUS ENTRANCE
2. EMERGENCY EXIT (KEPT CLOSED)
3. TEMPORARY BUS CHARGER AND PARKING (2 BUSES)
4. MAINTENANCE VEHICLE PARKING
5. RELOCATED EV PARKING AREA
6. GUEST PARKING
7. POV GARAGE ENTRY/EXIT
8. BUS/YARD VEHICLE EXIT

LEGEND

- NEW TRANSFORMER
- PROPERTY LINE
- 4' WIDE ISLANDS FOR CHARGERS/DISPENSERS
- 40' BUS PARKING (55 SPACES/54 REQUIRED)
- DIRECTION OF TRAFFIC

0 60' 120'

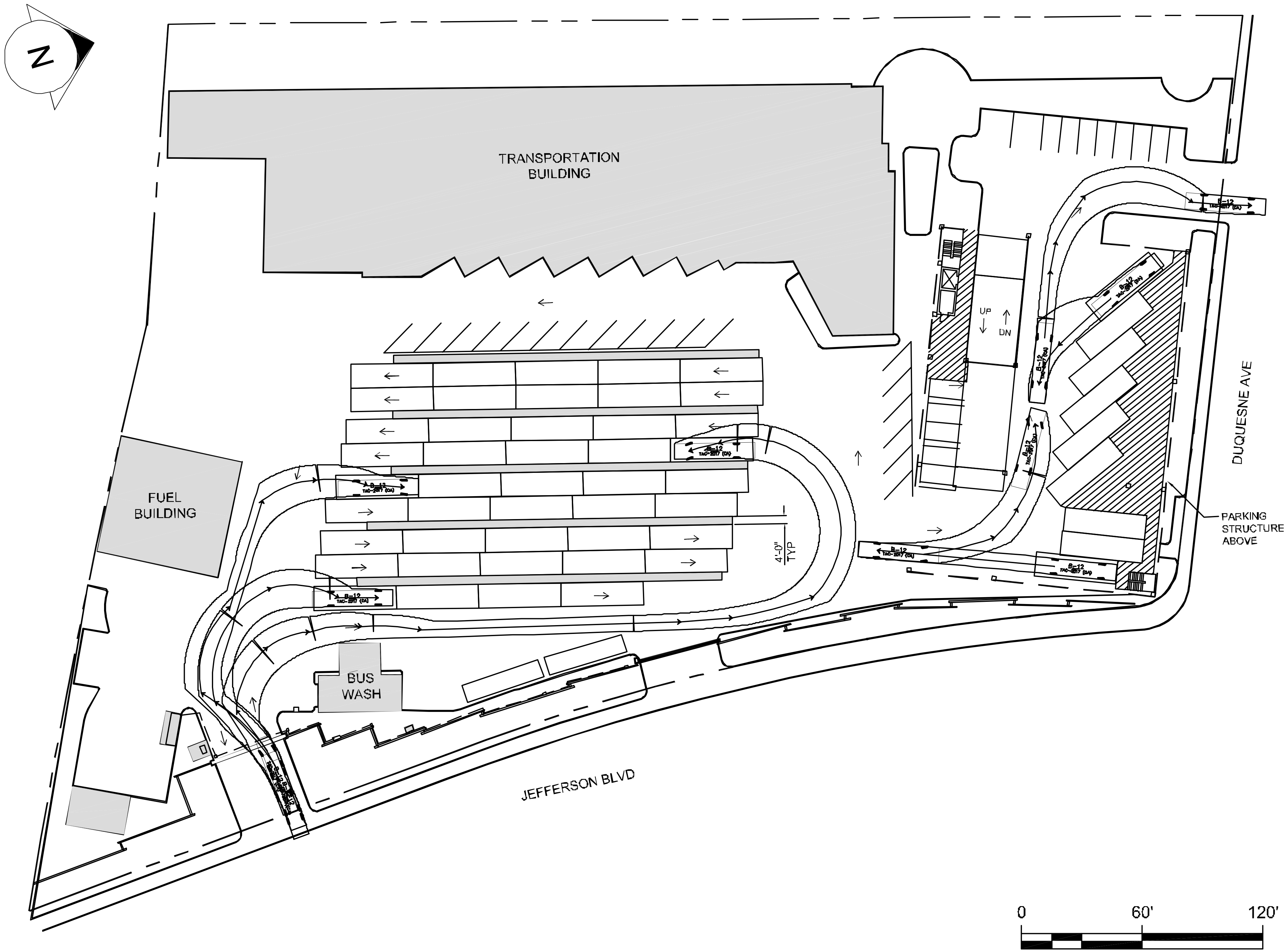
AECOM

SHEET A-1

SITE PLAN
OPTION 3A
YARD W/ PLUG-IN CHARGERS

CULVER CITY ZERO-EMISSIONBUS TRANSITION PLAN
CULVER CITYBUS
9815 JEFFERSON BLVD., CULVER CITY, CA
Project No.: 60650368
Date: 2021-09-08

Culver CITYBUS



CIRCULATION PLAN - OPTION 3A

SCALE: 1" = 60'

KEYNOTES

1. BUSES IN THIS BLOCK ARE ORIENTED AS THEY ARE IN THE CURRENT YARD, WITH THE UPPER HALF FACING THE FUEL BUILDING TO THE SOUTH, AND THE LOWER HALF FACING DUQUESNE AVE TO THE NORTH.
2. BUSES IN THIS BLOCK MUST EXIT TO DUQUESNE AVE AND RE-ENTER THE SITE FROM JEFFERSON, IN ORDER TO ACCESS THE MAINTENANCE BAYS OR BUS WASH.

AECOM

SHEET A-2

SITE PLAN
OPTION 3A
YARD CIRCULATION

CULVER CITY ZERO-EMISSIONBUS TRANSITION PLAN
CULVER CITYBUS
9815 JEFFERSON BLVD., CULVER CITY, CA
Project No.: 60650368
Date: 2021-09-08

Culver CITYBUS

Project Management Initials: Designer: EPB Checked: TB Approved: BRE ANSI B 11" x 17"
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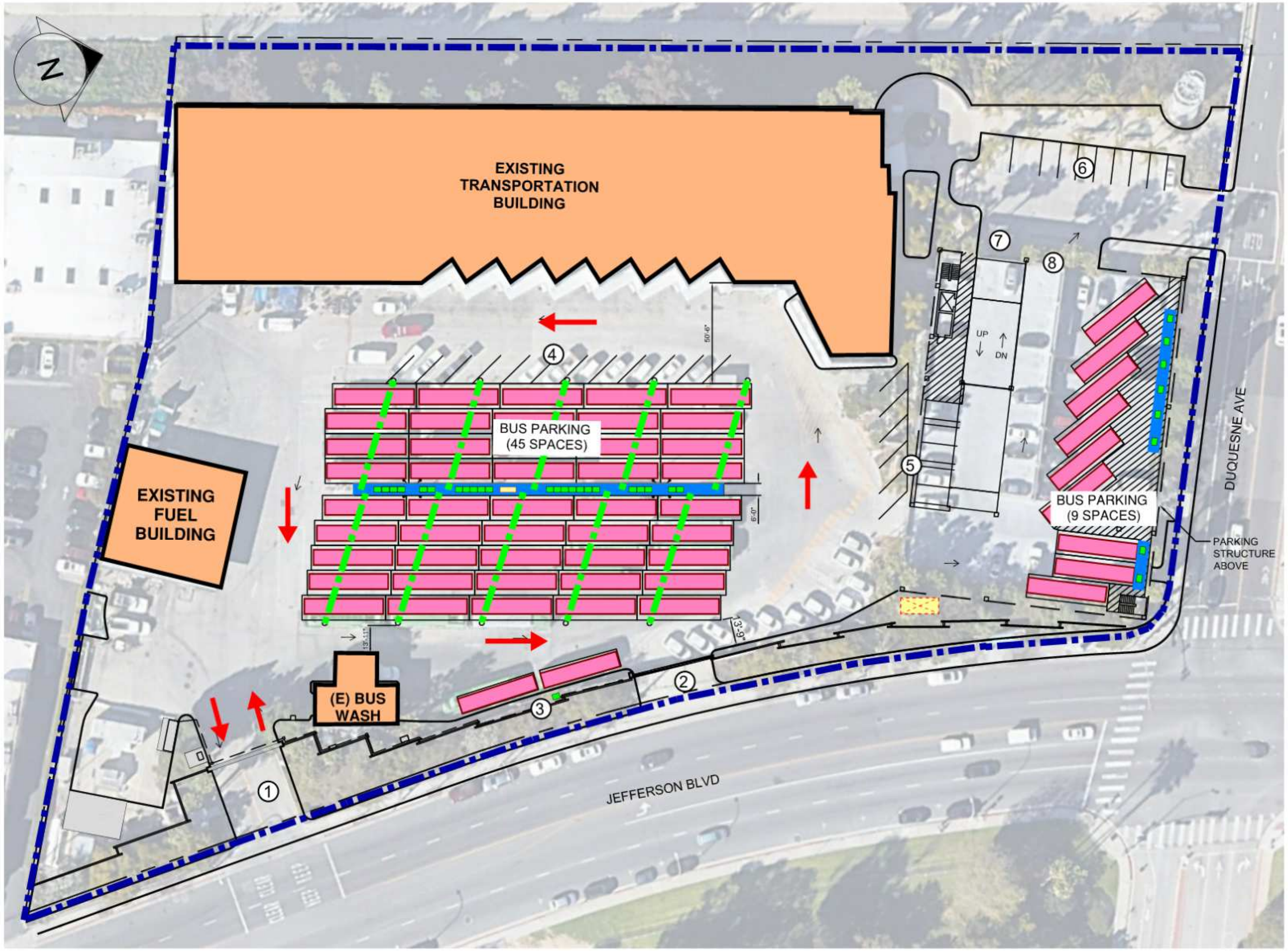


SITE PLAN w/ OVERHEAD GANTRIES

OPTION 3B (56 BUSES)

SCALE: 1" = 60'

KEYNOTES

1. BUS ENTRANCE
2. EMERGENCY EXIT (KEPT CLOSED)
3. TEMPORARY BUS CHARGER AND PARKING (2 BUSES)
4. MAINTENANCE VEHICLE PARKING
5. RELOCATED EV PARKING AREA
6. GUEST PARKING
7. POV GARAGE ENTRY/EXIT
8. BUS/YARD VEHICLE EXIT

LEGEND

- NEW TRANSFORMER
- PROPERTY LINE
- 3' WIDE GANTRY SUPPORT AREA
- 6' WIDE GANTRY SUPPORT & CHARGER AREA
- CHARGING DISPENSERS OR PANTOGRAPH, SUSPENDED FROM STRUCTURE ABOVE
- POTENTIAL CHARGER GANTRY LOCATION (5 GANTRIES/5 BUS SPAN, 5 GANTRIES/4 BUS SPAN)
- 40' BUS PARKING (56 SPACES/54 REQUIRED)
- DIRECTION OF TRAFFIC

0 60' 120'

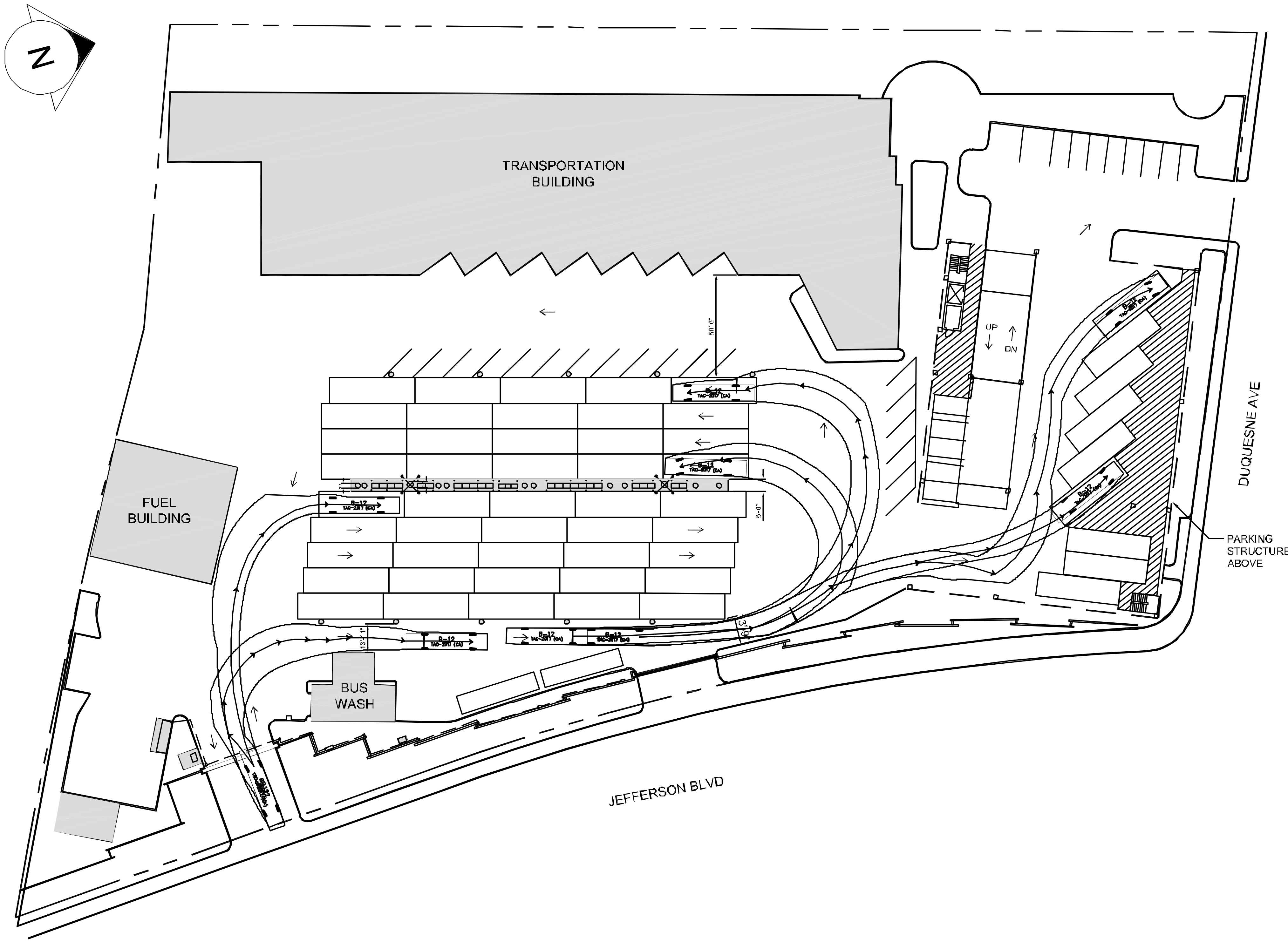
AECOM

SHEET A-3

SITE PLAN
OPTION 3B
YARD W/ OVERHEAD GANTRIES

CULVER CITY ZERO-EMISSIONBUS TRANSITION PLAN
CULVER CITYBUS
9815 JEFFERSON BLVD., CULVER CITY, CA
Project No.: 60650368
Date: 2021-09-08

Culver CITYBUS



KEYNOTES

1. BUSES IN THIS BLOCK ARE ORIENTED AS THEY ARE IN THE CURRENT YARD, WITH THE UPPER HALF FACING THE FUEL BUILDING TO THE SOUTH, AND THE LOWER HALF FACING DUQUESNE AVE TO THE NORTH.
2. BUSES IN THIS BLOCK MUST EXIT TO DUQUESNE AVE AND RE-ENTER THE SITE FROM JEFFERSON, IN ORDER TO ACCESS THE MAINTENANCE BAYS OR BUS WASH.

CIRCULATION PLAN - OPTION 3B

SCALE: 1" = 60'

0 60' 120'

AECOM
SHEET A-4

SITE PLAN
OPTION 3B
YARD CIRCULATION

CULVER CITY ZERO-EMISSIONBUS TRANSITION PLAN
CULVER CITYBUS
9815 JEFFERSON BLVD., CULVER CITY, CA
Project No.: 60650368
D Date: 2021-09-08

Culver CITYBUS

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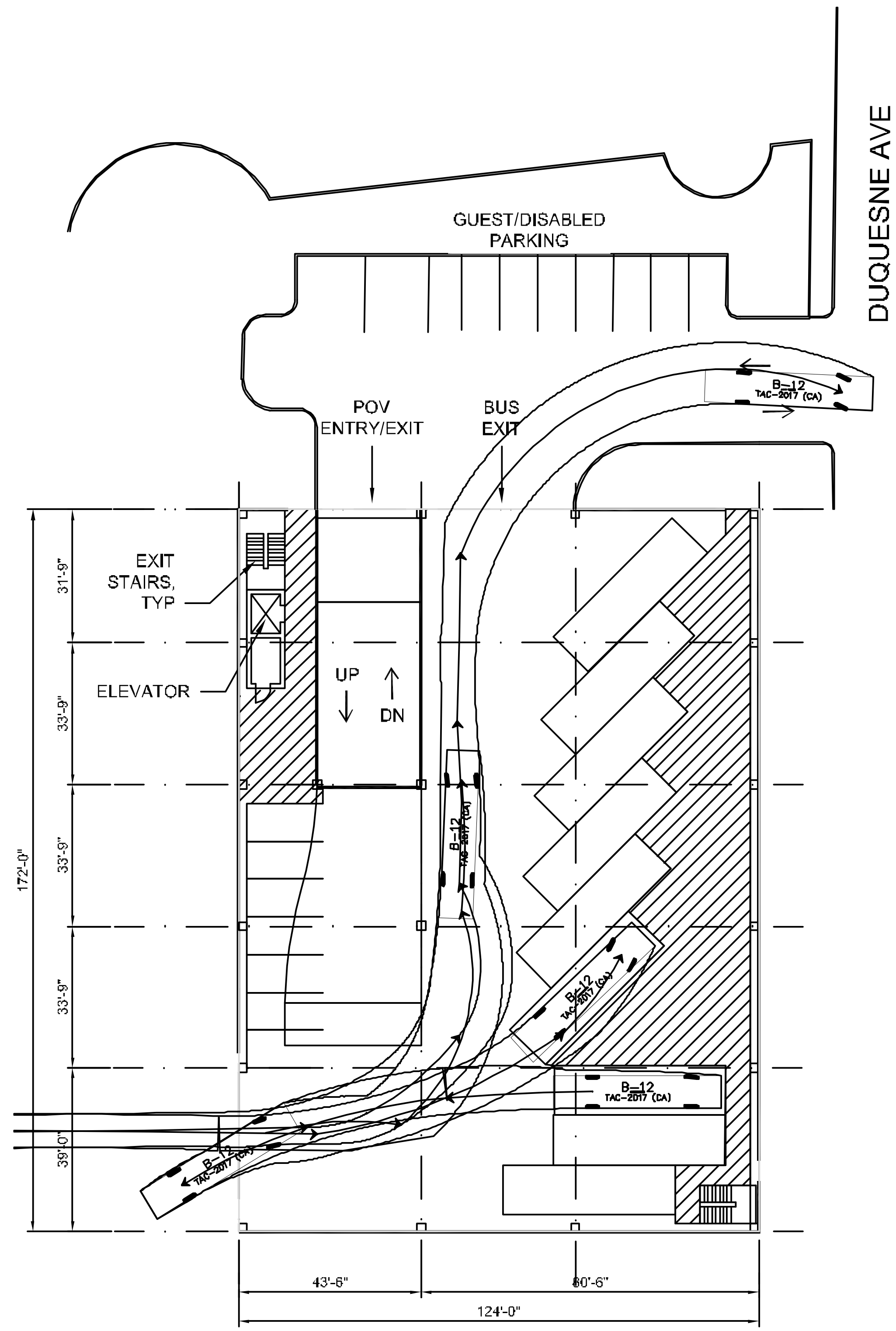
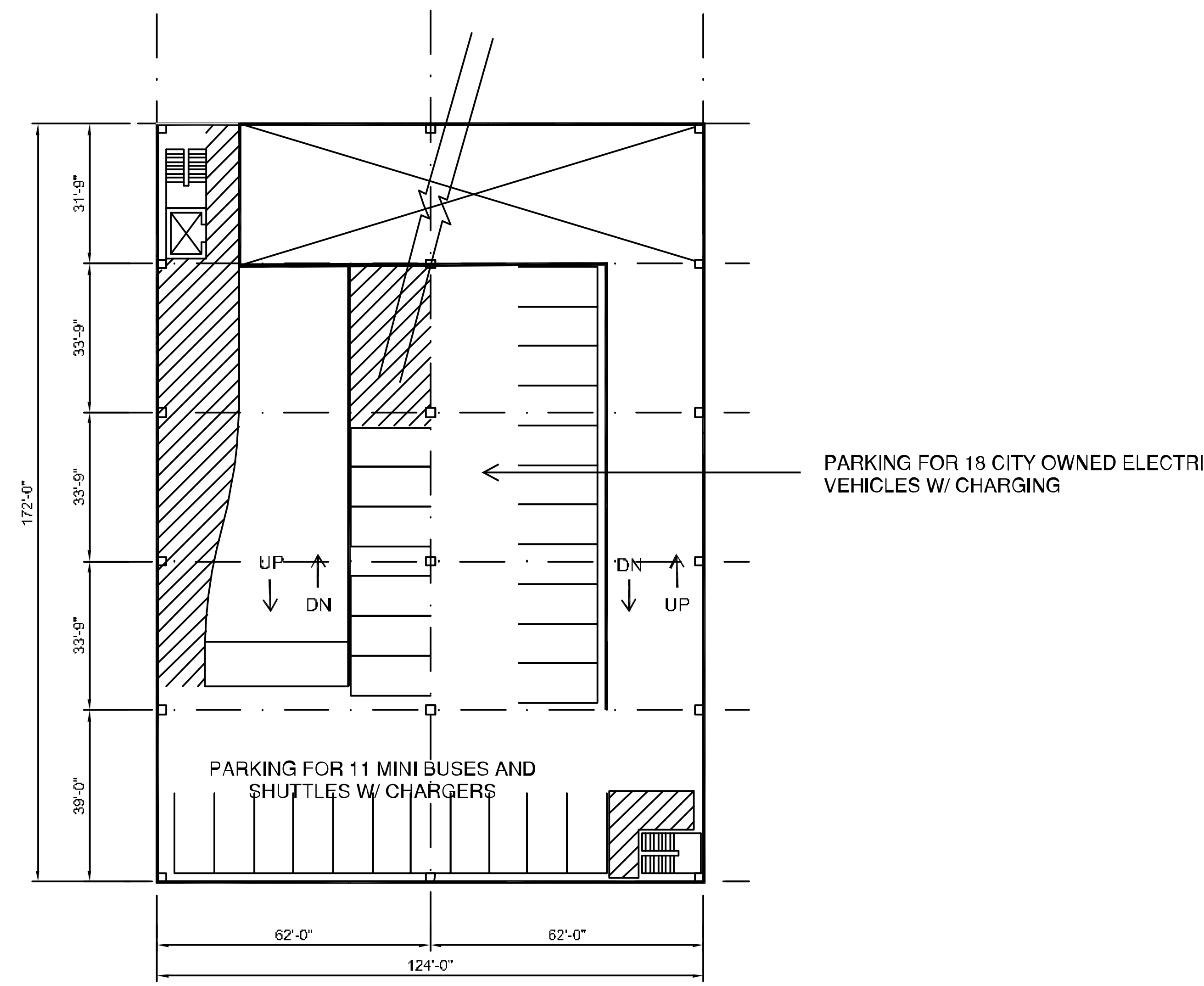


1ST LEVEL (GROUND)
9 SPACES



SECOND LEVEL
28 SPACES

NEW PARKING STRUCTURE PLANS (202 SPACES)

SCALE: 1" = 40'

0 40' 80'

PARKING STRUCTURE PLANS

CULVER CITY ZERO-EMISSIONBUS TRANSITION PLAN
CULVER CITYBUS
9815 JEFFERSON BLVD., CULVER CITY, CA
Project No.: 60650368
Date: 2021-09-08

AECOM
SHEET A-5

Culver CITYBUS

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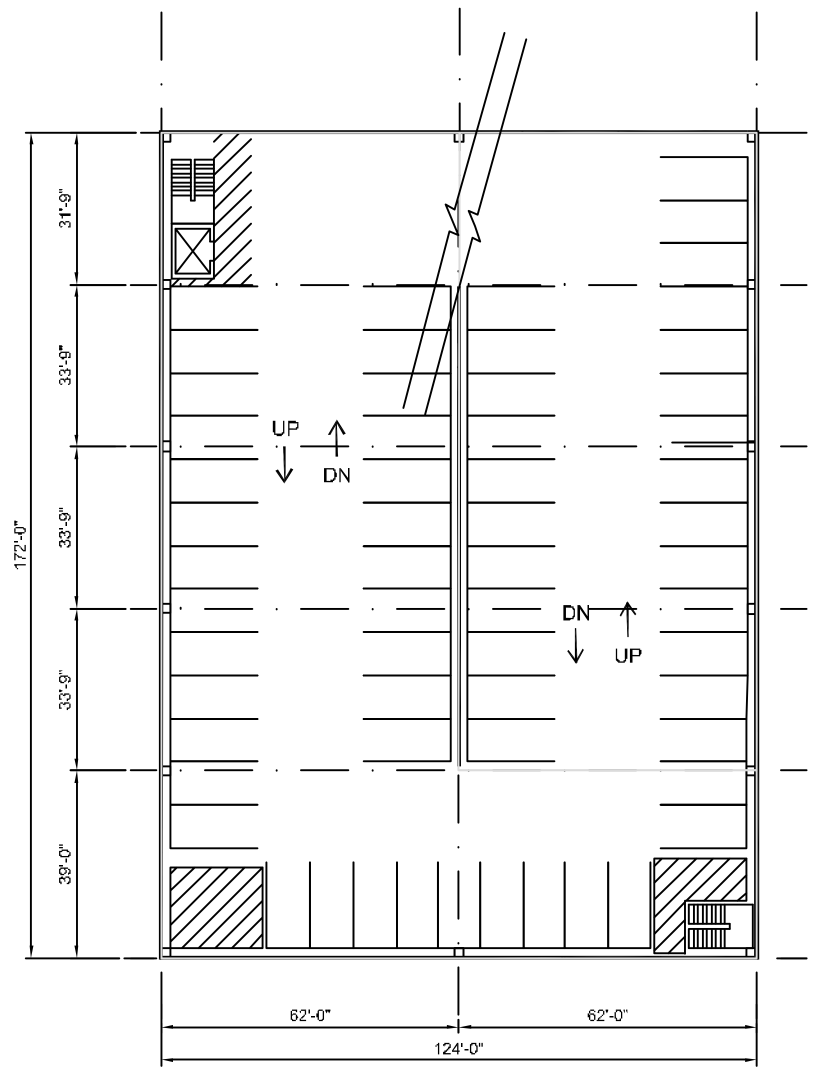
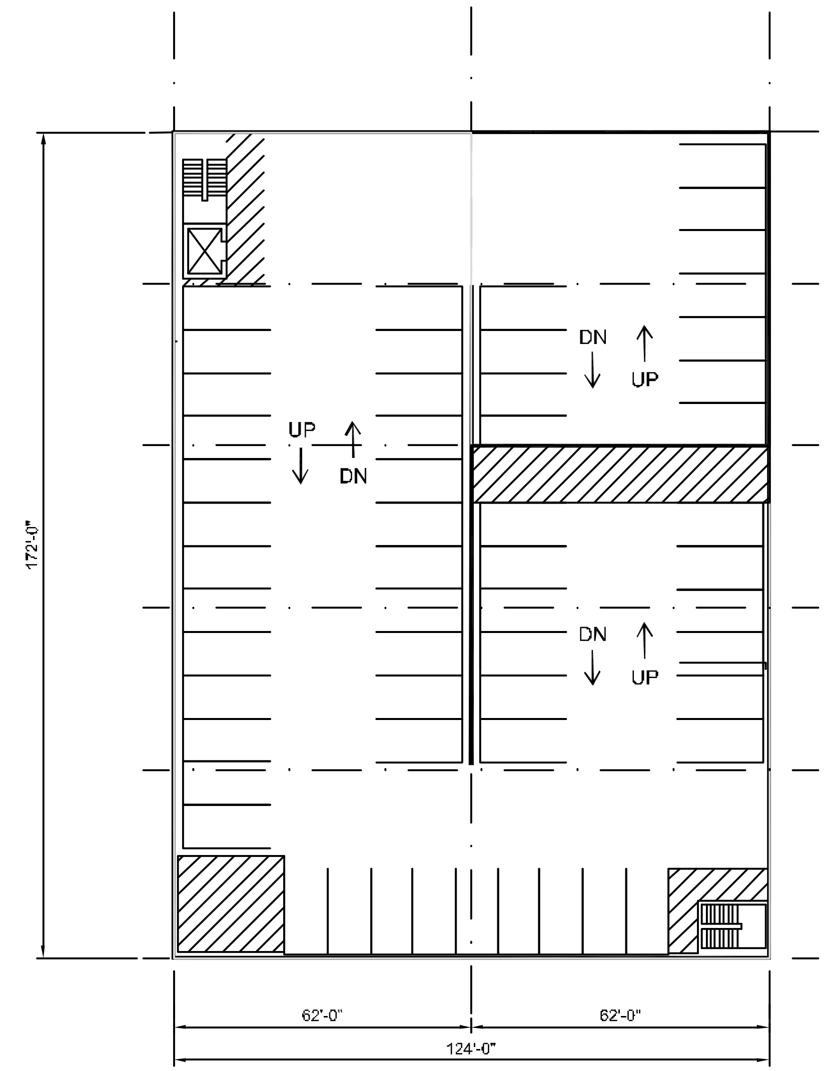


SECOND & THIRD LEVEL
60 SPACES



ROOF LEVEL (ALT)
45 SPACES
(202 SPACES TOTAL)

NEW PARKING STRUCTURE PLANS (202 SPACES)

SCALE: 1" = 40'

0 40' 80'

PARKING STRUCTURE PLANS

CULVER CITY ZERO-EMISSIONBUS TRANSITION PLAN
CULVER CITYBUS
9815 JEFFERSON BLVD., CULVER CITY, CA
Project No.: 60650368
Date: 2021-09-08

AECOM
SHEET A-6

Culver CITYBUS

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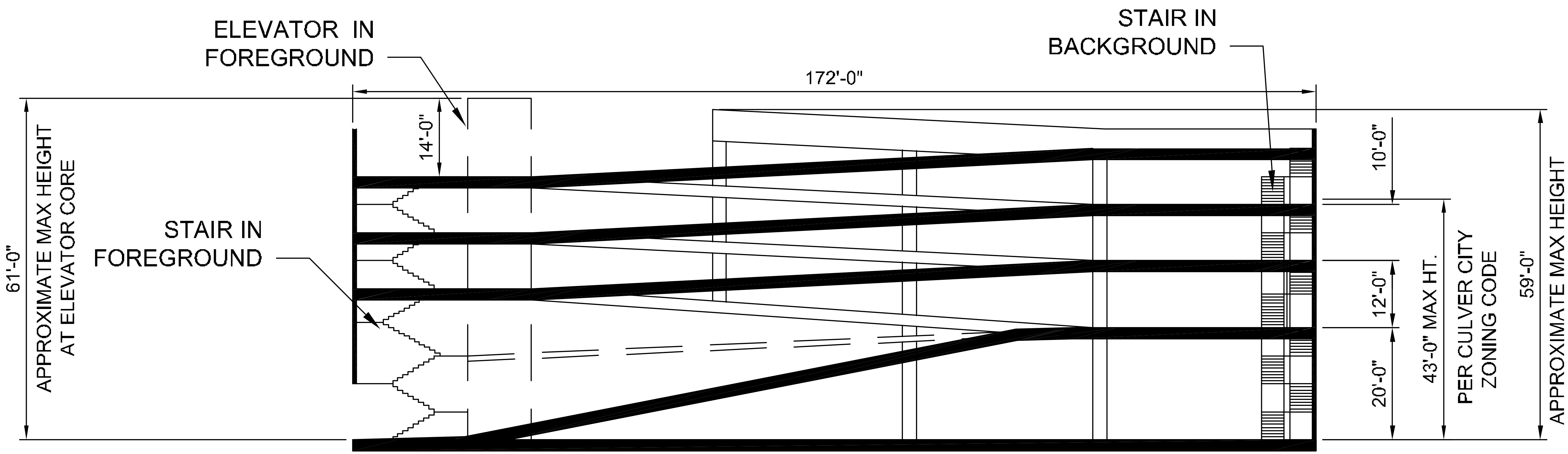

NEW PARKING STRUCTURE BUILDING SECTION

SCALE: 1" = 20'

0 40' 80'

PARKING STRUCTURE BUILDING SECTION

CULVER CITY ZERO-EMISSIONBUS TRANSITION PLAN
CULVER CITYBUS
9815 JEFFERSON BLVD., CULVER CITY, CA
Project No.: 60650368
Date: 2021-09-08

AECOM

Drawing: A-7

Culver CITYBUS

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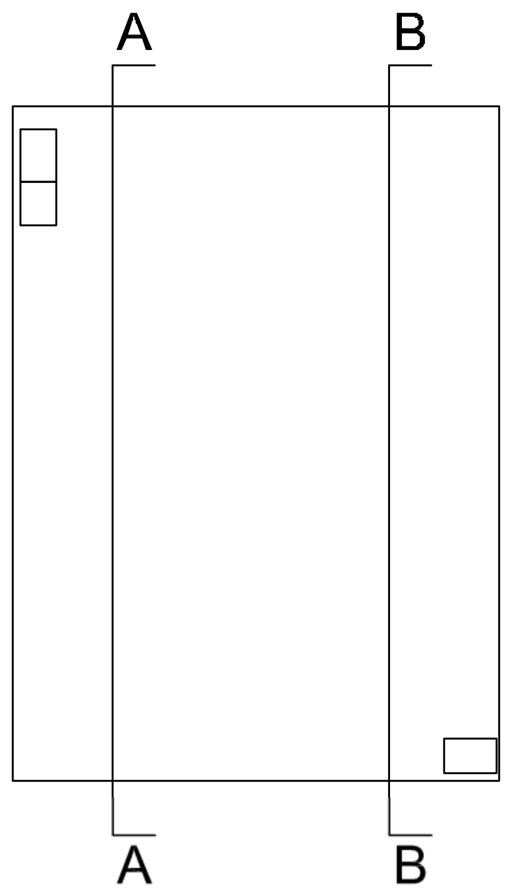
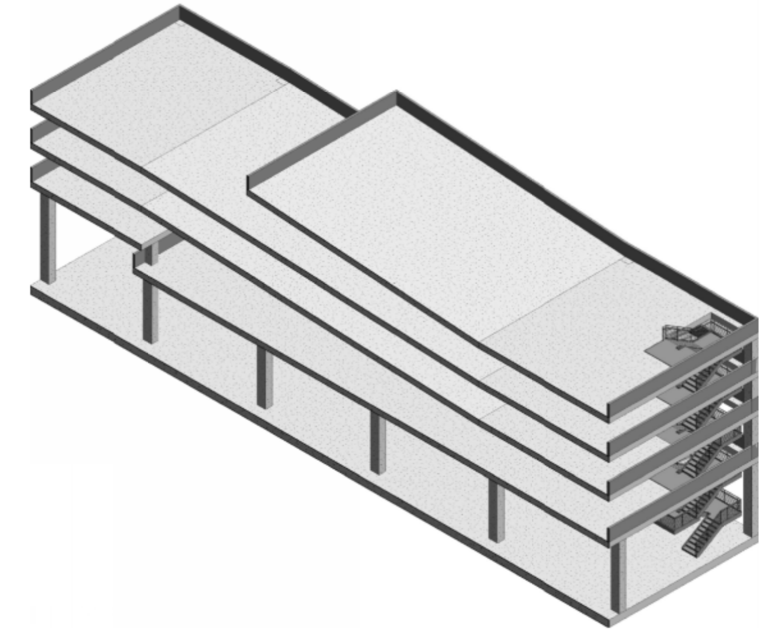
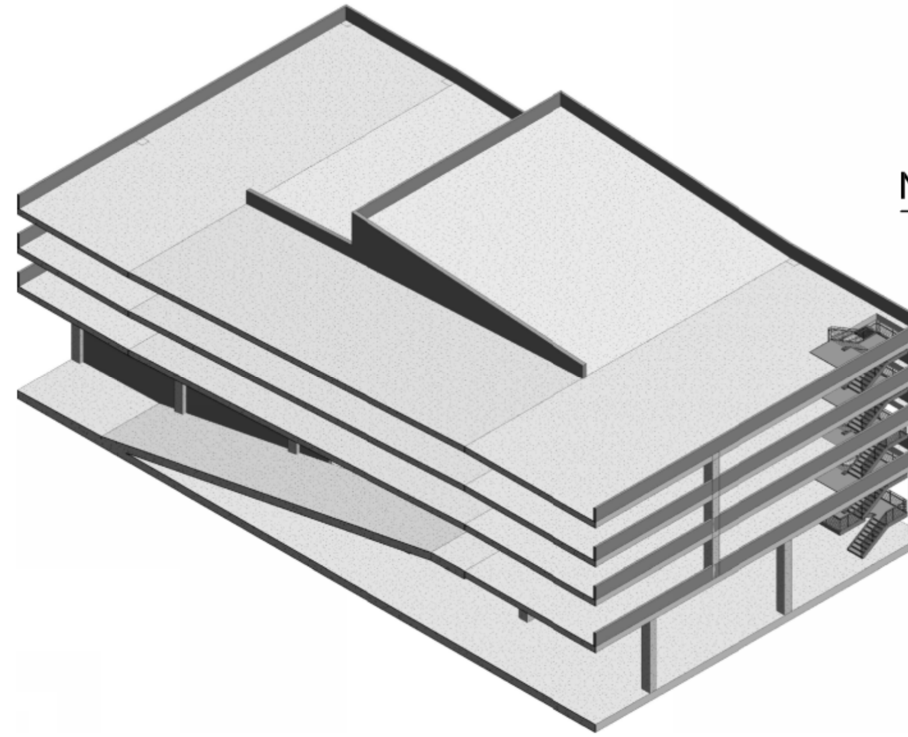




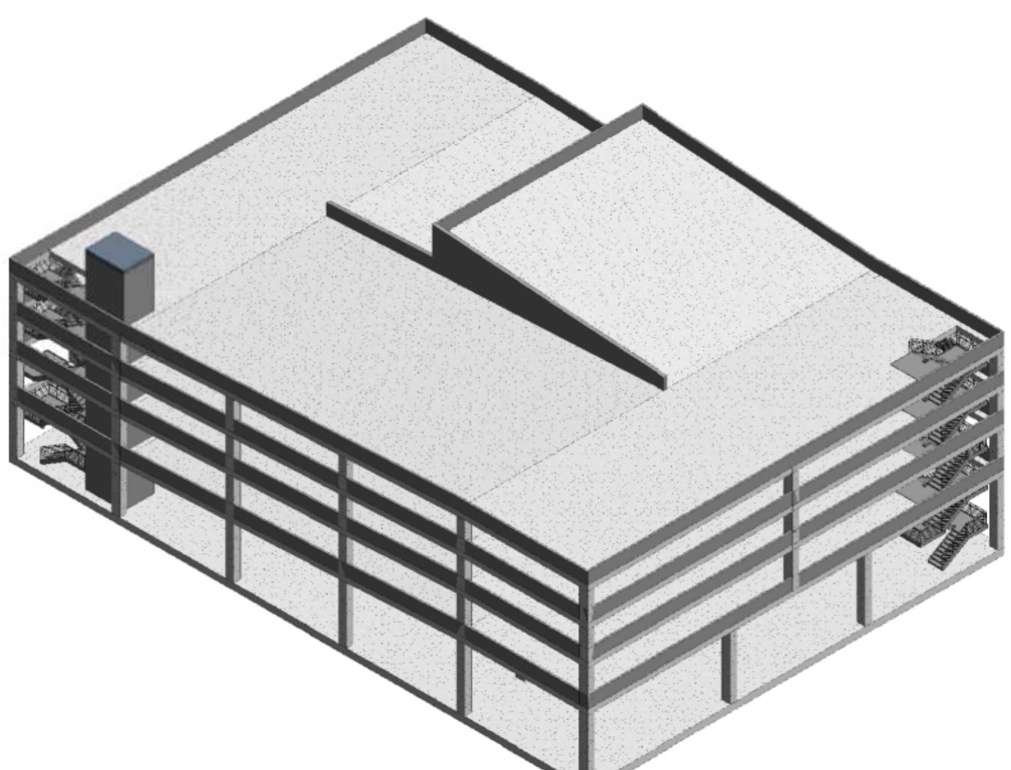
NEW PARKING STRUCTURE - 3D SECTION B

SCALE: NTS



NEW PARKING STRUCTURE - 3D SECTION A

SCALE: NTS



NEW PARKING STRUCTURE WHOLE BUILDING 3D VIEW

SCALE: NTS

AECOM

Drawing: A-8

3D VIEW

CULVER CITY ZERO-EMISSIONBUS TRANSITION PLAN
CULVER CITYBUS
9815 JEFFERSON BLVD., CULVER CITY, CA
Project No.: 60650368
Date: 2021-09-08

Culver CITYBUS

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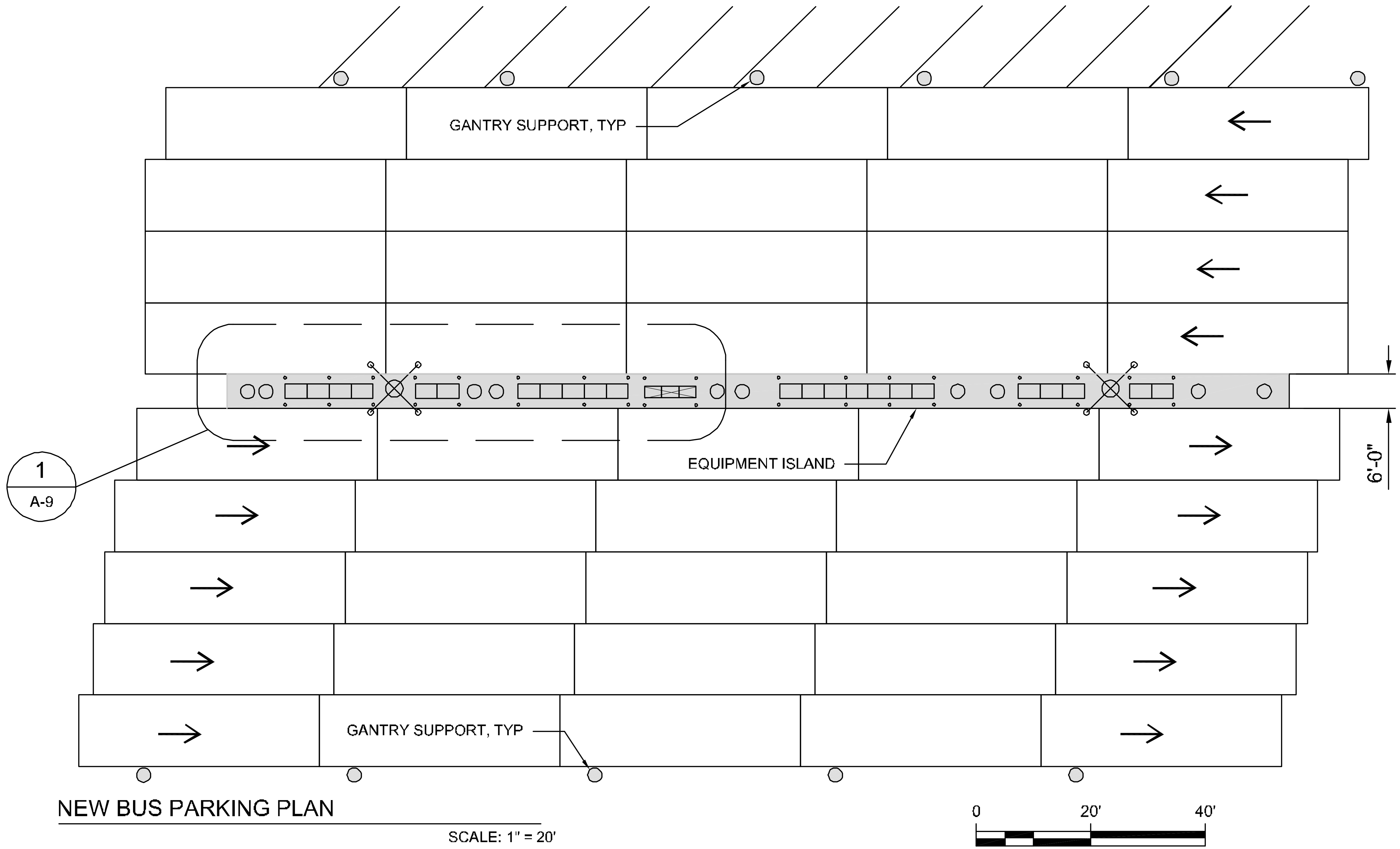
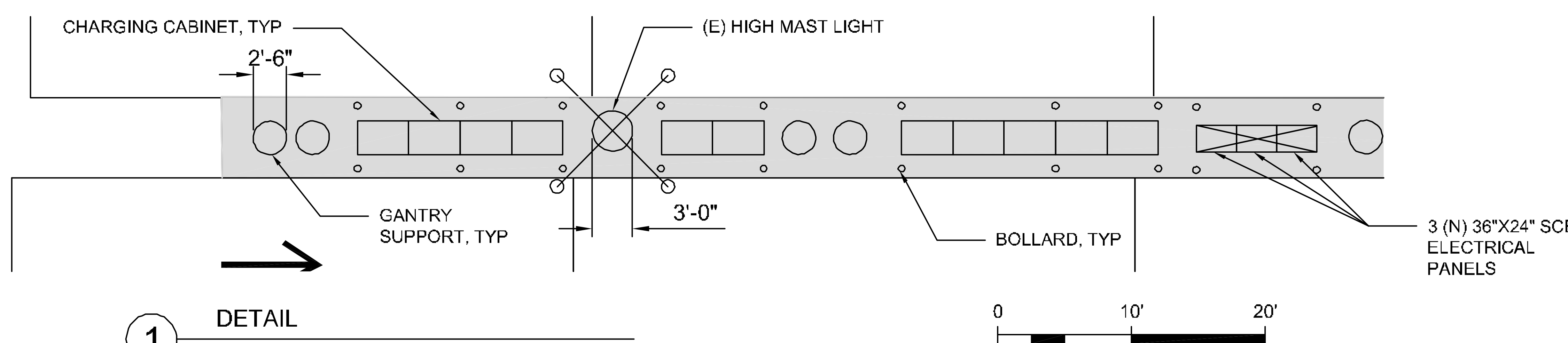


NEW BUS PARKING PLAN

SCALE: 1" = 20'



1 DETAIL

SCALE: 1" = 10'

CHARGING ISLAND DETAIL

AECOM

Drawing: A-9

CULVER CITY ZERO-EMISSIONBUS TRANSITION PLAN
CULVER CITYBUS
9815 JEFFERSON BLVD., CULVER CITY, CA
Project No.: 60650368
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Culver CITYBUS

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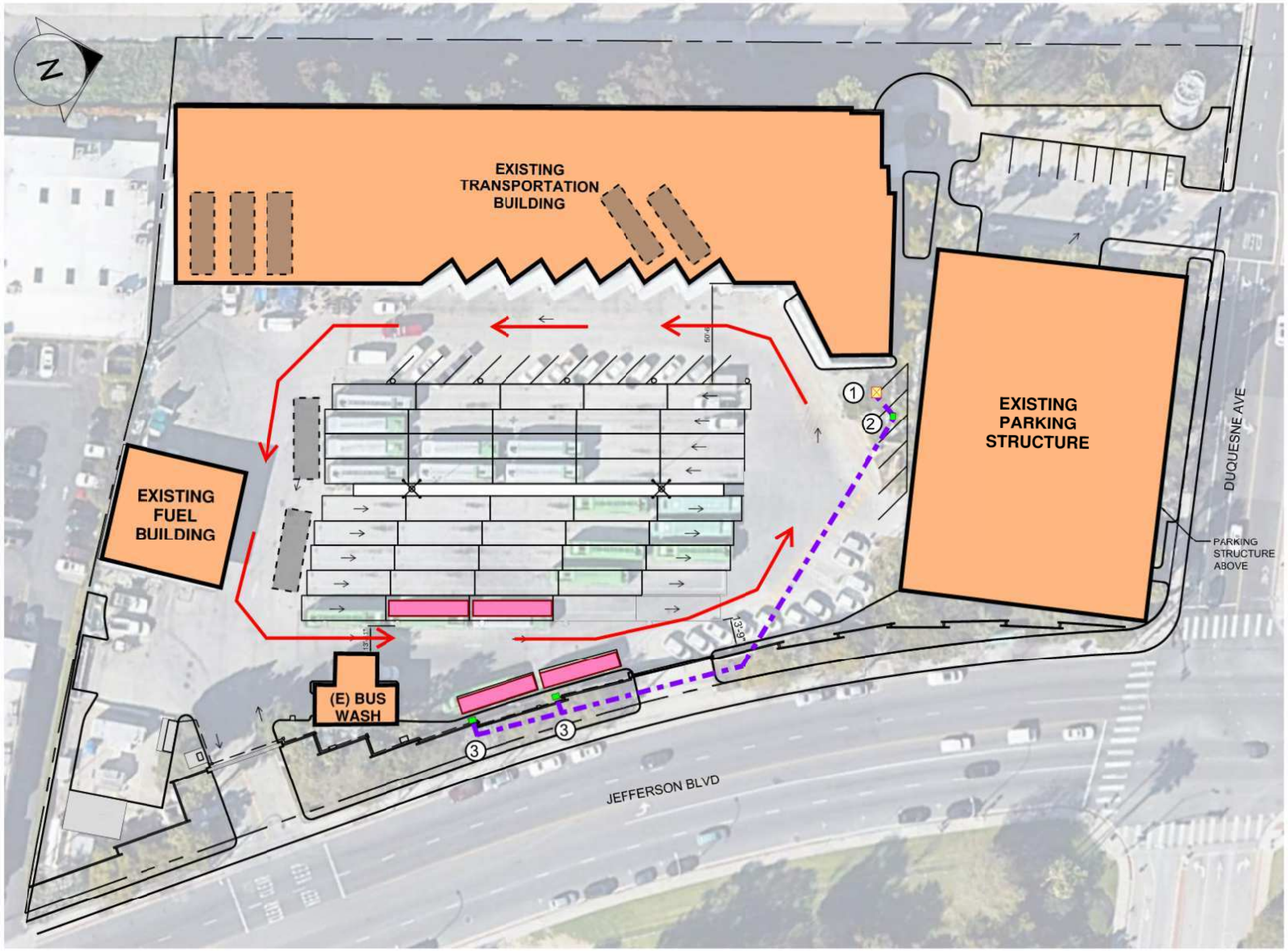


PILOT PHASE - TEMPORARY INFRASTRUCTURE

2020 - 2021 / 4 BEBs

SCALE: 1" = 60'

KEYNOTES

1. EXISTING UTILITY TRANSFORMER
2. HVC 150 CHARGING CABINET
3. DEPOT BOX CHARGER DISPENSERS

LEGEND

- NEW OR EXISTING TRANSFORMER
- 3' WIDE GANTRY SUPPORT AREA
- 6' WIDE GANTRY SUPPORT & CHARGER ISLAND
- CHARGING DISPENSERS OR CABLE, SUSPENDED FROM STRUCTURE ABOVE
- POTENTIAL CHARGER GANTRY LOCATION (5 GANTRIES/5 BUS SPAN, 5 GANTRIES/4 BUS SPAN)
- ELECTRIC BUS PARKING SPACE
- EXIST. RCNG BUS PARKING SPACE
- OVERFLOW PARKING SPACES FOR EXIST. RCNG BUSES
- ELECTRICAL CONDUIT/DUCTBANK INSTALLED UNDER THIS PHASE
- DIRECTION OF TRAFFIC

BUS FLEET COUNT

BEBs	4
EXIST. RCNG BUSES	50
TOTAL	54

0 60' 120'

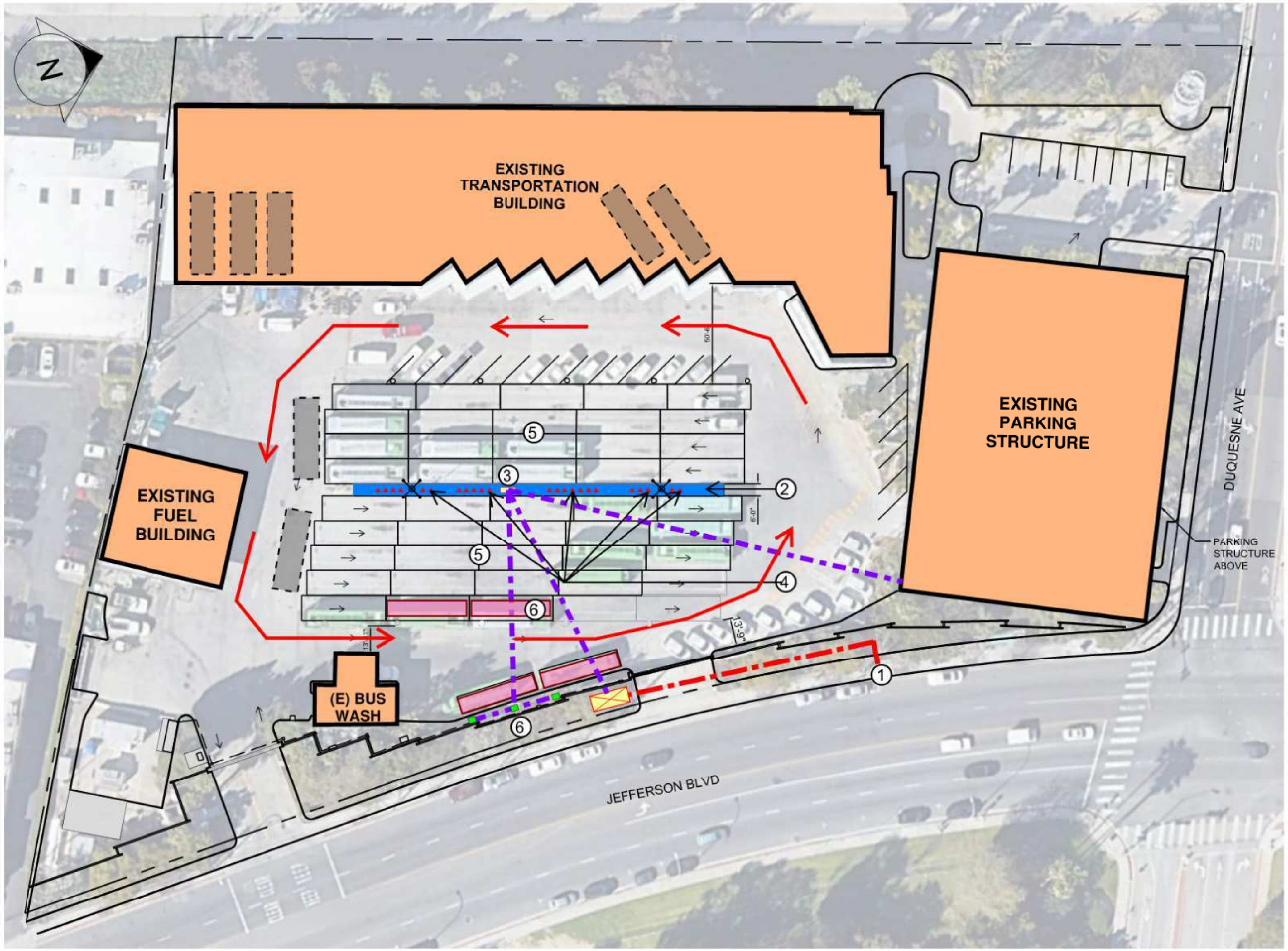
AECOM

SHEET P - 1

PHASING PLAN
PILOT PHASE

CULVER CITY ZERO-EMISSIONBUS TRANSITION PLAN
CULVER CITYBUS
9815 JEFFERSON BLVD., CULVER CITY, CA
Project No.: 60650368
Date: 2021-08-09

Culver CITYBUS



PHASE 1A - ELECTRICAL / CIVIL INFRASTRUCTURE

2021 - 2022 / 4 BEBs

SCALE: 1" = 60'

KEYNOTES

1. EXISTING UTILITY POWER POLE
2. REMOVE EXISTING CNG DISPENSERS AND BOLLARDS AT EXISTING PAINTED ISLAND. ABANDON BELOW GRADE PIPING, CAPPED AND SEALED
3. NEW UTILITY SWITCHGEAR/PANEL WITH CAPACITY FOR FUTURE CHARGER LOAD LOCATED ON THE CENTER OF NEW RAISED CONCRETE ISLAND
4. NEW POWER STUB OUTS FOR FUTURE CHARGING CABINETS BETWEEN EXISTING HIGH MAST LIGHT POLES AND FOUNDATIONS TO REMAIN
5. RESTRIPE BUS PARKING SPACES TO 12'-0" WIDE (FROM 12'-6")
6. RELOCATE PILOT PHASE CHARGING CABINET AND CONNECT PERMANENT POWER SUPPLY

LEGEND

- NEW OR EXISTING TRANSFORMER
- 3' WIDE GANTRY SUPPORT AREA
- 6' WIDE GANTRY SUPPORT & CHARGER ISLAND
- CHARGING CABINET/DISPENSERS OR CABLE, SUSPENDED FROM STRUCTURE ABOVE
- POTENTIAL CHARGER GANTRY LOCATION (5 GANTRIES/5 BUS SPAN, 5 GANTRIES/4 BUS SPAN)
- ELECTRIC BUS PARKING SPACE
- EXIST. RCNG BUS PARKING SPACE
- OVERFLOW PARKING SPACES FOR EXIST. RCNG BUSES
- ELECTRICAL CONDUIT/DUCTBANK INSTALLED UNDER THIS PHASE
- ELECTRICAL FEED FROM SCE
- ELECTRICAL STUB UP FOR FUTURE CHARGING CABINETS
- DIRECTION OF TRAFFIC

BUS FLEET COUNT

BEBs	4
EXIST. RCNG BUSES	50
TOTAL	54

0 60' 120'

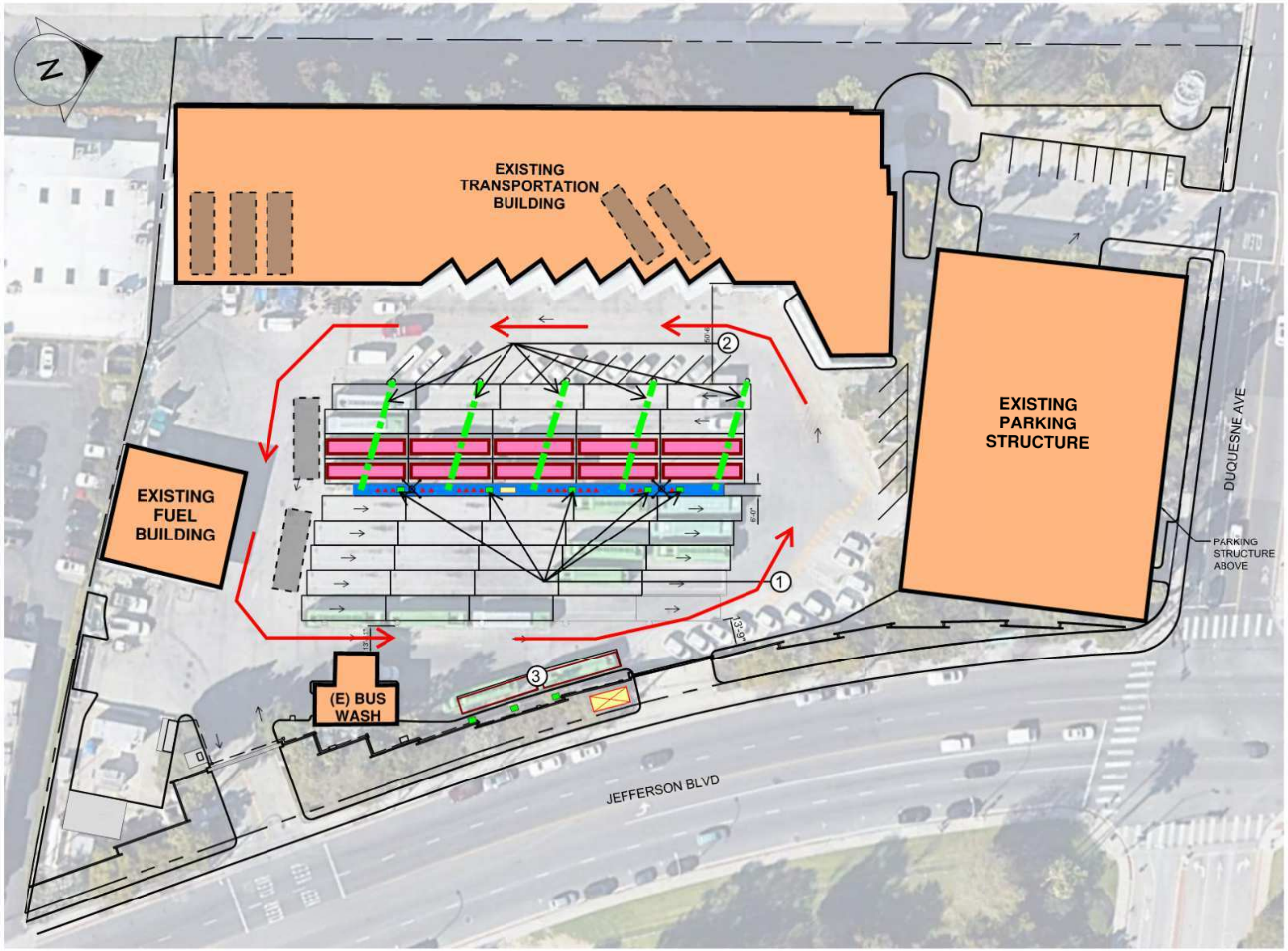
AECOM

SHEET P - 2

PHASING PLAN
PHASE 1A

CULVER CITY ZERO-EMISSIONBUS TRANSITION PLAN
CULVER CITYBUS
9815 JEFFERSON BLVD., CULVER CITY, CA
Project No.: 60650368
Date: 2021-08-09

Culver CITYBUS



PHASE 1B - ELECTRICAL / CHARGER & GANTRY INSTALLATION (IN YARD)

2021 - 2022 / 10 BEBs

SCALE: 1" = 60'

KEYNOTES

1. 5 NEW HVC 150 CHARGING CABINETS
2. 10 NEW DEPOT BOX CHARGER DISPENSERS MOUNTED ON 5 NEW OVERHEAD GANTRY STRUCTURES
3. THE TWO PILOT PHASE BEB CHARGER, DISPENSERS AND PARKING SPACES NOW BECOME BACKUP IF THE PRIMARY CHARGERS/DISPENSERS GO DOWN (MAINTENANCE)

LEGEND

- NEW OR EXISTING TRANSFORMER
- 3' WIDE GANTRY SUPPORT AREA
- 6' WIDE GANTRY SUPPORT & CHARGER ISLAND
- CHARGING CABINET/DISPENSERS OR CABLE, SUSPENDED FROM STRUCTURE ABOVE
- POTENTIAL CHARGER GANTRY LOCATION (5 GANTRIES/5 BUS SPAN, 5 GANTRIES/4 BUS SPAN)
- ELECTRIC BUS PARKING SPACE
- EXIST. RCNG BUS PARKING SPACE
- OVERFLOW PARKING SPACES FOR EXIST. RCNG BUSES
- ELECTRICAL CONDUIT/DUCTBANK INSTALLED UNDER THIS PHASE
- ELECTRICAL FEED FROM SCE
- ELECTRICAL STUB UP FOR FUTURE CHARGING CABINETS
- DIRECTION OF TRAFFIC

BUS FLEET COUNT

BEBs	10
EXIST. RCNG BUSES	44
TOTAL	54

0 60' 120'

AECOM

SHEET P - 3

PHASING PLAN
PHASE 1B

CULVER CITY ZERO-EMISSIONBUS TRANSITION PLAN
CULVER CITYBUS
9815 JEFFERSON BLVD., CULVER CITY, CA
Project No.: 60650368
Date: 2021-08-09

Culver CITYBUS

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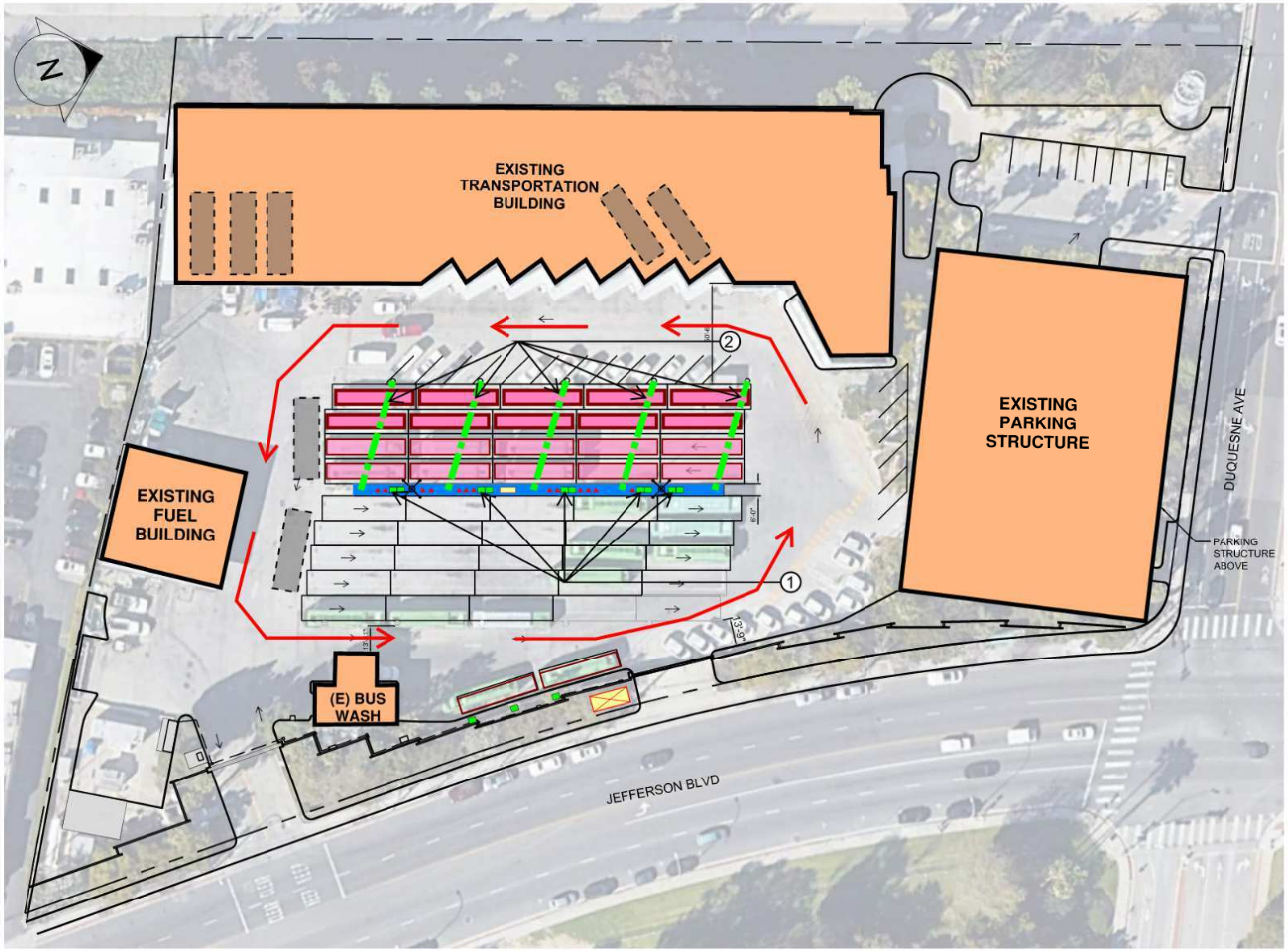


PHASE 2 - ADDITIONAL CHARGER INSTALLATION (YARD)

2024 / 20 BEBs

SCALE: 1" = 60'

KEYNOTES

1. 5 NEW HVC 150 CHARGING CABINETS
2. 10 ADDITIONAL NEW DEPOT BOX CHARGER DISPENSERS MOUNTED ON OVERHEAD GANTRY STRUCTURES INSTALLED IN PHASE 1A

LEGEND

- NEW OR EXISTING TRANSFORMER
- 3' WIDE GANTRY SUPPORT AREA
- 6' WIDE GANTRY SUPPORT & CHARGER ISLAND
- CHARGING CABINET/DISPENSERS OR CABLE, SUSPENDED FROM STRUCTURE ABOVE
- POTENTIAL CHARGER GANTRY LOCATION (5 GANTRIES/5 BUS SPAN, 5 GANTRIES/4 BUS SPAN)
- ELECTRIC BUS PARKING SPACE
- EXIST. RCNG BUS PARKING SPACE
- OVERFLOW PARKING SPACES FOR EXIST. RCNG BUSES
- ELECTRICAL CONDUIT/DUCTBANK INSTALLED UNDER THIS PHASE
- ELECTRICAL FEED FROM SCE
- ELECTRICAL STUB UP FOR FUTURE CHARGING CABINETS
- DIRECTION OF TRAFFIC

BUS FLEET COUNT

BEBs	20
EXIST. RCNG BUSES	34
TOTAL	54

0 60' 120'

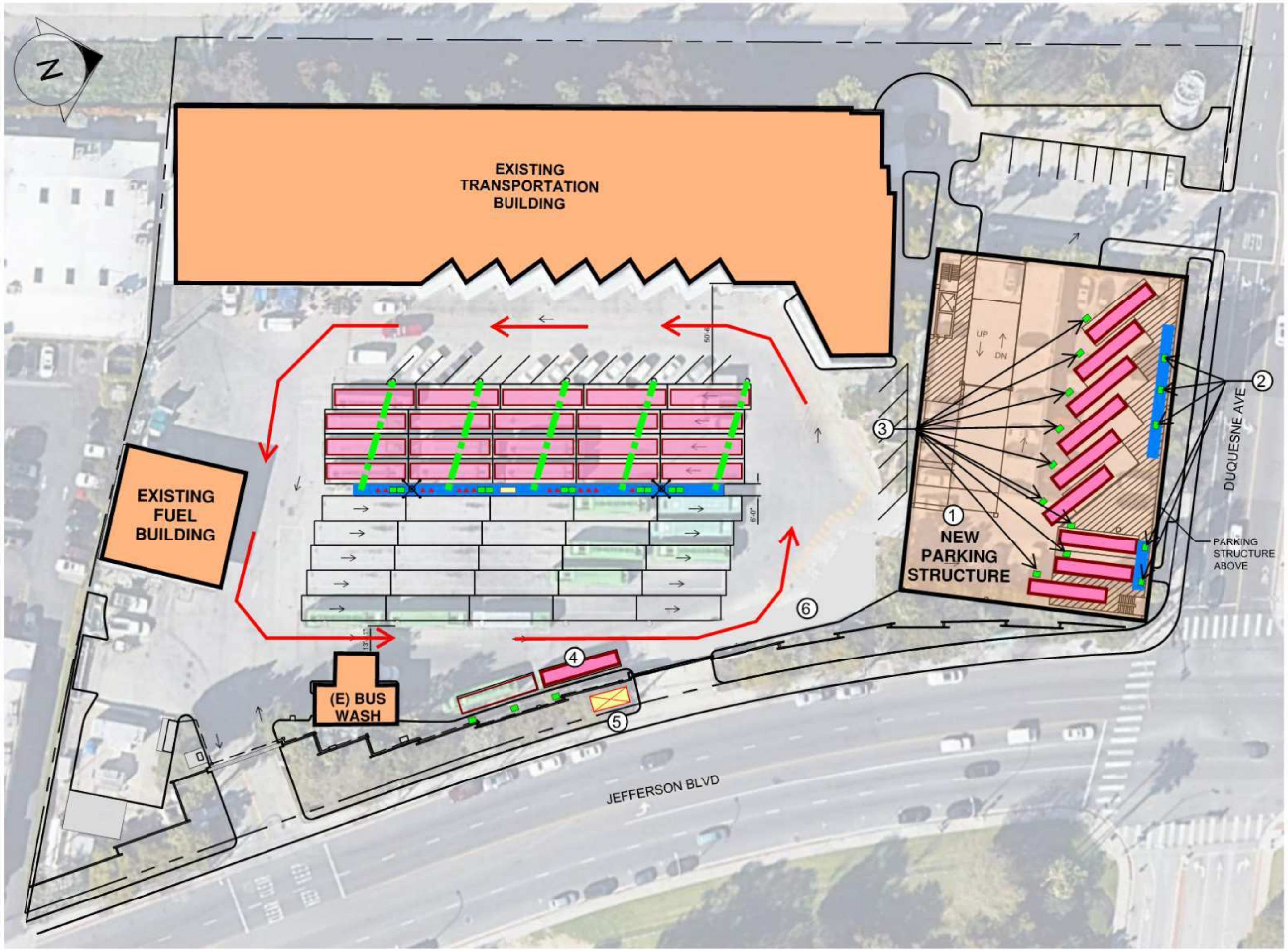
AECOM

SHEET P - 4

PHASING PLAN
PHASE 2

CULVER CITY ZERO-EMISSIONBUS TRANSITION PLAN
CULVER CITYBUS
9815 JEFFERSON BLVD., CULVER CITY, CA
Project No.: 60650368
Date: 2021-08-09

Culver CITYBUS



PHASE 3 - ADDITIONAL CHARGER & GANTRY INSTALLATION / REBUILD GARAGE

2025 / 30 BEBs

SCALE: 1" = 60'

KEYNOTES

1. DEMOLISH EXISTING PARKING STRUCTURE AND REPLACE WITH NEW STRUCTURE TO PROVIDE BUS PARKING/CHARGING ON THE GROUND LEVEL AND ACCESS TO UPPER FLOORS FOR PARATRANSIT BUSES AND AUTOMOBILES.
2. 5 NEW HVC 150 CHARGING CABINETS (IN PARKING STRUCTURE)
3. 9 ADDITIONAL NEW DEPOT BOX CHARGER DISPENSERS MOUNTED ON CEILING OF PARKING STRUCTURE
4. UTILIZE CHARGER/DISPENSER FROM PHASE 1A FOR 10TH NEW BUS
5. POSSIBLE UPGRADE TO UTILITY TRANSFORMER AND SWITCHGEAR (TO BE DETERMINED BY SCE)
6. RELOCATE EXISTING EVs INTO PARKING GARAGE

LEGEND

- NEW OR EXISTING TRANSFORMER
- 3' WIDE GANTRY SUPPORT AREA
- 6' WIDE GANTRY SUPPORT & CHARGER ISLAND
- CHARGING DISPENSERS OR CABLE, SUSPENDED FROM STRUCTURE ABOVE
- POTENTIAL CHARGER GANTRY LOCATION (5 GANTRIES/5 BUS SPAN, 5 GANTRIES/4 BUS SPAN)
- ELECTRIC BUS PARKING SPACE
- EXIST. RCNG BUS PARKING SPACE
- ELECTRICAL CONDUIT/DUCTBANK INSTALLED UNDER THIS PHASE
- DIRECTION OF TRAFFIC

0 60' 120'

BUS FLEET COUNT

BEBs	30
EXIST. RCNG BUSES	24
TOTAL	54

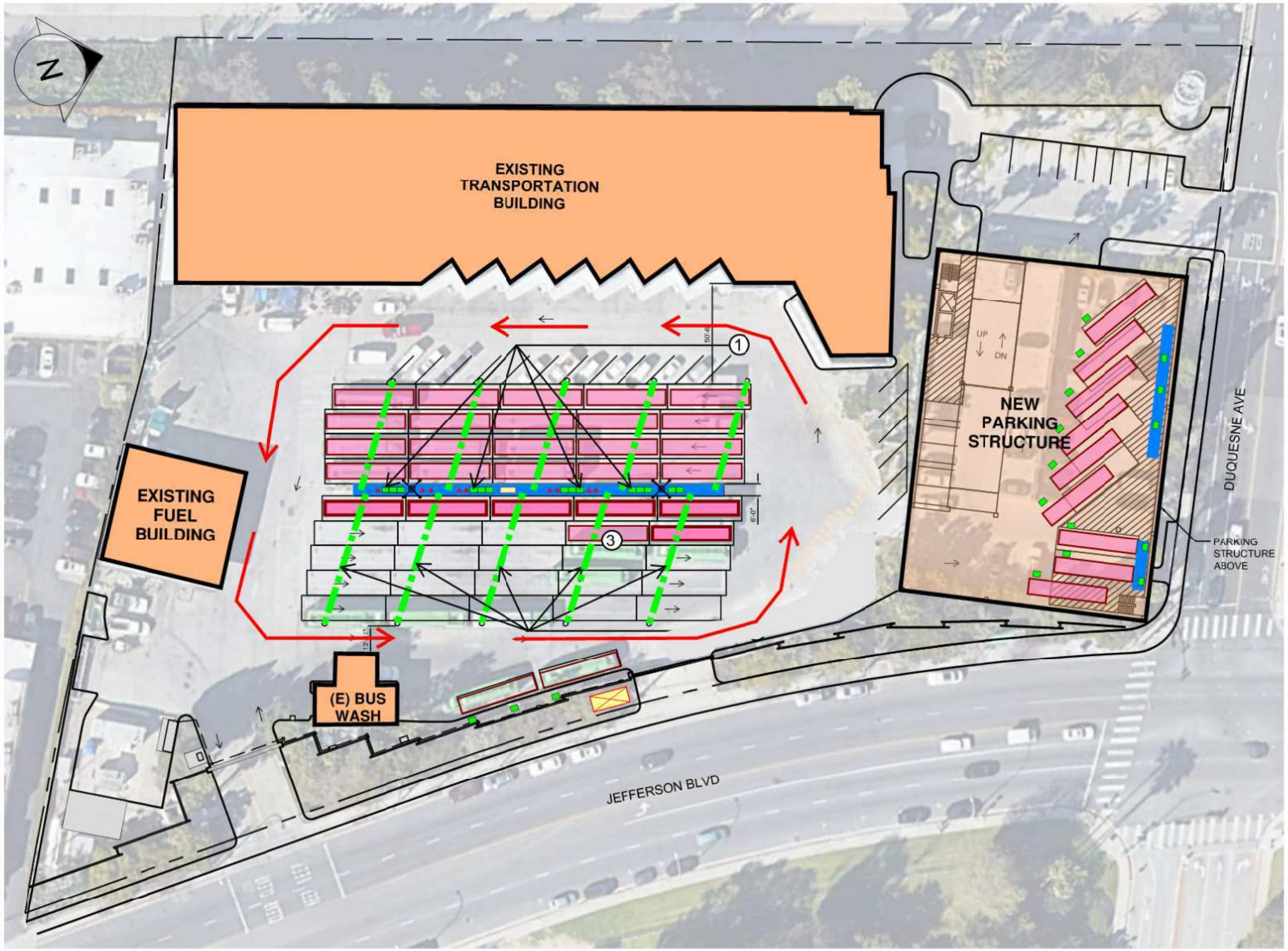
AECOM

SHEET P - 5

PHASING PLAN
PHASE 3

CULVER CITY ZERO-EMISSIONBUS TRANSITION PLAN
CULVER CITYBUS
9815 JEFFERSON BLVD., CULVER CITY, CA
Project No.: 60650368
Date: 2021-08-09

Culver CITYBUS



PHASE 4 - ADDITIONAL CHARGER INSTALLATION (YARD)

2026 / 36 BEBs

SCALE: 1" = 60'

KEYNOTES

1. 4 NEW HVC 150 CHARGING CABINETS
2. 7 ADDITIONAL NEW DEPOT BOX CHARGER DISPENSERS MOUNTED ON 5 NEW OVERHEAD GANTRY STRUCTURES INSTALLED IN PHASE 3
3. BEB FROM PHASE 3 (10TH BUS) MOVED TO YARD BLOCK FROM TEMP CHARGER SPOT

LEGEND

- NEW OR EXISTING TRANSFORMER
- 3' WIDE GANTRY SUPPORT AREA
- 6' WIDE GANTRY SUPPORT & CHARGER ISLAND
- CHARGING DISPENSERS OR CABLE, SUSPENDED FROM STRUCTURE ABOVE
- POTENTIAL CHARGER GANTRY LOCATION (5 GANTRIES/5 BUS SPAN, 5 GANTRIES/4 BUS SPAN)
- ELECTRIC BUS PARKING SPACE
- EXIST. RCNG BUS PARKING SPACE
- ELECTRICAL CONDUIT/DUCTBANK INSTALLED UNDER THIS PHASE
- DIRECTION OF TRAFFIC

BUS FLEET COUNT

BEBs	36
EXIST. RCNG BUSES	18
TOTAL	54

0 60' 120'

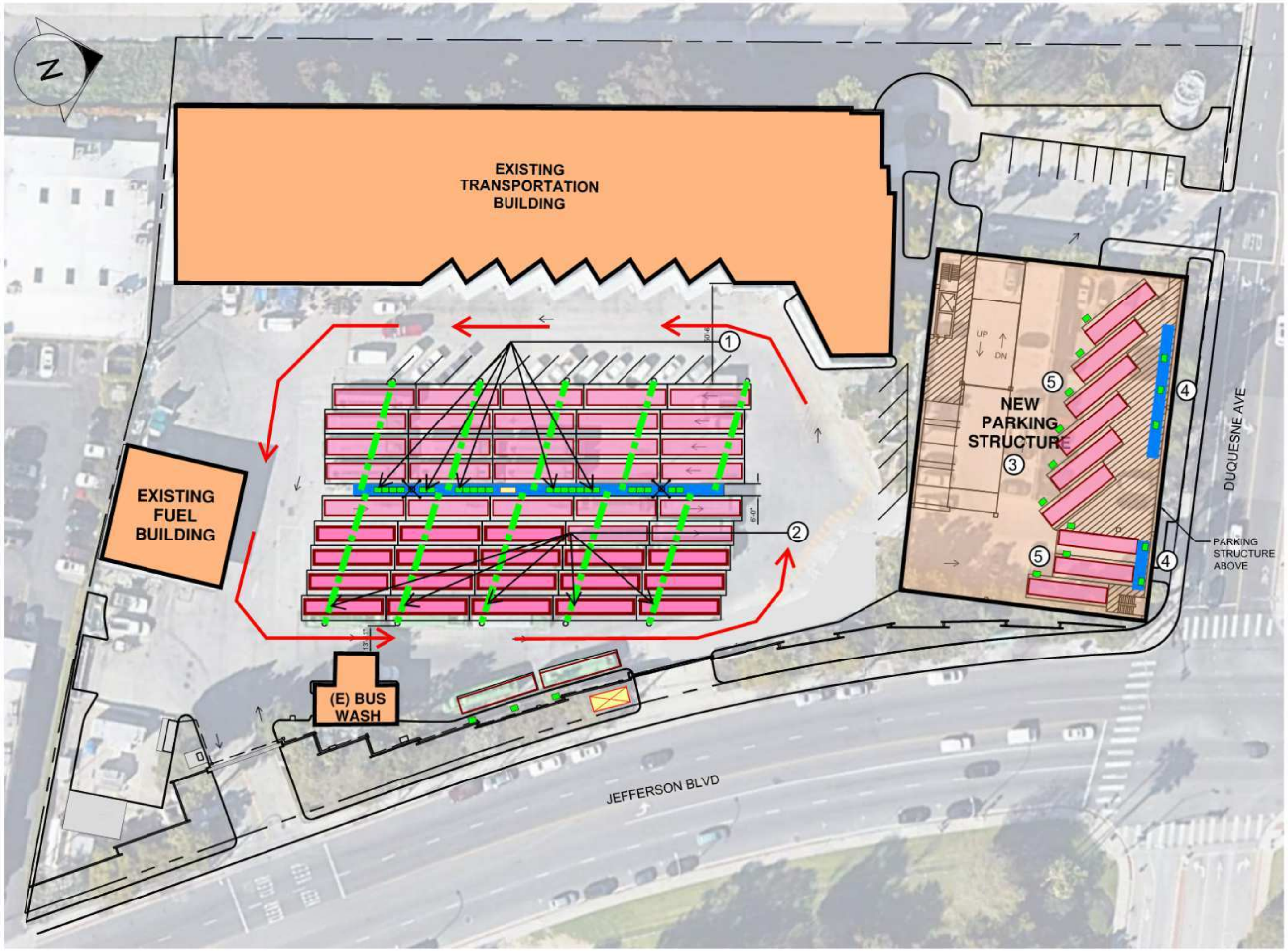
AECOM

SHEET P - 6

PHASING PLAN
PHASE 4

CULVER CITY ZERO-EMISSIONBUS TRANSITION PLAN
CULVER CITYBUS
9815 JEFFERSON BLVD., CULVER CITY, CA
Project No.: 60650368
Date: 2021-08-09

Culver CITYBUS



PHASE 5 - REMAINING CHARGER INSTALLATION (YARD) (FINAL BUILDOUT)

2028 / 54 BEBs

SCALE: 1" = 60'

KEYNOTES

1. 9 NEW HVC 150 CHARGING CABINETS (IN YARD)
2. 18 ADDITIONAL NEW DEPOT BOX CHARGER DISPENSERS MOUNTED ON OVERHEAD GANTRY STRUCTURES INSTALLED IN PHASE 3
3. DEMOLISH EXISTING PARKING STRUCTURE AND REPLACE WITH NEW STRUCTURE TO PROVIDE BUS PARKING/CHARGING ON THE GROUND LEVEL AND ACCESS TO UPPER FLOORS FOR PARATRANSIT BUSES AND AUTOMOBILES.
4. 4 NEW HVC 150 CHARGING CABINETS (IN PARKING STRUCTURE)
5. 7 ADDITIONAL NEW DEPOT BOX CHARGER DISPENSERS MOUNTED ON CEILING OF PARKING STRUCTURE

LEGEND

- NEW OR EXISTING TRANSFORMER
- 3' WIDE GANTRY SUPPORT AREA
- 6' WIDE GANTRY SUPPORT & CHARGER ISLAND
- CHARGING DISPENSERS OR CABLE, SUSPENDED FROM STRUCTURE ABOVE
- POTENTIAL CHARGER GANTRY LOCATION (5 GANTRIES/5 BUS SPAN, 5 GANTRIES/4 BUS SPAN)
- ELECTRIC BUS PARKING SPACE
- EXIST. RCNG BUS PARKING SPACE
- ELECTRICAL CONDUIT/DUCTBANK INSTALLED UNDER THIS PHASE
- DIRECTION OF TRAFFIC

0 60' 120'

BUS FLEET COUNT

BEBs	54
EXIST. RCNG BUSES	0
TOTAL	54

AECOM

SHEET P - 7

PHASING PLAN
PHASE 5

CULVER CITY ZERO-EMISSIONBUS TRANSITION PLAN
CULVER CITYBUS
9815 JEFFERSON BLVD., CULVER CITY, CA
Project No.: 60650368
Date: 2021-08-09

Culver CITYBUS

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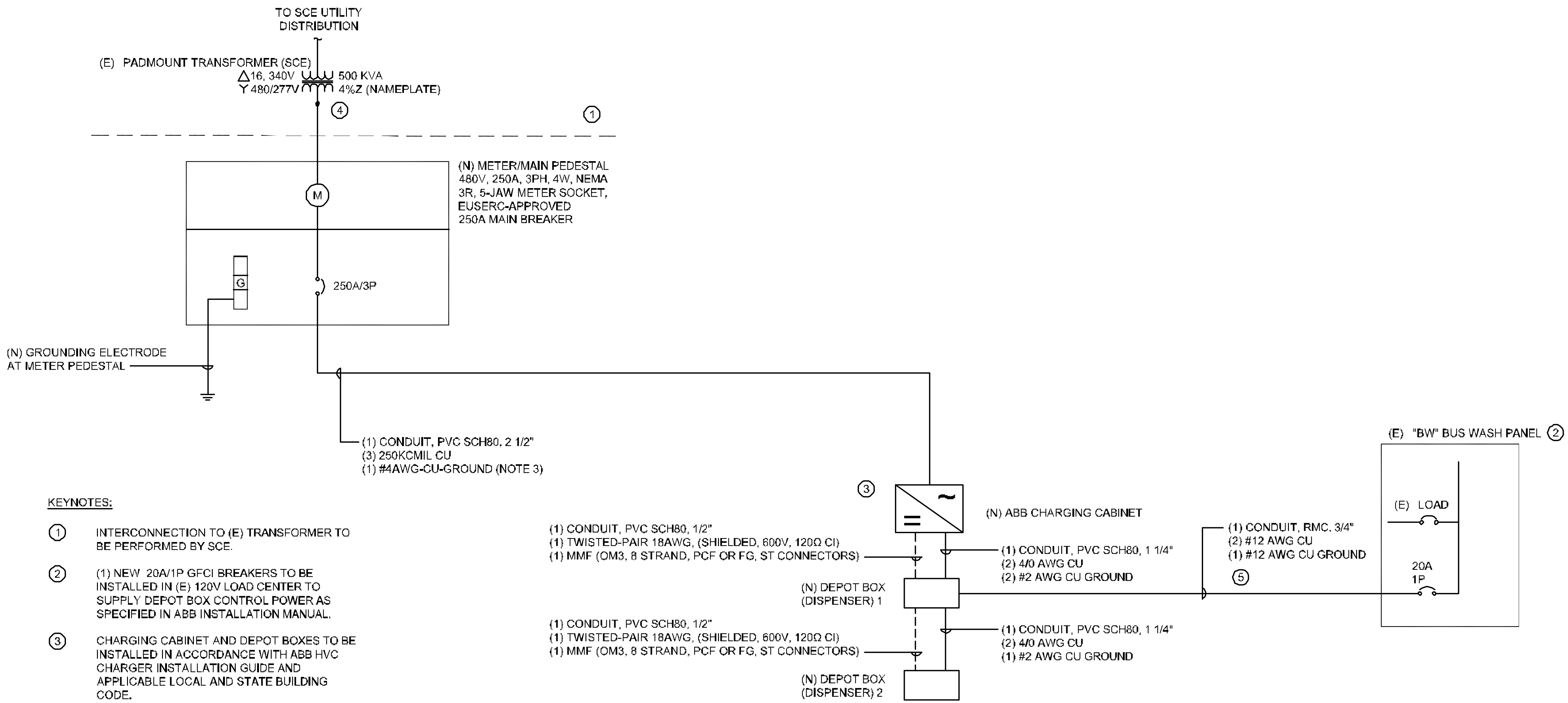
THIS IS A CONCEPTUAL LINE DIAGRAM BASED ON THE ELECTRICAL ASSESSMENT OF THE CCB FACILITY AND UNAPPROVED DRAFT SINGLE LINE DRAWINGS. THIS SHOULD NOT BE USED FOR CONSTRUCTION.



KEYNOTES:

1. INTERCONNECTION TO (E) TRANSFORMER TO BE PERFORMED BY SCE.
2. (1) NEW 20A/1P GFCI BREAKERS TO BE INSTALLED IN (E) 120V LOAD CENTER TO SUPPLY DEPOT BOX CONTROL POWER AS SPECIFIED IN ABB INSTALLATION MANUAL.
3. CHARGING CABINET AND DEPOT BOXES TO BE INSTALLED IN ACCORDANCE WITH ABB HVC CHARGER INSTALLATION GUIDE AND APPLICABLE LOCAL AND STATE BUILDING CODE.

   CONTRACTOR TO COORDINATE WITH UTILITY TO ENSURE SECONDARY LUGS ARE AVAILABLE AND PROVIDE NECESSARY EQUIPMENT FOR INTERCONNECTION. VERIFICATION OF CAPACITY HAS ALREADY BEEN VERIFIED BY ENGINEER.
5. DEPOT BOXES TO BE DAISY-CHAINED WITH AUXILIARY CONTROL POWER FROM (E) BUS WASH PANEL AS INDICATED ON PAGE 47 OF ABB INSTALLATION MANUAL.

ELECTRICAL SINGLE LINE DIAGRAM
TEMPORARY CHARGING UNIT

AECOM

Drawing: E-1

SINGLE LINE DIAGRAM
TEMPORARY CHARGER

CULVER CITY ZERO-EMISSIONBUS TRANSITION PLAN
CULVER CITYBUS
9815 JEFFERSON BLVD., CULVER CITY, CA
Project No.: 60650368
Date: 2021-09-08

Culver CITYBUS

ANSI B 11" x 17" Approved: BRE Checked: TB Designer: EPB Project Management Initials:
Last saved by: BULLOCKE(2021-08-11) Last Plotted: 2021-08-11
Filename: C:\USERS\BULLOCKE\DESKTOP\000100_CCZEB\CCZEB_SITEPLAN-AERIAL.DWG

ANSI B 11" x 17" Approved: BRE Checked: TB Designer: EPR Project Management Initials:
Last saved by: BULLOCKE(2021-09-08) Last Plotted: 2021-09-08
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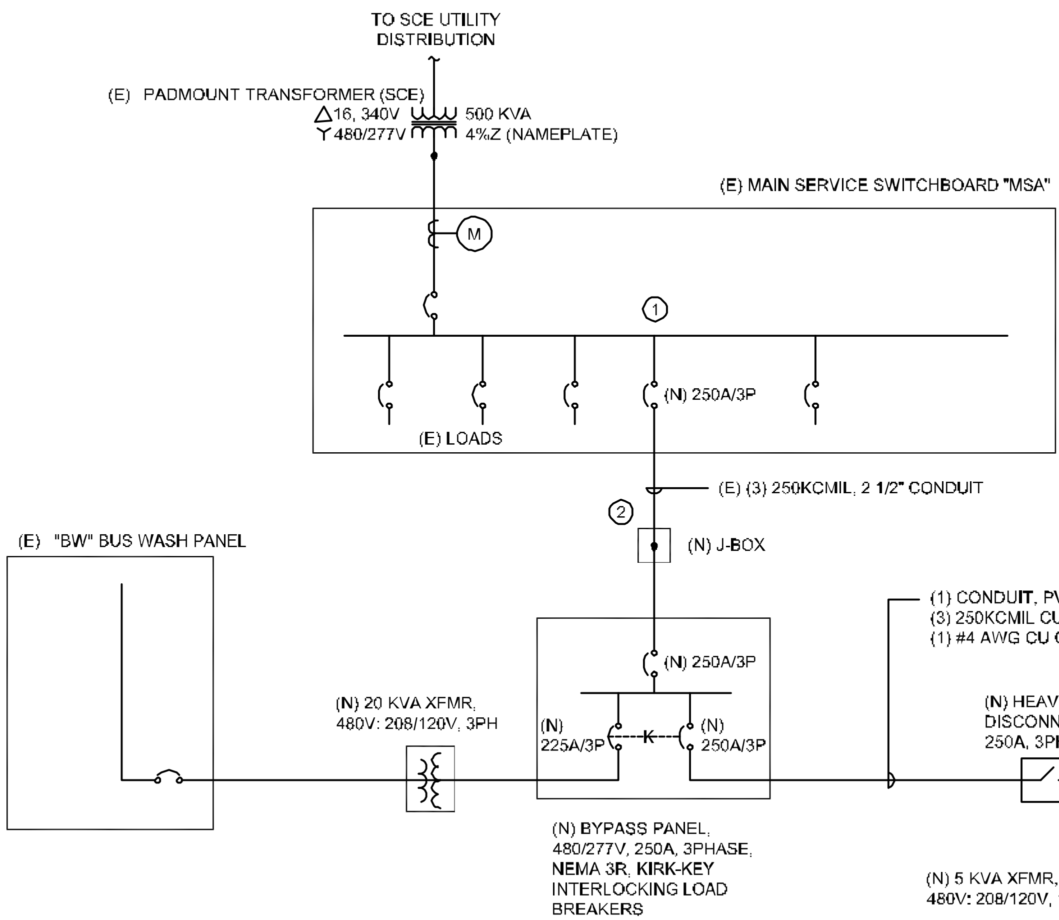
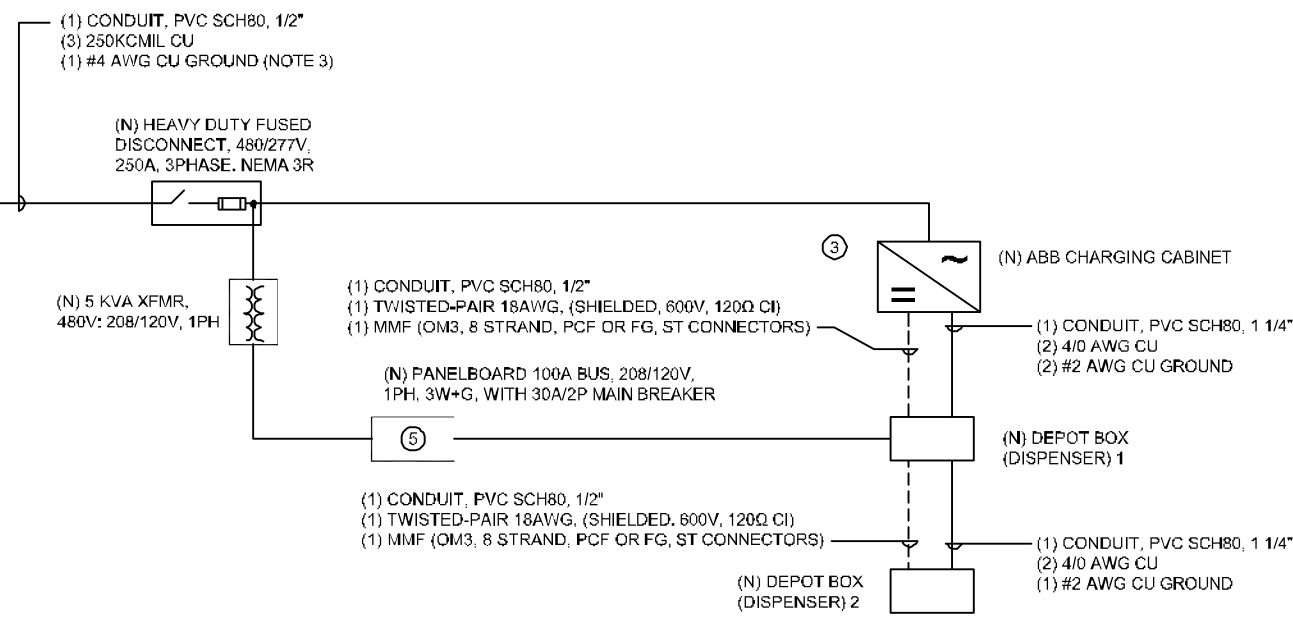




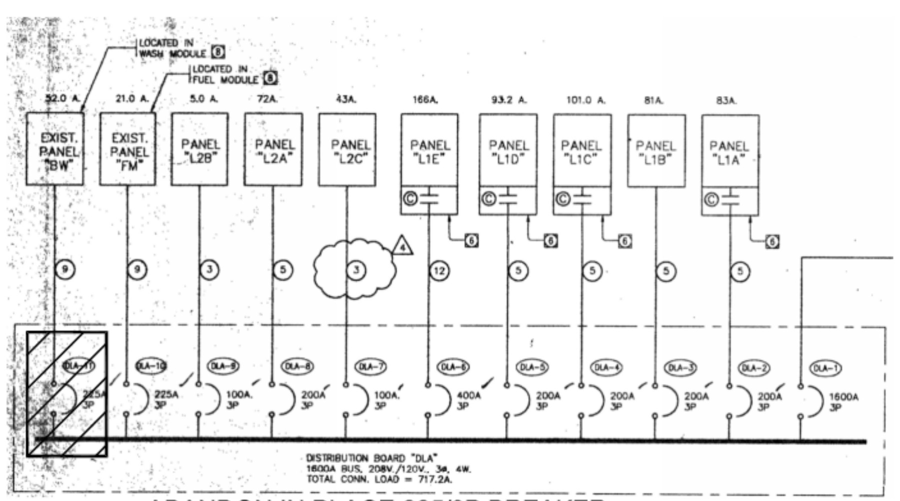
(E) BUS WASH PANEL

NOTE: CHARGING CABINET SHALL NOT BE OPERATED SIMULTANEOUSLY WITH BUS WASH. KIRK KEY INTERLOCKED BYPASS PANEL SHALL ENSURE INDEPENDENT OPERATION ONLY.

NOTE: BUS WASH PANEL PEAK LOAD TO BE CONFIRMED BY CONTRACTOR PRIOR TO INSTALLATION OF EQUIPMENT.

KEYNOTES:

1. (N) BREAKER TO BE INSTALLED IN EXISTING SWITCHBOARD UTILIZING COMPATIBLE EQUIPMENT TO BE APPROVED BY AECOM.
2. FEEDER TO (E) BUS WASH PANEL TO BE INTERCEPTED AND REROUTED TO NEW BYPASS PANEL.
3. CHARGING CABINET AND DEPOT BOXES TO BE INSTALLED IN ACCORDANCE WITH ABB HVC CHARGER INSTALLATION GUIDE AND APPLICABLE LOCAL AND STATE BUILDING CODE.
4. DEPOT BOXES TO BE DAISY-CHAINED WITH AUXILIARY CONTROL POWER FROM (E) BUS WASH PANEL AS INDICATED ON PAGE 47 OF ABB INSTALLATION MANUAL.
5. PROVIDE (3) 20A CIRCUIT BREAKER WITH 30 MA GROUND FAULT CURRENT INTERRUPTING FOR DEPOT BOX. MAX INTERRUPTING CURRENT OF THE BREAKER FRAME SHALL BE 100A FOR 5MS



ABANDON IN PLACE 225/3P BREAKER.

TABLE 2: VOLTAGE DROP CALCULATION

EQUIPMENT FROM	EQUIPMENT TO	VOLTAGE (V)***	PHASE	WIRE SIZE (AWG)	IMPEDANCE (/1000FT)** (?)	DESIGN LOAD (A)*	CIRCUIT LENGTH (FT)	CALCULATED VOLTAGE DROP (V)	VOLTAGE DROP (%)
SWITCHBOARD	CHARGING CABINET	480	3	250 kcmil, CU	0.073	198	450	11.27	2.35%
(N) 1P PANEL	DEPOT BOX 1	120	1	#12 AWG, CU	1.7	2.2	40	0.30	0.25%
BW PANEL	DEPOT BOX 2	120	1	#12 AWG, CU	1.7	2.2	60	0.45	0.37%
CHARGING CABINET	DEPOT BOX 1	300	DC	4/0 AWG, CU	0.0626	50	198	1.24	0.41%

1 PHASE VD%= 2*I(DESIGN LOAD) * Z(CONDUCTOR IMPEDANCE) * L (LENGTH)
3 PHASE VD%= SQRT(3)*I(DESIGN LOAD) * Z(CONDUCTOR IMPEDANCE) * L (LENGTH)
DC VD%= 2*I(DESIGN LOAD) * Z(CONDUCTOR RESISTANCE) * L (LENGTH)

*DESIGN LOAD TAKEN FROM ABB HVC150 CUT SHEET
**IMPEDANCE BASED ON NEC TABLE 9, EFFECTIVE Z AT 0.85 PF FOR UNCOATED COPPER WIRES IN STEEL CONDUIT
***DC CONDUCTOR DESIGN VOLTAGE SET AT 300V PER INSTALLATION MANUAL SUFFICIENT WORST CASE ASSUMPTION

Issue Status: DRAFT

AECOM

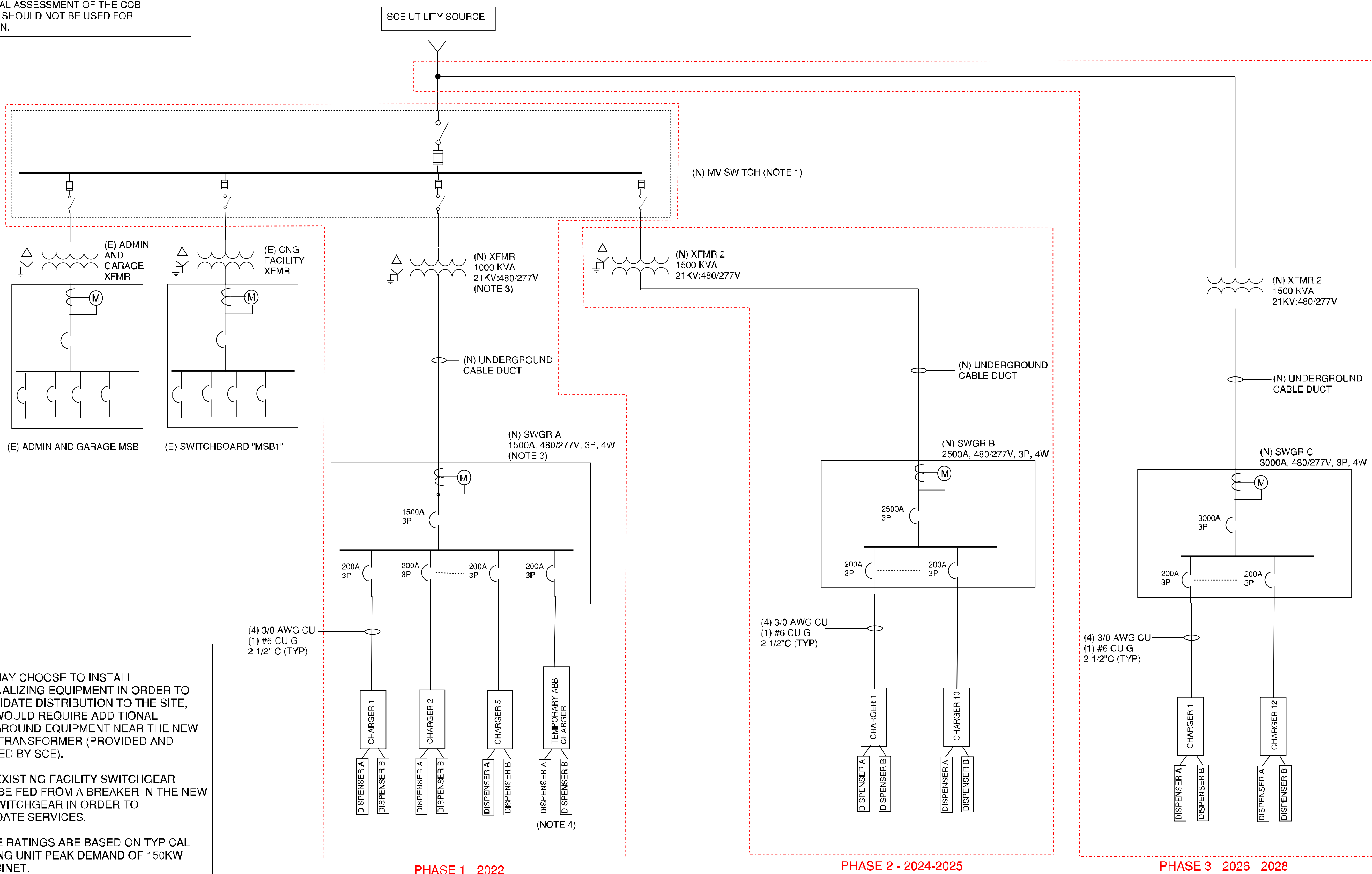
Drawing: E-2

SINGLE LINE DIAGRAM
TEMPORARY CHARGER
OPTION 1

ZERO-EMISSION BUS PILOT PROGRAM CHARGER
CULVER CITYBUS
9815 JEFFERSON BLVD., CULVER CITY, CA
Project No.: 60650368
Date: 2021-09-08

Culver CITYBUS

THIS IS A CONCEPTUAL LINE DIAGRAM BASED ON THE ELECTRICAL ASSESSMENT OF THE CCB FACILITY. THIS SHOULD NOT BE USED FOR CONSTRUCTION.



NOTES

1) SCE MAY CHOOSE TO INSTALL SECTIONALIZING EQUIPMENT IN ORDER TO CONSOLIDATE DISTRIBUTION TO THE SITE, WHICH WOULD REQUIRE ADDITIONAL UNDERGROUND EQUIPMENT NEAR THE NEW UTILITY TRANSFORMER (PROVIDED AND INSTALLED BY SCE).

2) THE EXISTING FACILITY SWITCHGEAR WOULD BE FED FROM A BREAKER IN THE NEW 4000A SWITCHGEAR IN ORDER TO COSOLIDATE SERVICES.

3) THESE RATINGS ARE BASED ON TYPICAL CHARGING UNIT PEAK DEMAND OF 150KW PER CABINET.

4) TEMPORARY CHARGER POWER WOULD BE RECONFIGURED TO BE SERVED FROM NEW SWITCHBOARD ONCE INSTALLED.

ELECTRICAL SINGLE LINE DIAGRAM
2022 - 2028

AECOM

Drawing: E-3

SINGLE LINE DIAGRAM
2022 - 2028

CULVER CITY ZERO-EMISSIONBUS TRANSITION PLAN
CULVER CITYBUS
9815 JEFFERSON BLVD., CULVER CITY, CA
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Culver CITYBUS