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Renovation of El Camino Real of Santa Clara

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I HEREBY RECOMMEND THAT THE THESIS PREPARED
UNDER MY SUPERVISION BY

Thao Nguyen-Pham, John Garzee

ENTITLED

RENOVATION OF EL CAMINO REAL OF SANTA CLARA

BE ACCEPTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

BACHELOR OF SCIENCE
IN
CIVIL ENGINEERING

____
Advisor: Rachel He

date 06/10/2016

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Department Chair: Mark Aschheim

date 6/9/16

RENOVATION OF EL CAMINO REAL OF SANTA CLARA

by

Thao Nguyen-Pham
&
John Garzee

SENIOR DESIGN PROJECT REPORT

submitted to
the Department of Civil Engineering

of

SANTA CLARA UNIVERSITY

in partial fulfillment of the requirements
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\We would like to thank our Professor, Rachel He, for her assistance throughout the year as we worked towards completing our project. Without her advice and guidance, we would not have been able to put together a project as complete as it is now. She brought to our attention material we had not learned in class or heard from our own experiences. Her professional experience and kindness are greatly appreciated and we can only hope to impress her with our future accomplishments. Thank you for helping us further our learning and strengthen our confidence in turning our dreams into reality.

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Thank you to everyone else, to family and friends, for encouraging us through the difficulties of balancing a job, being a student and this project. Without you, we would not have had the same drive to do great things. Thank you for being there for us and being the reason we hope to change the world for the better.

RENOVATION OF EL CAMINO REAL OF SANTA CLARA

Thao Nguyen-Pham, John Garzee

Department of Civil Engineering
Santa Clara University, Spring 2014

ABSTRACT

In this project we focus on a section of the El Camino Real that is a major corridor that connects the South Bay to much of the Peninsula. The portion that we are looking at is by Santa Clara University from Lafayette Street to Scott Boulevard which consists of 3-lanes in both directions. This is much wider than sections farther north as there are much higher traffic volumes in the spread out South Bay. As a result, El Camino Real can be dangerous for pedestrians and cyclists. Along with pedestrian safety concerns, our project goes into the inadequate service levels for public transit, the VTA 522- El Camino Real Rapid Bus in particular. Our re-design of El Camino Real was inspired by the VTA's BRT, Bus Rapid Transit, which converts 1 of 3 car lanes into a Bus Only lane and adds a bike lane. We created several alternative design options for the project and discuss each option's strengths and weaknesses. After we decided on a design, we ran a Synchro simulation to see how the traffic conditions would be affected by our redesign. We noted the different service levels and safety improvements.

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1. INTRODUCTION

1.1 History

In response to the increased traffic conditions and accidents, California is looking for better and safer roads. Some projects include Bus Rapid Transit (BRT) and Complete Streets. The Silicon Valley is an arterial lane-heavy area with limited public transit and bike infrastructure. There are projects involved to improve the most important corridor for the Silicon Valley, the El Camino Real. Currently, the road has three lanes in both directions, where cars are the main users of the road space. The current use of the right-of-way does not provide enough infrastructure for other modes of transportation and could use improvement to bring better traffic flow and income to local businesses.

In May 2010, the planning for the upgrade of the 522 Rapid Bus Route on El Camino Real to BRT project began. The improvements include converting two lanes of El Camino (one lane in each direction) adjacent to the median into dedicated BRT lanes, and constructing median stations and curb bulbouts. Furthermore, the project would involve bicycle lanes in both directions. Existing 522 stations would be upgraded to include weather protection and Clipper card tap stations. The funding for the El Camino Real BRT project comes from the Measure A Transit Improvement Program and Federal Transit Administration's Small Starts Program. Construction is set between 2018 and 2020.

The Santa Clara University design team worked alongside Santa Clara Valley Transportation Authority(VTA) and BRT for the duration of the project. Our responsibility was to draft sustainable street designs that incorporated features such as bike and pedestrian accessibility, efficient traffic signal sequences according to the increasing traffic demands, and effective stormwater management measures.

1.2 General Site Description

El Camino Real is located in the City of Santa Clara. Santa Clara has a rapidly growing population, estimated currently at 118,000 residents. The city is primarily a residential area with one business park. Travelling north on El Camino Real, Santa Clara University is located on the left while the Caltrain line and local businesses are located on the right(Figure 1). We are focusing on the southernmost section of El Camino Real that begins from Lafayette St and ends at the intersection of Scott Blvd(Figure 2).

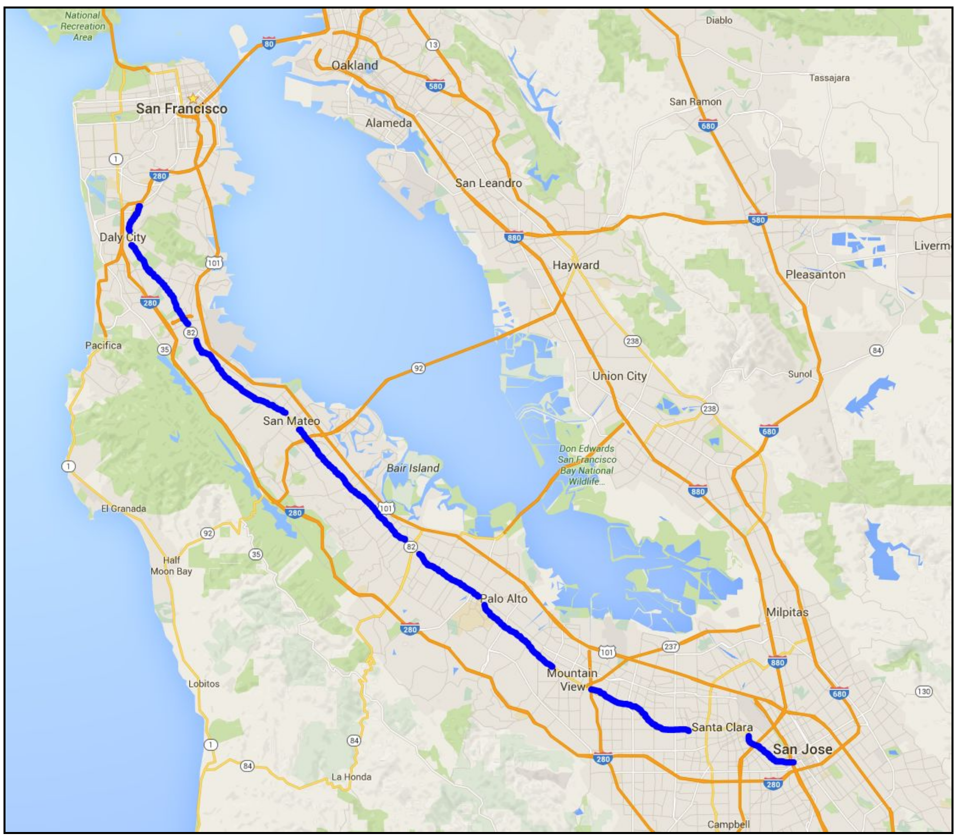

Figure 1. The entire El Camino Real route

Figure 2. El Camino Real layout. Outline/highlight the section that we are focusing on

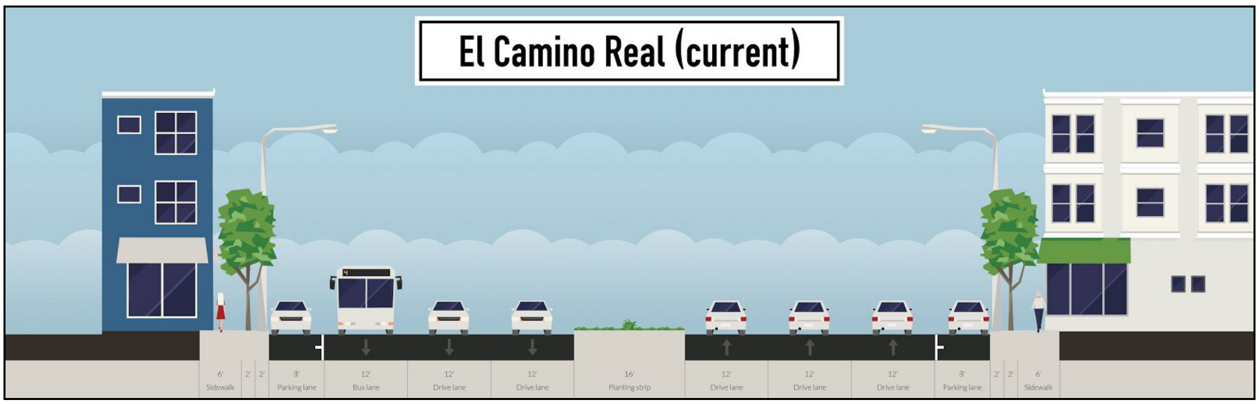

Figure 3. Cross-section of the current El Camino Real

1.3 Demonstrated Need

Although El Camino Real serves as the backbone of Silicon Valley and a highly popular route for local commuters heading North and South, it provides an unequal level of service and safety to different modes of transit. While it is a convenient route for many drivers, it is often very unsafe for cyclists who do not have a protected lane on the busy corridor. The other issue is that the VTA buses that travel on these streets get stuck in traffic and cannot help their riders get to their destination in a timely manner. The buses usually lag behind cars because they have to make constant stops and wait behind car traffic. A solution to this issue is to convert El Camino Real to a Complete Street. A Complete Street is a road designed to accommodate diverse modes, users and activities, including walking, cycling, taking public transit, traveling by automobile, and accessing nearby businesses and residences. Complete Streets encourage multi-modal transport systems and more livable communities. In addition, they are affordable, safer, and potentially economically viable.

As shown in Table 2, the current Level of Service, a method of expressing the delay experienced by each driver, is considered to be adequate or acceptable from the Transportation Engineer's' perspective. However, it is predicted that the total population in the Bay Area will increase as shown in Table 1. Therefore, we can expect that with an increase in population, there will also be an increase in traffic volumes if we do not improve the public transit system. This will cause the the Level of Service will drop to a Level of Service of E or F, which are considered unacceptable to everyone. This is the evidence that El Camino Real is in great need of a redesign.

Year	Total Households	Total Population	Total Employment
2013	67,109	164,155	120,251
2018	71,987	178,539	126,090
Growth 2013-18	7%	9%	5%
2040	93,459	241,792	151,798
Growth 2013-40	39%	47%	26%

Table 1. Total Household, population, and employment growth from 2013 to 2040. Table data from El Camino Real BRT: Report to the Independent Third Party Steering Committee Draft Environmental Impact Report/Environmental Assessment (DEIR/EA)

El Camino Real	AM		PM	
Intersection	Delay	LOS	Delay	LOS
Scott Blvd	39.9	D	48.8	D
Lincoln St	21.0	C	20.0	C
Monroe St	27.4	C	36.4	D
Lafayette St	44.4	D	44.1	D
Benton St	10.8	B	26.1	C

Table 2. Existing (2013) Level of Service in Traffic Flow in delay (seconds per vehicle) in both directions

1.3.1. Commercial Need

A Complete Street design will improve foot traffic for local businesses and provide safer and more enjoyable spaces to travel. By improving the public transit, we can expect more people to arrive via the VTA Bus to shop and enjoy food and entertainment. Improving the pedestrian and cyclist space will encourage more people to commute along this route using alternative modes of transit. These new users can easily stop by a store while passing; helping to increase foot traffic for local business. Since most of El Camino Real is currently full of heavy car traffic, it is relatively uninviting for local people to walk or bike to and we believe that our improvements to other modes of transit will help to bring in a larger and more diverse group of people to El Camino Real.

1.3.2. Community Need

A Complete Street will improve the traffic time for bus riders by prioritizing buses and dedicating them space exclusively for them. Since a bus can carry 25 people per bus, it makes sense to provide them with space proportional to the number of people they can carry. This will provide better public transit and improve the chance that commuters along this corridor will use public transit over a personal vehicle. This will, in effect, decrease the overall number of cars driven. Since our roads are reaching their capacity with cars during rush hour, we should consider the alternative of using mass transit options, such as a Light Rail System or a BRT system. By providing a more reliable and frequent public transit system, people will find it more effective than driving.

1.3.3.Regulatory Need

A Complete Street will improve current safety and pollution levels of this street, and having road space for alternate modes of transit would provide a much more equal level of service. Since El Camino Real provides no bike lane, it leaves cyclists who choose this road with an uncertain level of protection. Providing road space to modes of transit such as biking or public transit, which emit less pollution per person transported will help to not only lower traffic levels, but will also lower pollution levels, which is a serious problem in the Silicon Valley.

1.3.4. Emergency Response Need

A Complete Street will improve emergency response travel through traffic. If fire engines, ambulances, or police enforcement need to quickly get through heavy traffic, the addition of a bus-only would provide the perfect amount of space for a emergency vehicles without having to worry about clearing the lane. If coordinated properly, emergency vehicles would simply take the bus-only lane and could possibly use the signal priority of the bus to move smoothly through intersections.

1.4 Scope of Work

The goal of this project is to convert the section of El Camino Real from Lafayette to Scott Blvd, a mostly car-used road, into a shared road, allowing for a comfortable, enjoyable and more equal distribution of space for cars, public transit, cyclists and pedestrians. El Camino Real will become a Complete Street, allowing for users to have a safer multi-modal road, encouraging alternative modes of transportation.

The design project will incorporate mainly Transportation Engineering with consideration of storm and drainage. We will redesign the street to have a dedicated bus-only lane in the center median, along with an integrated bike lane as an extension of the sidewalk. Figure 3 below shows the major milestones needed to achieve before moving onto the next step. Figure 4 below displays the work breakdown structure of all the steps in order to complete the project. Each step has multiple tasks that also needs to be completed as well as what points are needed to be made or obstacles to overcome.

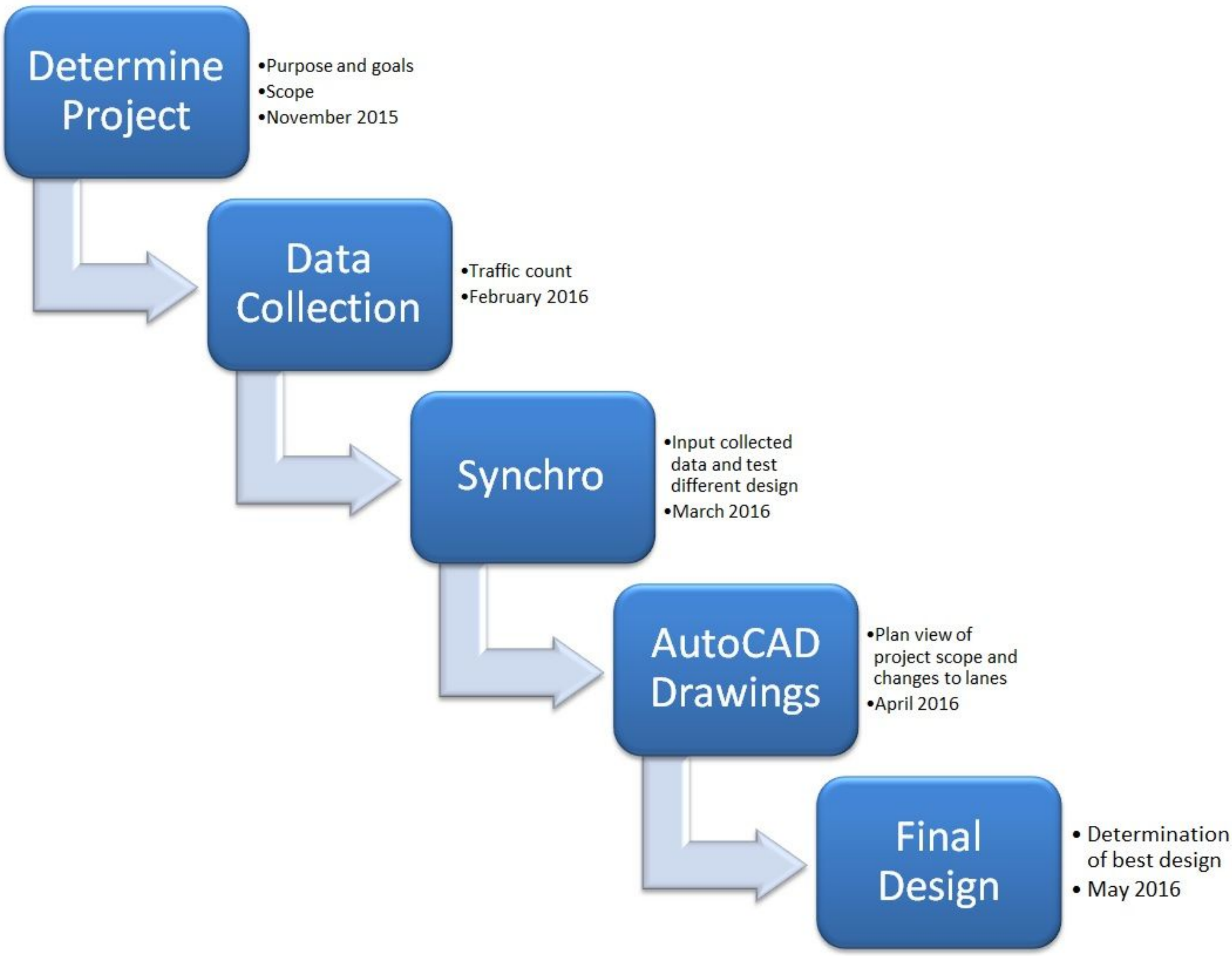

Figure 4. Major milestones and timeline

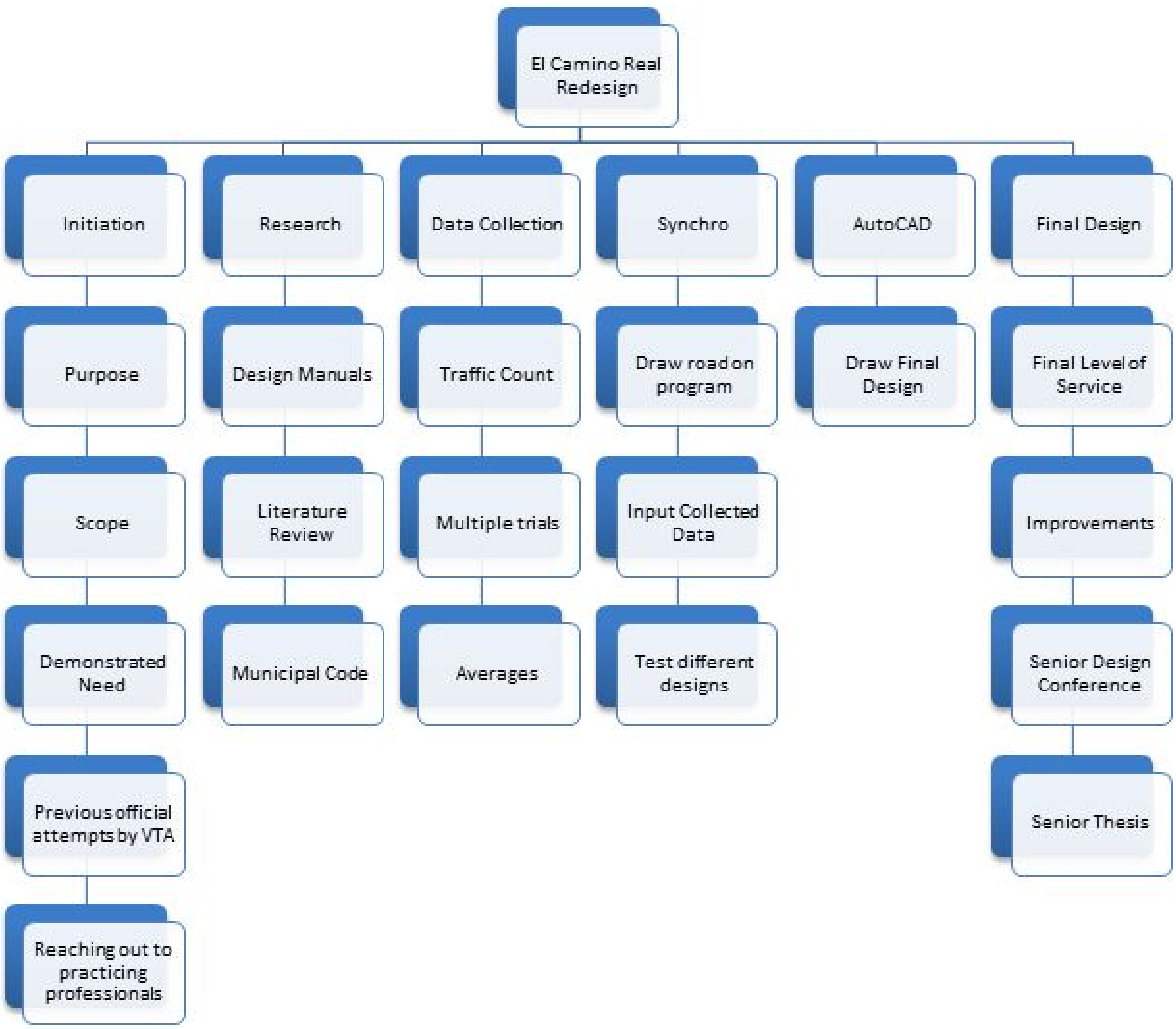

Figure 5. Work breakdown Structure

1.5 Literature Review

As more and more people move into the Bay Area, traffic levels has increased. Moveover, with more automobiles around, there are more greenhouse gasses, such as carbon dioxide, being added to the atmosphere and contributing to global warming. Other modes of transportation that are more environmentally-friendly need to be used by commuters in order to lessen the negative impact on Earth. One alternative mode of transportation is bicycling. Many cities in the United States have added bicycle lanes on the streets or as a separate section on the sidewalks. However, the design of bicycle lanes on urban streets is still very recent and not as developed as other modes of transportation. With further research, an emerging standard method of designing bicycle lanes soon developed. Scholarly journal articles such as the ones listed in Appendix B (Bibliography) formed the basis of a new standardized method of designing or renovating streets to integrate bicycle lane(s).

Before implementing any kind of project, the outcome of the finished product must be clear and positive. While developing the redesign of the street, we also considered what design features would lead more people to use the bicycle lanes in contrast to certain design features that would repel people from using the bicycle lanes. Lei's and Fricker's journal article, "Bicyclist Commuters' Choice Of On-Street Versus Off-Street Route Segments," intensely examines these design features: effective sidewalk width, traffic signals, segment length, road functional class, street pavement condition, and one-way street configuration. A reaffirming conclusion by them is that bicycle lanes should be on the streets due to their ability to increase safety. "If a bicyclist's feeling of safety (as measured by the BCI) is improved, the use of on-street facilities is increased" (Lei and Fricker 899). We needed to ensure that the design of El Camino Real would make cyclists feel safe riding on the streets by examining how those different design features would affect cyclists. Therefore, the overall design should offer a comfort and safety level that cyclists can perceive.

There are many factors that influence the design of the project. One of the most crucial factors is the behaviors of drivers, cyclists, and pedestrians. Certain design aspects will motivate people to engage in dangerous behavior either for themselves or other people while some aspects will motivate people to act more safely. Abdel-Aty’s and et al scholarly article, “Developing crash modification functions to assess safety effects of adding bike lanes for urban arterials with different roadway and socio-economic characteristics,” looks at how the annual average daily traffic (AADT), number of lanes, AADT per lane, median width, bike lane width, and lane width will affect the likelihood of a car crash. We kept in mind that each aspect can affect how to design another aspect. Ultimately, adding a bike lane will reduce the chances of a car accident, which is a reassuring confirmation that our senior design project is for the common good.

Likewise, Huan’s and Yang’s scholarly article, “A Reliability-Based Analysis Of Bicyclist Red-Light Running Behavior At Urban Intersections,” reveals that we should also take into account the traffic conditions, movement information, bicyclists’ waiting times, and situation factors because all of these factors can provoke dangerous bicycling or driving behaviors, crossing a red-light in particular. “[A]n increase in the corresponding covariates can increase the risk of bicyclists' red-light running and decrease their safe crossing reliability. [...]. Bicyclists who wait closer to the motorized lane have higher likelihoods of red-light running and lower safety crossing reliabilities. [...]Older bicyclists have higher violation risks and lower crossing reliability” (Huan and Yang 4). As you can see, there are many factors that could affect the behaviors of commuters. As we progressed in the design of our project, we recognized the personality and characteristics of the street users and considered their behavior possibilities to develop a design that decreases the likelihood of the street users to engage in dangerous behaviors.

A possible design option that we considered was left bike lanes. In his article, “The Difference Between Right And Left Bike Lanes,” Trinh promotes left side bicycle lanes because they increase safety, but advises to use left side bicycle lanes for streets that are one-way or median divided streets with bus stops and loading zones on the right side. "When [left-side bike lanes are] implemented as part of a road diet, [they] can be even more effective in achieving the goals of a successful bicycle corridor" (Trinh 15), and Trinh defines a "successful bicycle corridor" as a street that "should enable free-flowing bicycle traffic and slow motor vehicles down"(Trinh 15). Having bike lanes on both traveling directions was a possible option in our final design, especially since El Camino Real has a median with bus stops and loading zones on the right side. Plus, left-side bike lanes increase safety.

The most important factor of this design project was to ensure safety. Striping on the pavement helps guide drivers and bicyclists in the right direction and decrease accidents. Brady et al confirms this statement in their journal article, "Effects Of Shared Lane Markings On Bicyclist And Motorist Behavior." If the final design calls for a road to be shared between bicyclists and drivers, shared lane markings should be placed. "[T]he shared lane marking [is] effective at reducing unsafe bicyclists behavior (such as riding outside of the full lane or bypassing a queue of stopped vehicles) [...]. Additionally, the installation of the shared lane markings result[s] in improved motorist behaviors during passing events - motorists [are] less likely to pass, more likely to change lanes when passing, and [are] less likely to encroach on the adjacent lane when passing," (Brady et al 37-38). In short, shared lane markings discourage dangerous behaviors by commuters. We were able to incorporate this discovery into our senior design project by including street striping on El Camino Real. However, how exactly the markings looked varied and also, the design varied for each street.

It was apparent that the scholarly research has established a background and a few guidelines as we considered the final design for El Camino Real. Some information even confirmed that the design project would theoretically be an improvement on the traffic conditions and commuters involved. The final design for our senior design project is not as accident-proof as other streets because integrating bicycle lanes on existing streets is still a new and developing idea. There are yet to be official standardized design manuals on how to integrate bicycle lanes on existing streets or design a brand new street that is multimodal. However, there is a promising future for this new concept, and hopefully, there will be more consistent approaches to designing bicycle lanes onto urban streets.

2. SUMMARY ALTERNATIVE ANALYSIS

2.1 Definition of Complete Street

A Complete Street is a road designed to accommodate diverse modes, users and activities, including walkers, cyclists, public transit riders, automobiles, nearby businesses and residents. A Complete Street encourages multi-modal transport systems and more livable communities. In addition, it is affordable, safer, and potentially supports economic goals. All proposed solutions made by the SCU design team include a variation design of Complete Streets.

Figures 3 and 4 are cross-section examples of a Complete Street:

Figure 6. Bus-only lane with protected bike-lanes that is integrated into the sidewalks

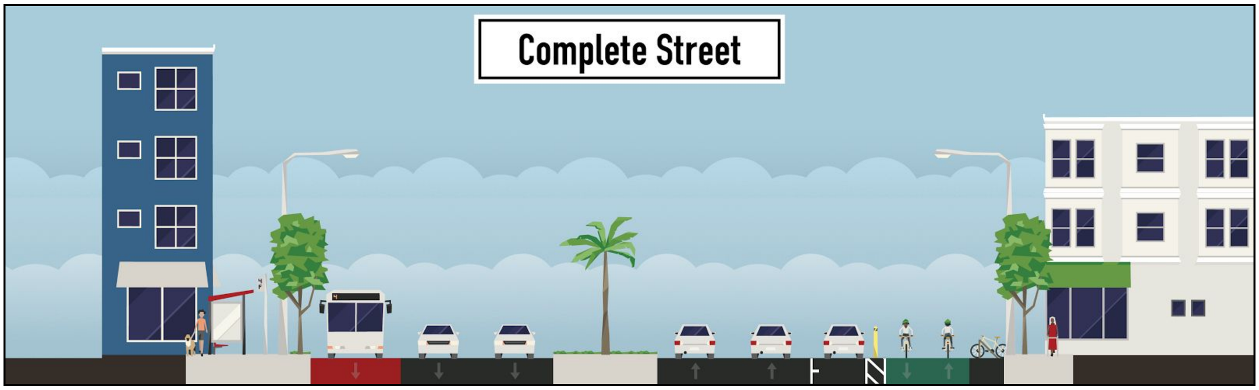

Figure 7. Complete Street example with bus lane-only and bike route on one side of the street

2.2 Overview of VTA BRT's Alternative Designs

VTA's project alternative was selected by a Locally Preferred Alternative (LPA), which is influenced by the cities along El Camino Real and Caltrans. Caltrans is the agency that owns El Camino Real north of Interstate Highway 880 and has the jurisdiction. Therefore, any changes to the BRT project must be approved by Caltrans. This project is funded by Measure A Transit Improvement Program and Federal Transit Administration (FTA)'s Small Starts Program.

The VTA's BRT alternative design involves converting two lanes of El Camino Real (one in each direction) adjacent to the median into dedicated BRT lanes. The medians would be used as stations. The current existing 552 Rapid Bus Route stations would be upgraded with more amenities such as weather protection, more seats, real-time next bus information, ticket vending machines, clipper tap stations, informational displays, brighter lighting, and security cameras. Additionally, bike-only lanes would be installed on El Camino Real adjacent to the sidewalk. Figures 5 to 7 below display the cross-sections of the VTA's BRT Alternative Design:

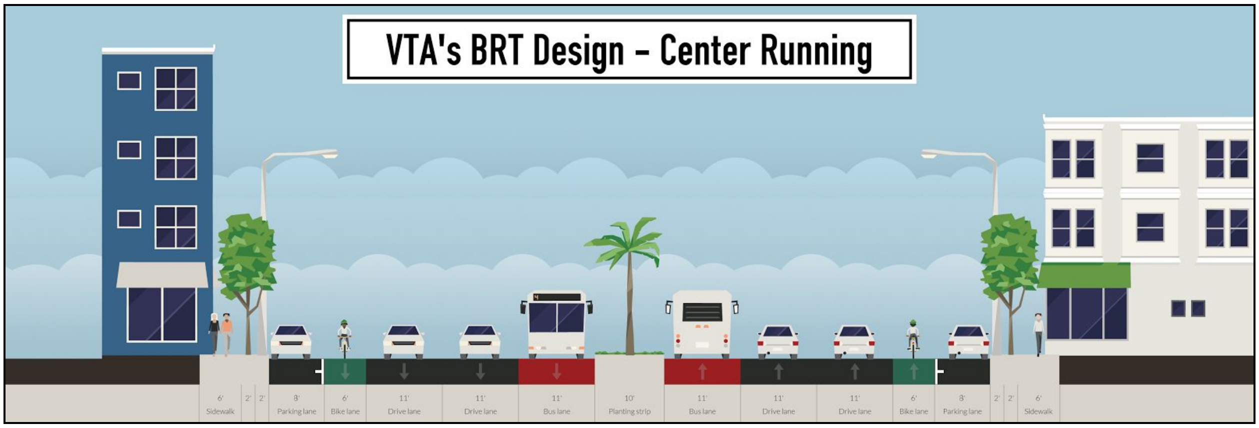

Figure 8. VTA's BRT Alternative Design of the Center Running

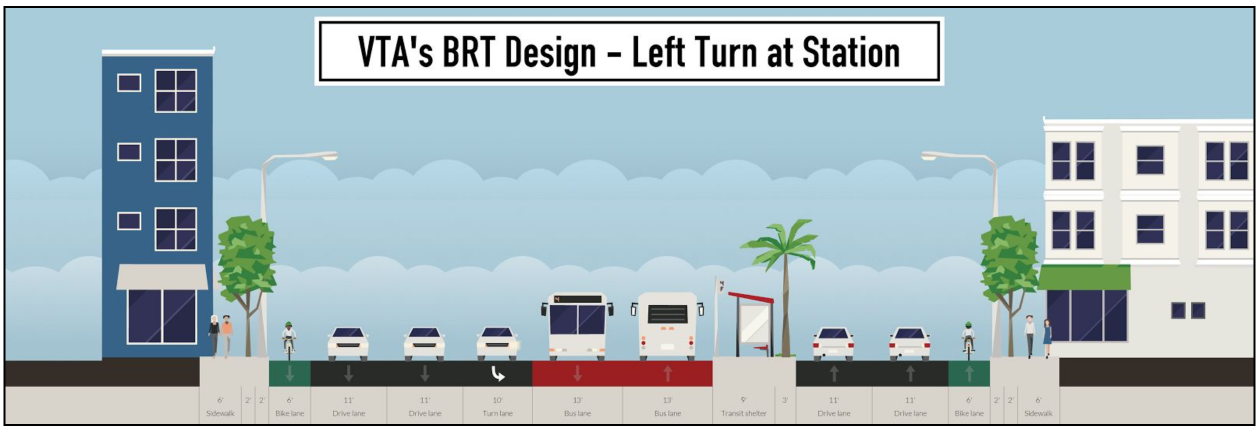

Figure 9. VTA's BRT Alternative Design of the Left Turn with a Transit Station

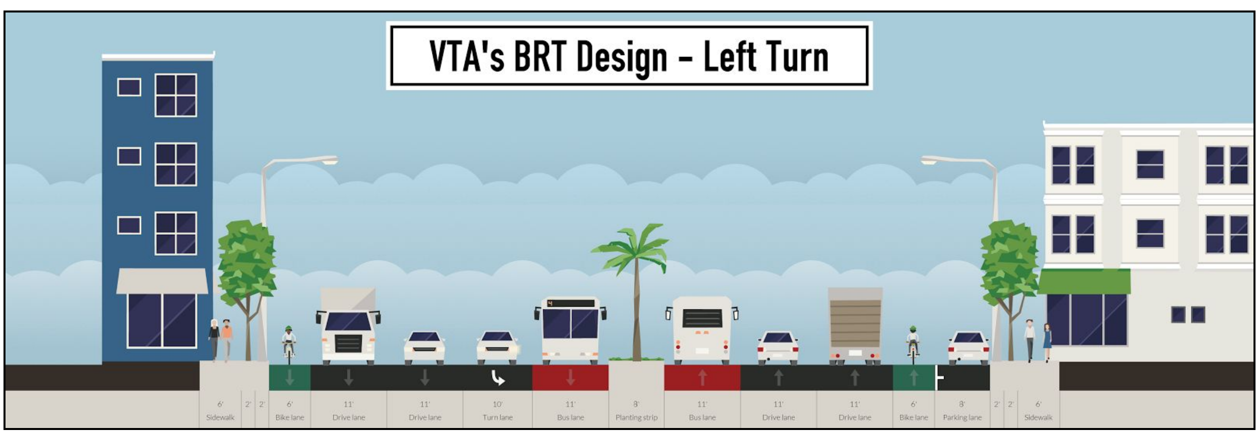

Figure 10. VTA's BRT Alternative Design of the Left Turn

2.3 Overview of SCU's design team Alternative Designs

In the sections below, we will be describing the different alternative designs that we put together and chose from. All proposed solutions take into account the high demand of automobile traffic, the safest mode of travelling for cyclists and pedestrians, and faster travel times for transit riders. Other considerations include how to implement these safe and convenient road spaces without taking up space on El Camino Real. The main differences in the design options is the location of pedestrian and cyclists improvements as well as the location and amount of road space that we took from drivers on El Camino Real.

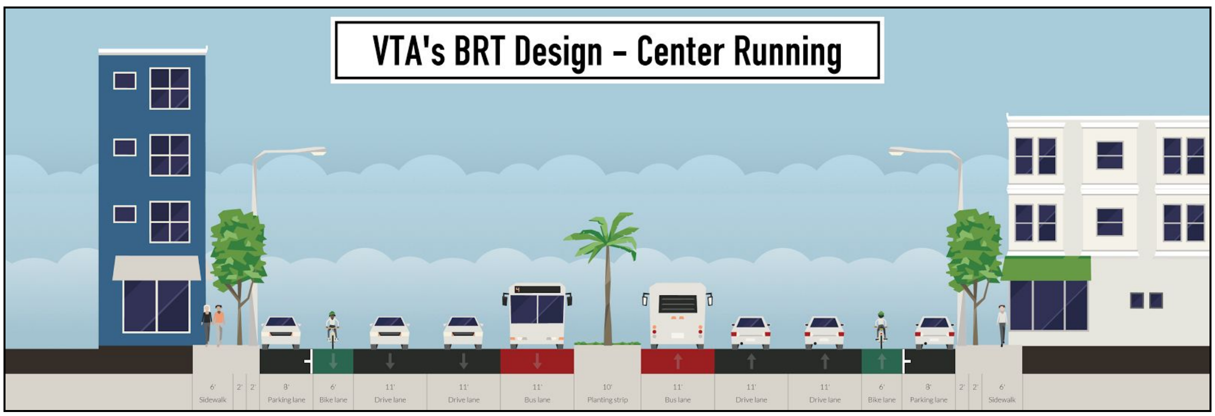

Figure 11. Option 1: VTA's BRT Alternative Design of the Left Turn

Option 1. Dedicated lanes for buses and bikes to improve the service of the VTA 522 and provide a safer bicycle facility. Providing road space for non-automobile modes that currently use the road space is a very simple improvement that will increase accessibility to El Camino for a more diverse population. Sharing the road space among different modes of transit will make for safer travel overall and increased reliability of the public transit system. This will require cars to give up space for other modes, but will benefit other modes. This is the most basic design that most redesigned streets are given.

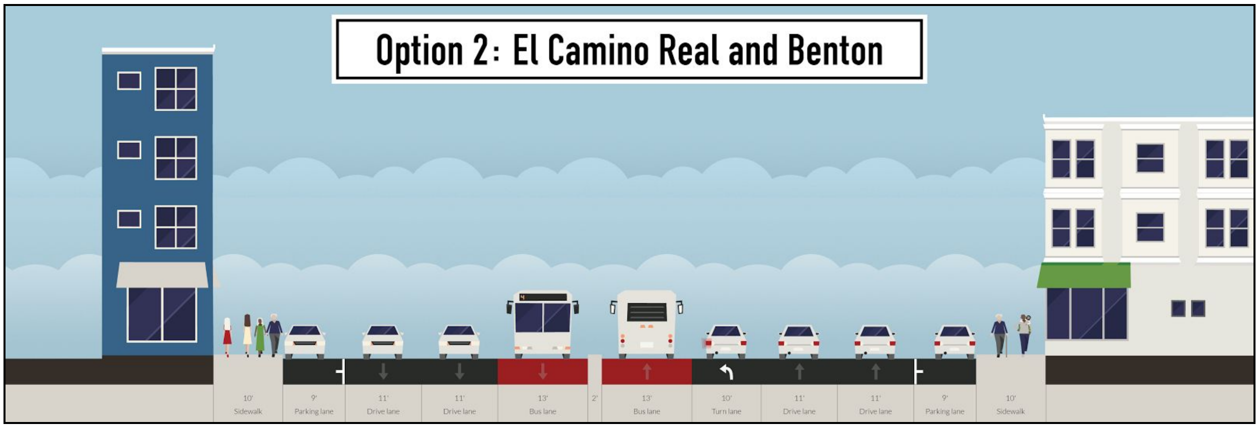

Figure 12. Option 2 - Part 1

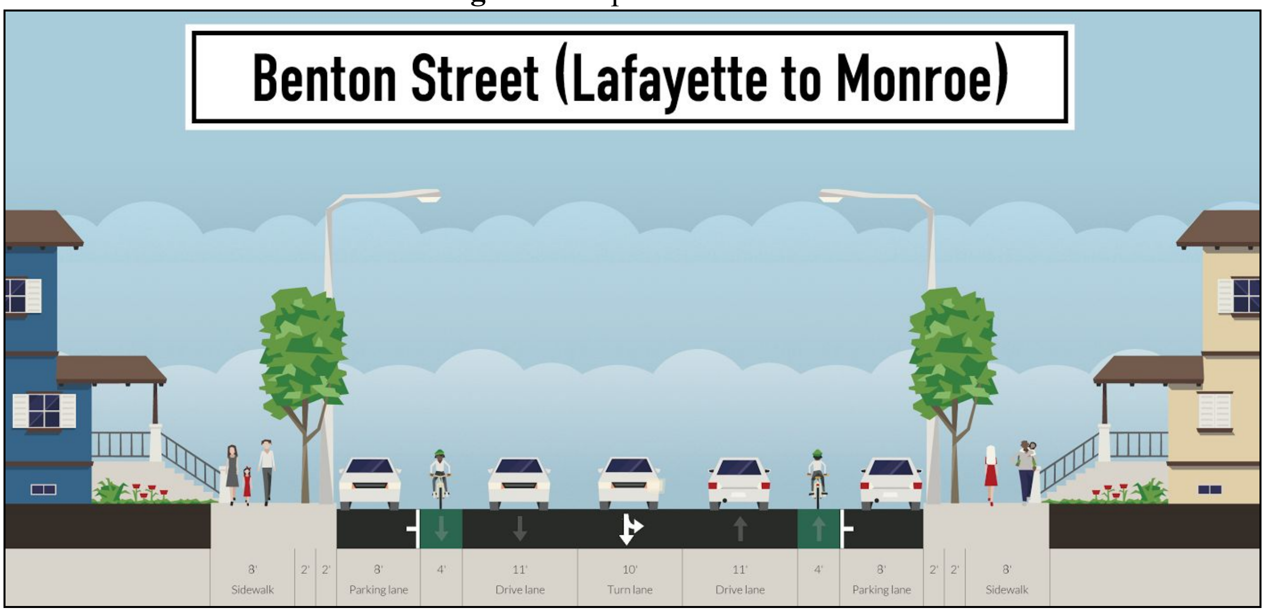

Figure 13. Option 2 - Part 2

Option 2. Dedicate a bus-only lane on El Camino Real and create a bike friendly route one block adjacent to El Camino Real: This option is a middle ground that still includes Option 1's addition of a bike lane, but in a way that will 1) not disrupt traffic on El Camino and 2) provide a safer and most comfortable cycling environment. Having a bike lane next to a busy road may seem intimidating to some cyclists, but having a bike lane one block over will offer a more scenic and calm environment to ride. The 3rd benefit that this option provides is limiting the amount of cars that travel in these residential streets looking to bypass El Camino's rush hour traffic.

Figure 14. Option 3

Option 3. Dedicate a bus-only lane in the center median along with an integrated bike lane that is an extension of the sidewalk and not the street: This option once again leaves the Bus lane in the center where it is best suited, but changes the placement of the bike lane. Currently, most bike lanes are placed between parked cars and moving traffic. This design will protect cyclists and provide for a more pedestrian-like environment. Not only would this help to separate cyclists from motorists, but it will also bring cyclists closer to local stores. This design was included since cyclists travel on average at 10-15 mph, which is much closer to pedestrian speed (3 mph) than car speed (35-50 mph). This option is very similar to the El Camino Real BRT project design.

Below is a table addressing the advantages and disadvantages of each option:

Proposed Solution	System Constructability	Safety	Overall reliability
#1	Restriping of lanes Median reconstruction Signal Retiming	**Medium**	**Low**
#2	Median Reconstruction Restriping lanes Signal Retiming	**Medium**	**Medium**
#3	Reconstruction of Sidewalks, Median Transit signals	**High**	**High**

Table 3. Comparison of design options

We decided that a combination of Options 2 and 3 is the best design option because it provides a more comfortable environment and experience for pedestrians and cyclists due to having a dedicated bike lane and more space on a different street and a bus-only lane on a high commuting road. There will be improved travel for public transit on El Camino Real due to having its own designated lane. This method may appear to give the impression that streets are only to be used by cars, however our top priority is safety for all transportation users, including drivers, bicyclists, and pedestrians. By providing a bike lane on an adjacent street, we will be accommodating bicyclists. Reasons for not choosing Option 1 and option 2 are listed below:

- Option 1 has a high safety risk for bicyclists on this major commuting road. With the high speed that cars and other vehicles will be traveling, the chances for collisions will be higher than normal. The change will be too abrupt to our current transportation system and there will be great protest. There is a high risk that the public will not enjoy this change.

- Option 2 provides a more comfortable environment to have a bike lane, but fails to improve the cycling environment on El Camino Real. Even though this option solves comfort, it is crucial to protect the cyclists that choose El Camino as it is a major route. Even though this option has the lowest construction cost and impact on traffic, we believe it not enough of an improvement to be a safe street for all modes.

We believe that our design is pushing for better public transit and bike infrastructure, which would have much a more positive effect in the long run. By including the improvements to public transit use on this major road and adding bicycle lanes on an adjacent street, the project could potentially lead to a change in how we deal with traffic conditions.

3. DESIGN CRITERIA AND STANDARDS

For the conversion of El Camino Real into a Complete Street, the following manuals were used as references throughout the duration of the project to ensure that all street, traffic, storm water management, pedestrian, and bike design criteria and standards were met:

- Federal Highway Administration: Separated Bike Lane Planning and Design Guide (May 2015)
- NACTO's Urban Street Design Guide (2012)
- California Department of Transportation: Highway Design Manual - Chapter 1000: Bicycle Transportation Design (July 2015)

Due to El Camino Real being a state highway, it is under the jurisdiction of California. Therefore, the California Department of Transportation Highway Design Manual governed most of the designs regarding the specific dimensions and striping. However, the street lights and other utilities will be maintained by the City of Santa Clara after construction and will need to be designed to meet the City of Santa Clara's standards and specifications.

3.1 California Department of Transportation: Highway Design Manual

3.1.1. Bike Lane widths:

According to the California Department of Transportation Highway Design Manual, the minimum paved width of travel way for a two-way bike path shall be 8 feet, but 10 feet is preferred. Where heavy bicycle volumes are anticipated and/or significant pedestrian traffic is expected, the paved width of a two-way bike path should be greater than 10 feet, but preferably 12 feet or more. The minimum paved width for a one-way bike path shall be 5 feet. There should be a minimum 2-foot wide shoulder, composed of the same pavement material as the bike path or all weather surface material that is free of vegetation, adjacent to the traveled way of the bike path when not on a structure. A shoulder width of 3 feet should be provided where feasible. There should be a minimum 2-foot horizontal clearance from the paved edge of a bike path to obstructions. From the car lanes, a 3 feet shoulder should be provided. Adequate clearance from fixed objects is needed regardless of the paved width.The vertical clearance to obstructions across the width of a bike path shall be a minimum of 8 feet and 7 feet over shoulder. Where practical, a vertical clearance of 10 feet is desirable. These dimensions mentioned would potentially be used if we were to put a bike lane on El Camino Real.

A bike lane on Benton Street would classify as a Class II Bikeway (Bike Lane). Class II bikeways (bike lanes), for the preferential use of bicycles, may be established within the roadbed and shall be located immediately adjacent to a traffic lane as allowed in this manual.The minimum Class II bike lane width shall be 4 feet, except where it is adjacent to on-street parking, then the minimum bike lane should be 5 feet. When there are posted speeds are greater than 40 miles per hour, the minimum bike lane should be 6 feet. On highways with concrete curb and gutter, a minimum width of 3 feet measured from the bike lane stripe to the joint between the shoulder pavement and the gutter should be provided. Although the bike lanes are adjacent to on-street parking, the bike lanes on Benton Street will be the minimum of 4 feet in order to keep construction costs low.

3.1.2. Car Lane & Parking widths

For car lanes, the minimum lane width on two-lane and multilane highways, ramps, collector-distributor roads, and other appurtenant roadways shall be 12 feet, except for the following reasons:

- For conventional State highways with posted speeds less than or equal to 40 miles per hour and AADTT (truck volume) less than 250 per lane that are in urban, city or town centers (rural main streets), the minimum lane width shall be 11 feet. The preferred lane width is 12 feet.

- Where a 2-lane conventional State highway connects to a freeway within an interchange, the lane width shall be 12 feet.
- Where a multi-lane State highway connects to a freeway within an interchange, the outermost lane of the highway in each direction of travel shall be 12 feet.

According to Table 302.1 Mandatory Standards for Paved Shoulder Widths on Highway, the width for parked cars is minimum 8 feet for 2 lanes for each direction of travel is required.

Since Benton Street has a posted speed less than 40 miles per hour, the lane width shall be designed to be 11 feet to accommodate the bike lanes.

El Camino Real will be redesigned to have a posted speed of 35 miles. Therefore, the lane width will be designed to be 11 feet in order to accommodate a bus-only lane in both directions of travel. The bus-lane will be redesigned to have a width of 13 street to allow the bus to travel quickly on its own lane and to provide safety to the cars on the adjacent car lane.

3.1.3. Sidewalk width

The minimum width of a sidewalk should be 8 feet between a curb and a building when in urban and rural main street place types. For all other locations the minimum width of sidewalk should be 6 feet when contiguous to a curb or 5 feet when separated by a planting strip. Since Benton Street is a urban and rural street, the width of the sidewalk will be at least the minimum of 8 feet. However, because we want to keep construction costs low, we will aim to maintain the original width of the sidewalk of 10 feet. Therefore, the width of the sidewalk of Benton Street will be designed to a width of 10 feet.

For El Camino Real, we aim to make the street a more pedestrian-friendly street due to having the bus-only lane. Therefore, to accommodate the increased number of bus riders, the width of the sidewalk will be extended from the original 10 feet to 12-15 feet, depending on the location. Mid block, the width will be 12 feet, and at intersections it will be 14 feet except for at the Scott Blvd bus station where it will be 15 feet.

3.2 Federal Highway Administration: Separated Bike Lane Planning and Design Guide

We will be using a One-Way Separated Bike Lane on a Two-Way Street design for Benton Street. This design will provide one-way separated bike lanes on each side of a two-way street, which creates a predictable design for users. Each separated bike lane will run to the outside of the travel lanes. A potential challenge with this design is it takes up more roadway space compared to the alternatives of providing a two-way separated bike lane or developing alternate corridors for directional travel.

3.2.1 Details

Bicycle symbols should be placed periodically in the bicycle lane. Drainage grates and gutter seams should not be included in the usable width. It is preferred that the width of the bicycle lane is 7 feet. Separations should be 3 feet. A minimum buffer width of 3 feet is required to allow for the opening of doors and other maneuvers. In the redesign of Benton Street, the preferred width of 7 feet for the bicycle lane will not be feasible due to the limited width of Benton Street as well as the buffer width of 3 feet. No forms of separations can be used because Benton Street is a mainly residential street. Adding obstructions to driver's views when attempting to exit the driveway will be dangerous. For striping, the bicycle lane will be painted green with a white outline. When the bicycle lane comes into a conflicting area, the bicycle lane becomes dashed. There will be a 30 feet minimum merge area and 25 feet minimum queue storage length for automobiles needed for operations. Shorter queue storage lengths are preferred because it allows for a longer distance of midblock separation relative to the intersection and slows motor vehicle speeds. Therefore, we will use the minimum lengths for the required dashed lines of a total of 55 feet.

3.3. NACTO's Urban Street Design Guide (2012)

3.3.1 Curb Extensions

Curb extensions visually and physically narrow the roadway, creating safer and shorter crossings for pedestrians while increasing the available space for street furniture, benches, plantings, and street trees. They may be implemented on downtown, neighborhood, and residential streets, large and small. Conventional curb extensions are a recommended feature where there is on-street parking. Curb extensions are often applied at the mouth of an intersection. When installed at the entrance to a residential or low speed street, a curb extension is referred to as a "gateway" treatment and is intended to mark the transition to a slower speed street. The length of a curb extension should at least be equal to the width of the crosswalk, but is recommended to extend to the advanced stop bar. A curb extension should generally be 1–2 feet narrower than the parking lane, except where the parking lane is treated with materials that integrate it into the structure of the sidewalk. However, according to the California Department of Transportation: Highway Design Manual for bulbouts, the curb face of the bulbout should be setback a minimum of 2 feet. A bulbout longer than 25 feet is considered a busbulb, which usually facilitates bus loading and unloading, and provides for enhanced bus mobility. The minor streets entering El Camino Real are not currently bus routes and will therefore not be required to be over 25 feet. Curb extensions should be installed whenever on-street parking is present to increase visibility, reduce the crossing distance, provide extra queuing space, and allow for enhancements such as seating or greenery. Combine stormwater management features, such as bioswales or rain gardens, with curb extensions to absorb rainwater and reduce the impervious surface area of a street. Curb extensions will be installed on El Camino Real for minor streets entering El Camino Real. The curb extensions will be 6 feet wide (2 feet narrower than the parking lane) and 25 feet long into the minor street as recommended.

4. DESCRIPTION OF DESIGNED FACILITY

4.1. Project Schedule and Planning

The SCU team followed the Gantt Chart schedule shown in Figure __ below to ensure that the project was completed on time. *More description of the gantt chart and how we time managed here*

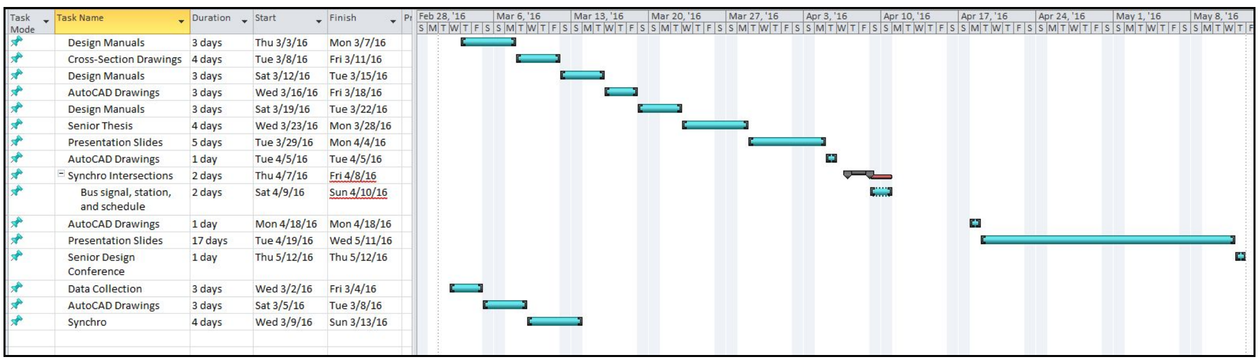

Figure 15. Gantt chart schedule.

4.2 Technical Issues

4.2.1. POLITICAL

There is local government support for our development project. We expect there to be some resistance to reducing a car lane. We hope that this will change as people find the bus to be a better method of getting around El Camino Real. We will require an encroachment permit from the City of Santa Clara in order for the project to be constructed.

4.2.2. ENVIRONMENTAL

The City of Santa Clara will have jurisdiction over the requirements for assessing environmental impact for this project. Construction phase impact will be reduced by ensuring the highest quality of Best Management Practices (BMPs) and erosion control. The socio-economic "culture" of the local community will be changed due to more people commuting by bicycles or on foot. The new design will reduce collisions and injuries, encourage multimodal modes of travel, maximize investments, support economic development, and raise property values. More people will have incentives to travel by foot, bicycle, or public transit. In short, it will make a very positive impact on the community, economy, and environment.

4.2.3. ECONOMIC

The chosen design is the most cost-effective solution for a life-cycle cost perspective. There are economic benefits associated with the project and they include increased property values and investments for the private companies associated. The chosen project is a high priority infrastructure investment and is affordable. The project will be financed by the government.

4.2.4. SAFETY

Some unintended ethical consequences of our project may include initial traffic back ups and unhappy citizens. There are no special construction-related safety issues and all relevant ADA and OSHA requirements will be satisfied for people who visit or work within the project site during its long-term operation.

4.2.5. AESTHETICS

The project may need to be approved based on its aesthetics since the aesthetics will potentially have an impact on the willingness of citizens to use and approve the street. The renovated street is expected to fit with its surroundings.

4.2.6. ETHICS

Some citizens may not like the newly designed street. However, users' satisfaction is predicted a few months after the project is completed and therefore, initial users' disapproval will not be a huge concern unless escalated. There is an equitable distribution of benefits associated with this project. We will aim to use more sustainable materials for this project.

4.3 Preliminary Design

El Camino Real will be redesigned to have a bus-only lane in the center and an adjacent street, Benton Street, will be redesigned to install a bike route. Figure _ shows the overview of the project.

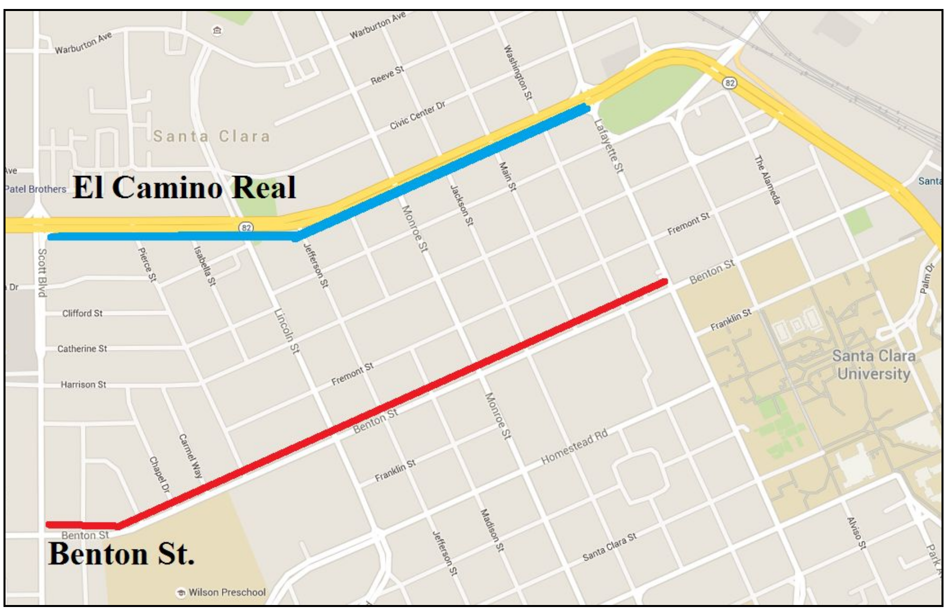

Figure 16 . Overview of Project.

	Width	Parking (W)	Bike (W)	Car (W)	Turn	Car (E)	Bike (E)	Parking (E)
Lafayette - Monroe	56	8	4	11	10	11	4	8
Monroe - Lincoln	46	8	4	11	-	11	4	8
Lincoln - Scott	36	-	4	11	-	11	4	8

Table 4. Widths of streets and lanes on portions of Benton St (Westbound and Eastbound)

Benton:

- At Lafayette to Monroe, the total width of the street is 56 feet. One lane each direction, with another buffer zone in the middle for left turns.
- Parking is on the side of the cemetery and school to maximize parking

4.4. Traffic Intersection Analysis

To be certain about the data we used for our traffic simulation, we measured traffic volumes ourselves using a Jamar Tracking Device. The specific device that we used, the TDC Ultra Traffic Data Collector, allowed us to count the number of cars turning in each direction. By measuring the turning movements of each lane as well as the length of each cycle, we were able to create an accurate model of the current conditions. With this initial study done, we made a Synchro simulation of the current road condition and layout and found the level of service, which was measured by the average delay experienced by each driver. After quantifying our current level of service, we built our proposed design on Synchro and ran a test. The LOS results from both tests are shown in table 5. Thankfully, since the traffic levels weren't at capacity, we were able to keep the level of service for automobile travel relatively the same. Some of the changes that we made were to the design speed(5 miles per hour slow), the lane widths and light timing and synchronization. We believe that we were able to keep the LOS at similar levels because we increased the overall capacity of the street by lowering the speed to the optimum level of flow curve. The main way we believe speeds were impacted is from the reduction in lane width, causing drivers to feel more restricted. Seeing as how the LOS still remains in the C/D range, we believe that we have made an improvement to the public transit system without reducing the capacity of cars.

When creating our proposed design on Synchro, we wanted to model it with a lane dedicated to buses. Due to the limitation of Synchro being only able to simulate cars and trucks we had to make some adjustments. One method that I found to be useful, was by splitting up El Camino Real into 3 roads: the East and Westbound directions and the Bus only lane in both directions in the center. With these the bus only lane being modeled separately we were able to time the signals to prioritize the bus when it approaches the intersection. To activate the lights, the bus had an activated light switch embedded in the ground. We would have liked to have simulated this interaction in a more accurate way if we were able to revisit this project.

El Camino Real		
	PM	
Intersection	**LOS (Current)**	**LOS (Proposed)**
Scott Blvd	D	D
Lincoln St	C	C
Monroe St	C	D
Lafayette St	D	C

Table 5. Level of Service before and after implementation of Bus Only lane

4.5. Final Design

The final design became one that focused on multi-modal transportation. The additions of a dedicated bus-only lane and bicycle lane in each direction of travel makes this road more environmentally friendly. Figure 17 displays the cross-section of the Final Design.

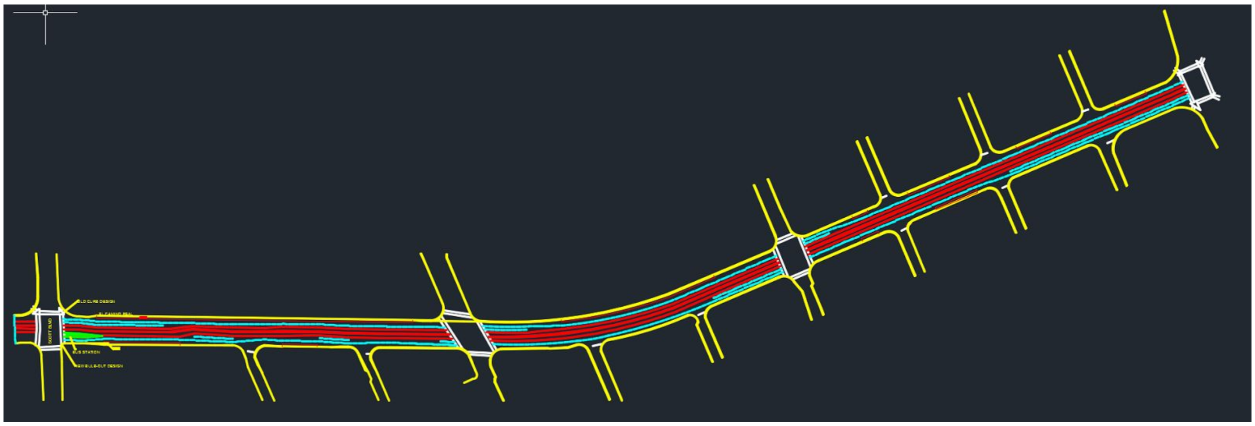

Figure 17. Plan view of Final Design for El Camino Real

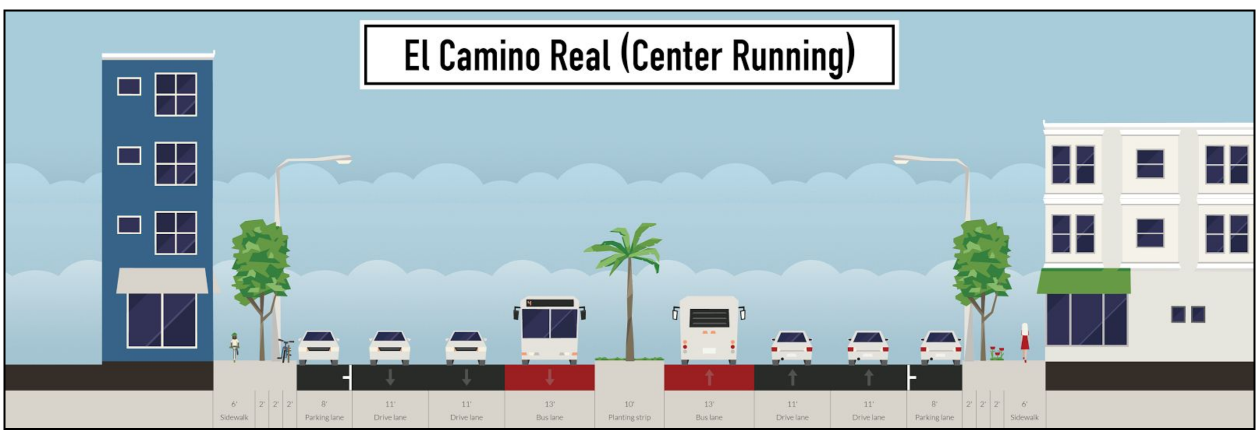

Figure 18. Cross-section of Final Design

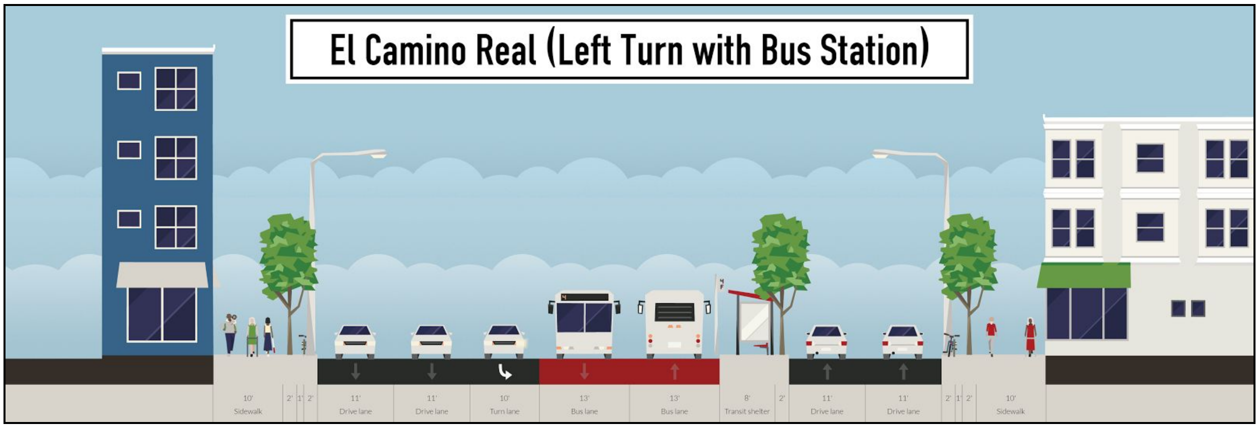

Figure 19. Cross-section of Final Design including bus station for El Camino Real

Figure 20. Cross-section of Final Design including left turn lane for El Camino Real

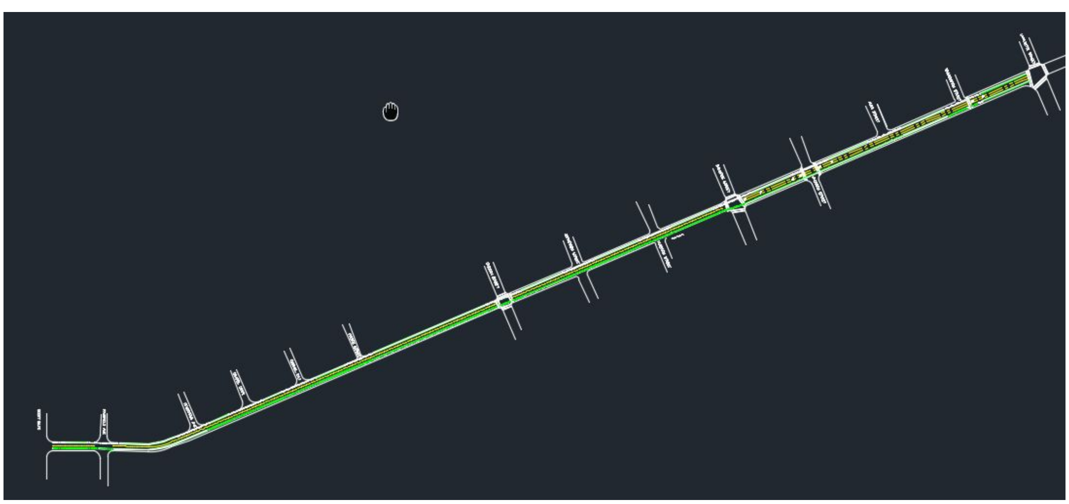

Figure 21. Plan view of Final Design for Benton Street on AutoCAD

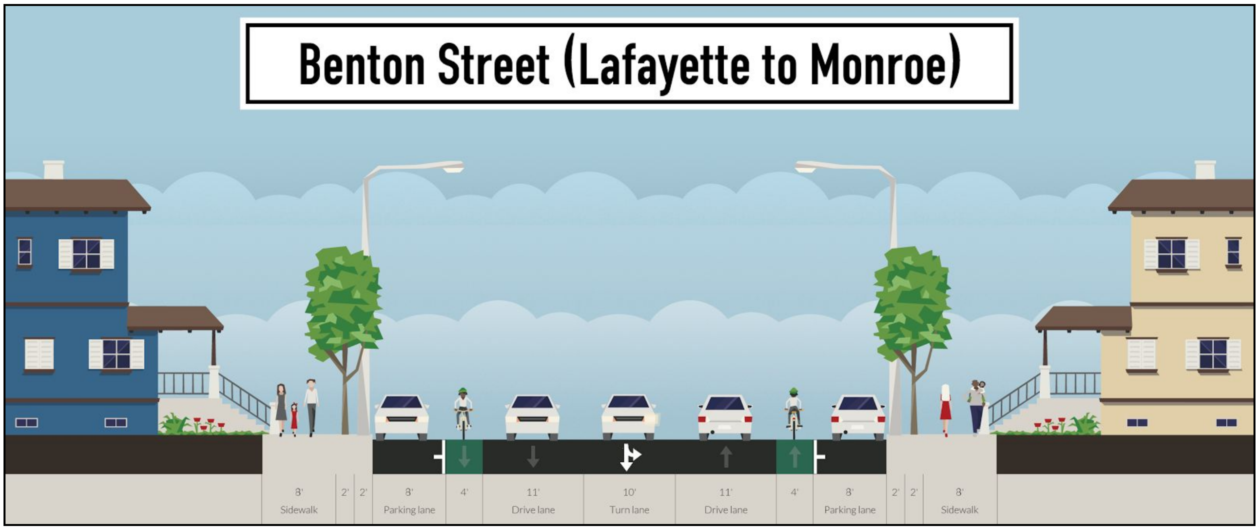

Figure 22. Cross-section of Final Design including left turn lane for Benton Street (Lafayette to Monroe)

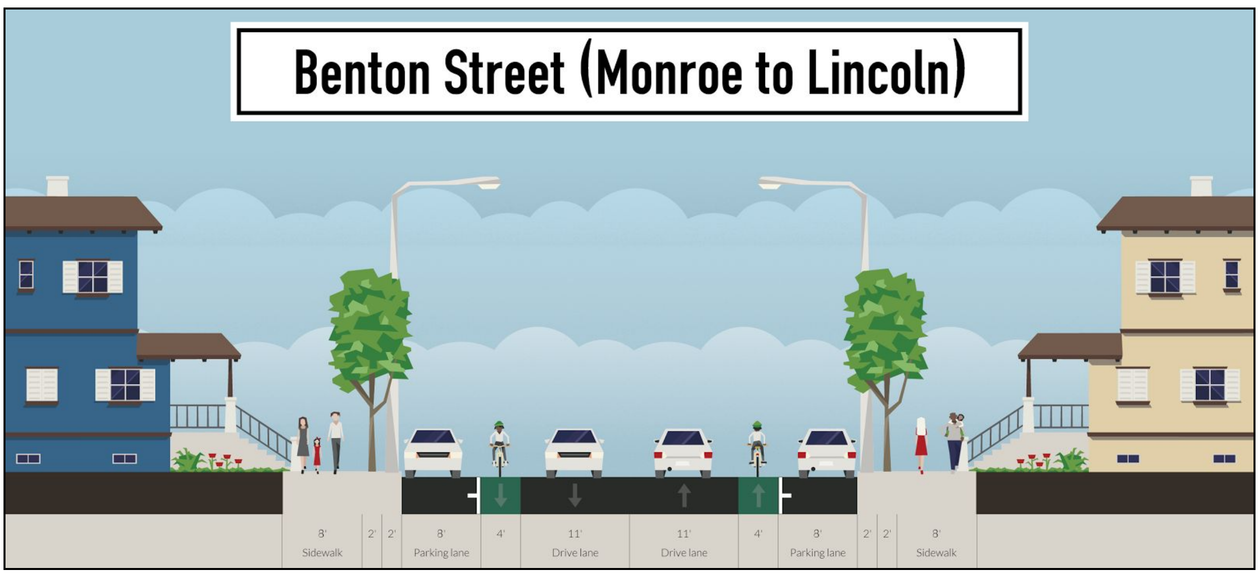

Figure 23. Cross-section of Final Design for Benton Street (Monroe to Lincoln)

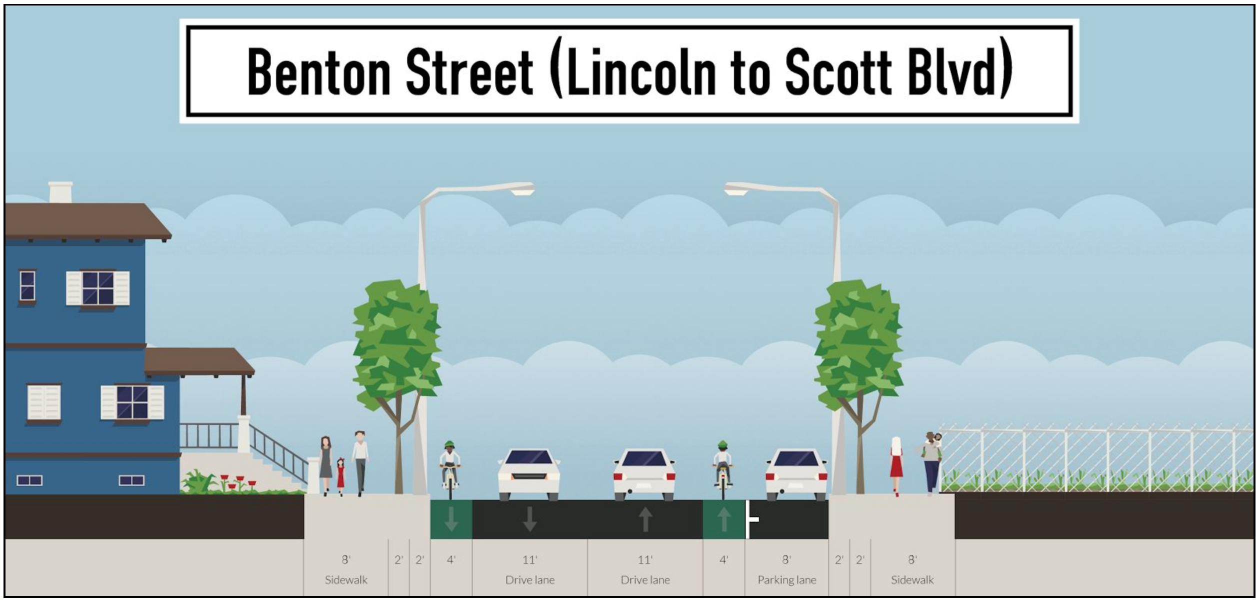

Figure 24. Cross-section of Final Design for Benton Street (Lincoln to Scott)

5. COST ESTIMATE

Due to El Camino Real being a very popular road to commute through Santa Clara, Sunnyvale, Mountain View, San Mateo, and up to San Francisco, the breakdown of the costs is a very important political part of the entire project. Table 5 summarizes the general items that contributed to the cost of the project.

Item	Estimated Amount (per/ft)	
Sidewalk Widening: includes curb, gutter, and sidewalk	$ 90	
Lane Striping	$1.8	
Median Reconstruction	$45	
SubTotal Cost	**$136.8**	
	El Camino Real	Benton Street
Lanes To Stripe:		
Bus	2 x 13 ft	N/A
Car	4 lanes striped	
Bicycle		1 lane each direction
Length (feet)	4066	4827
Total Cost	**$556,228.80**	**$660,333.60**

Table 6. Cost breakdown for the different construction costs.

6. CONCLUDING REMARKS

El Camino Real is unsafe for other modes of transportation. With the new design of El Camino Real, it becomes a Complete Street, which is a Sustainable Transportation Design. Furthermore, the new design raises property value and increase employment. Ultimately, it will decrease our dependence on cars.

6.1 Ethical Issues

6.1.1. TEAM AND ORGANIZATIONAL ETHICS

The project team upheld the American Society of Civil Engineers' Code of Ethics, Santa Clara University's ethical requirements, and their own personal code of ethics in order to act ethically within the team and as members of Santa Clara University throughout the whole project.

THE PROJECT

The project itself is constructive and will most likely have political support. It will improve the community and environment by providing a safer road of travel for cyclists and a separate lane only for buses. This will overall encourage public transit or a more sustainable method of travelling.

RESOLVING ISSUES

Practical steps for resolving ethical issues within the partnership and with the university or professors are listed in order below:

1. Discuss the ethical issue with the other partner
2. Consult with the senior design project advisor
3. Formulate a solution to the ethical issue or recommend a change to the project design
4. Implement the solution or change the specific element of the project design
5. If it is not possible to come up with a solution or change, dropping the project may be inevitable.

Our personal code of ethics will require us to abandon the project when the project itself requires us to no longer uphold the American Society of Civil Engineers' Code of Ethics, Santa Clara University's ethical requirements, or when any element of the project is against the law.

6.1.2. SOCIAL ETHICS

Our ethical duty for potential users of the newly renovated road is to promote sustainable modes of transportation and to enhance human welfare by providing a safer road.

OUR RESPONSIBILITY

Our ethical responsibility for the newly redesigned road will be partly or fully transferred if the design of the road is not the primary cause of the issue. Therefore, the extent of our ethical obligations will concern the design portion of the project. This includes how environmentally-friendly, safe, aesthetically pleasing, lawful, and safe the design would be to users. Issues due to users' absolute carelessness will not be our ethical responsibility.

UNINTENDED ISSUES

Some unintended ethical consequences of the project may include initial traffic back ups and unhappy citizens. However, users' satisfaction is predicted a few months after the project is completed and therefore, initial users' disapproval will not be a huge concern unless traffic continues to becomes escalated. Another concern is that this road diet will take space from cars and give it to public transit. A majority of users do not take public transit, but commute in a vehicle. This improvement can be seen as a regression, but it is the best way to move to a more multi modal transit system.

6.1.3. PRODUCT DEVELOPMENT ETHICS

Integrity was ensured in our research and design project by having each partner audit each other's progress and work. We also refered back to the American Society of Civil Engineers'

Code of Ethics, Santa Clara University's ethical requirements, and our own personal code of ethics as necessary.

ACCURACY OF DATA

Processes we had in place to ensure the truthfulness, quality, and accuracy of the background information, data, and design are set and the following will assist in reviewing and evaluating:

- The other partner
- Advisor or another professor in the specialized topic
- Santa Clara University Library

All data used to support our senior design project were obtained through the referral of Santa Clara University professors, the University library databases, Adam Burger from VTA and coworkers or supervisors at the City of San Jose. Statements regarding how Complete Street Designs will impact the community all had professional support from journal articles. We distinguished the difference between errors of commission and omission by limiting errors of commission to construction work and errors of omission to design. In order to prevent errors of omission, we simply did not do anything that we should not do, which is breaking any code of ethics.

INTELLECTUAL PROPERTY

Scientific experiment processes were disclosed in general terms as required and can potentially be discussed in further details if requested by our advisor or other professors. We disclosed our thinking process as well as our learning process and what errors we have to correct in order to display honesty and critical thinking in our project. It is our ethical obligation to extend to subsequent teams who may wish to continue the design project because civil engineering is a growing field. Technology is constantly improving at a fast pace while infrastructures are being upgraded as soon as possible. It is in the community's best interest that the subsequent team can develop a superior design than ours.

POTENTIAL RISKS

Our project did not cause any potential safety and health risks for those who live, work, or pass by El Camino Real. There are no special construction-related safety issues and all relevant Americans with Disabilities Act (ADA) and Occupational Safety and Health Administration requirements (OSHA) will be satisfied.

6.2 Quality Control and Assurance

Since the design of this project was much greater than previous projects we experienced, we had the assistance of Adam Burger, a Transportation Planner at VTA. We first contacted him via email and set up meeting times where we discussed the issues around the El Camino Real BRT project and ways that they could be solved. We talked to him about several different ideas we had and discussed the possible downsides of each design. He provided us with much information about VTA’s studies and their proposed design plan drawings.

6.3 Conclusion

Our redesign of El Camino Real and Benton Street had several issues we wanted to solve: safety for pedestrians and cyclists, improving bus travel time, and still provide an acceptable level of service for automobile flow. We thought of several designs and came to the conclusion that a bike facility on along a busy street needs to have protection that is more than paint, but a physical barrier. We also recommended an additional bike lane and center turn lane along Benton Street to provide another cycling option while also improving traffic conditions.

We used designs that delineate road space to specific modes and uses(bus, bike and center turn lanes) which helps to share the road space among different users while still helping to improve traffic flow. As the Silicon Valley’s population and number of jobs increases, these types of roads that provide safe transit for alternative modes like biking and walking and prioritize mass transit will be crucial if we hope to sustainably move people in the future. It will allow us to move more people with less fuel and promote active modes of transit.

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APPENDIX A
Resumes

THAO THIEN NGUYEN-PHAM

ttnguyenpham@scu.edu | Cell: 408-478-1124 | 710 Hellyer Ave, San Jose, CA 95111

OBJECTIVE

Seeking a Part-Time Structural Drafter position with 4x Engineering to expand and utilize my knowledge and skills

EDUCATION

Santa Clara University, Santa Clara, CA
Masters of Science – Civil Engineering, Structural Engineering focus — Expected: June 2017
Bachelors of Science – Civil Engineering, Structural Engineering focus — Expected: June 2016

RELEVANT COURSES

- Masonry Engineering
- Earthquake Engineering Design
- Reinforced Concrete Design
- Structural Steel Design
- Structural Analysis
- Construction Engineering

EMPLOYMENT EXPERIENCE

Department of Public Works, City of San José– San José, CA — August 2015 – Present
Engineering Trainee

- Continue to work on the same Engineering Services Division in the Development Review Team as I did as a Student Intern and continue the progress of open-ended projects
- Prepare and revise spreadsheets for the division's non-personal base budget, approved concrete mix designs and pipes, utilities companies and contact information, employees' overtime, and electrical inspection deficiencies
- Research and verify local cities' specifications regarding street moratorium to prepare documents for proposal
- Evaluate and apply engineering techniques, procedures, and criteria and when assisting inspectors on minor inspections
- Update list of projects by Inspection Zones when permits are issued or submitted as completed

November 2013 – August 2015
Student Intern

- Worked on the Engineering Services Division in the Development Review Team responsible for processing private development projects
- Reviewed & issued sewer lateral, joint trench, & minor encroachment permits related to private development projects
- Communicated with project team to conduct new project research and file set-up
- Prepared simple Planning memorandum and responses and conducted basic civil plan reviews
- Independently drove City Vehicles to project sites in order to update the statuses of projects
- Tracked projects' progress using City's AMANDA permitting system
- Coordinated with project applicants, Engineers and Consultants to facilitate the development review process

SKILLS

Engineering software: AutoCAD, ArcGIS, SAP2000, ENERCALC, MODFLOW
Art-related software: Adobe Photoshop CS3, Final Cut Pro, Sony Vegas
Languages: Vietnamese

John Garzee
San Francisco CA
Phone: (415)-370-4396
Email: jgarzee@scu.edu

EDUCATION

Santa Clara University, Santa Clara, CA **Expected Grad Date: June, 2016**
Major: Civil Engineering Minor: Environmental Studies
Saint Ignatius College Prep, San Francisco, CA **Class of 2012**

Advanced Couse Work
Municipal Engineering Design, Hydraulic Engineering, Structural Analysis, Reinforce Concrete Design
Additional Skills:
Proficiency in AutoCAD, SAP 2000 and Japanese (Speaking)

EXPERIENCES

ETDC: Green Team of Silicon Valley – Intern *Santa Clara, CA* **June - September 2014**
Collaborated and studied with the Gilroy Electric School Bus Project in preparation of project funding

Transform California – Intern *San Jose, CA* **March - June 2014**
Surveyed riders on VTA to help understand how to best design new BRT (Bus Rapid Transit) program

ELV Motors - Employee *Santa Clara, CA* **September 2014 - Present**
Sales Manager
- Attended and represented the company for an exclusive distribution deal at a Bike Expo
- Developed business network opportunities within the e-bike community

Postmates Courier – Employee *San Francisco, CA* **June - September 2014**
Delivered customer orders around the city of San Francisco, performed on-time, accurate, and high-quality services in a fast- paced urban environment

LEADERSHIP

California Transportation Foundation **October 2014**
- Was one of two students nominated by my school to participate in the Annual Education Symposium
- Presented a mock proposal for a transportation project where we presented alternative ideas as well as please multiple different groups in the community

Chi Upsilon Zeta- Multi-Cultural Service Fraternity **2013-Present**
- “Cultural Chair” & “Historian and Web Master”
- Organized cultural dinners and maintained social media network
- Volunteered 10+ hours per academic quarter

Jean Donovan Fellowship **June-September 2015**
- Volunteered 200+ hours with Hope Services and the SF Bike Kitchen
- Increased online sales by $2000 in a month

APPENDIX B

Bibliography

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APPENDIX C
Design Specifications for El Camino Real Renovation Project

CALIFORNIA DEPARTMENT OF TRANSPORTATION

Quality Assurance Program (QAP) Manual for Use by Local Agencies

This manual provides quality assurance guidelines for materials used in Federal-aid projects off the State Highway System.

APPROVED BY:

DENIX D. ANBIAH
Chief
Division of Local Assistance
California Department of Transportation

01/06/09
Date

for
VINCENT MAMMANO
Acting California Division Administrator
Federal Highway Administration

1/09/09
Date

December 2008
Division of Local Assistance

Note: Quality Assurance Programs should be reviewed and updated every five years or more frequently.

When local agencies hire a consultant to perform the acceptance sampling and testing, they may choose to:

- Perform IA services using a qualified person from within the agency, or
- Hire a second consultant from another firm to perform IA services, or
- ***Request Caltrans provide IA services for the consultant if California Test Methods are used.***

A check list of IA items is presented in Appendix L to help the local agency monitor all the required IA activities.

Prior to performing any acceptance tests on a local agency project, IA personnel should ensure laboratories are accredited and acceptance samplers and testers are qualified. This generally includes verifying test equipment, checking for current calibration stickers, reviewing the testing laboratory's Quality Control Manual, issuing written examinations to qualify samplers and testers, and issuing Certificates of Proficiencies.

5.1 QUALIFICATIONS FOR THE LOCAL AGENCY'S IA PERSON

Local agencies should ensure their IA person is qualified to verify equipment calibration, perform witness tests, perform proficiency tests, issue sampler and tester qualification certificates, issue laboratory accreditation and prepare accurate records associated with all IA services. This person can be a consultant or an employee from within the local agency.

Suggested minimum qualifications for the IA person are noted below:

- The consultant (or local agency employee) should have at least three years of experience in materials testing and/or construction.
- When non-CT methods are used, the consultant (or local agency) laboratory that will be used for IA activities should regularly perform proficiency tests with AMRL and/or CCRL, or the laboratory and tester to be used should be demonstrating proficiency by splitting samples with a laboratory that is certified by AMRL and/or CCRL.
- When CT methods are used, the consultant or local agency laboratory that performs IA services for the local agency should perform proficiency tests with a laboratory that is accredited by Caltrans.
- Caltrans Reference Sample Program (RSP) or the laboratory and tester to be used should be demonstrating proficiency by splitting samples with a laboratory that is certified by Caltrans. See Appendix P.
- The consultant (or local agency employee) should maintain accurate IA records, as outlined in the local agency's approved QAP. The IA person selected by the local agency should have a good knowledge of all facets of the construction process. Specifically, the IA person should have a good understanding of transportation construction practices, standard test procedures, equipment calibration and materials testing. The IA person should be organized and familiar with the local agency's approved QAP. When an IA person is selected by the local agency, the local agency should prepare a letter, stating that the local agency has approved this person to perform their IA services. See Appendix M.

5.2 PROFICIENCY TESTING (BY THE IA PERSON)

It is suggested that the IA person work in a laboratory that performs annual proficiency tests using AMRL, CCRL and/or CT methods. Proficiency tests are also called corroboration tests, round-robin tests and split-sample tests. For local agencies that use ASTM and AASHTO standards, the qualified laboratory should be accredited by AASHTO and perform annual proficiency tests with AMRL and/or CCRL. For local agencies that use CT methods on their projects, annual proficiency tests should be performed with the Caltrans Reference Sample Program.

If the IA person is not working through an AMRL, CCRL or a Caltrans accredited laboratory; at a minimum, the following tests should be performed by the IA person with the accredited laboratory:

- Sieve Analysis
- Sand Equivalent
- Cleanness Value

When an IA person working from an unaccredited laboratory performs proficiency tests with a tester from an accredited laboratory, material samples for proficiency tests should be prepared by the accredited laboratory. The IA person should perform the material tests, using IA person's own equipment, and forward the test results to the accredited laboratory for evaluation. See Appendix N for a corroboration chart used to determine acceptable comparisons between an IA person and a tester from an accredited laboratory. The IA person must receive acceptable test results on each test performed (i.e., "Good" or "Fair" rating for each test performed) to be eligible as an IA person. An example of acceptable round-robin testing between a tester from an accredited laboratory and an IA person is shown in Appendix P.

5.3 IA PERSONNEL RESTRICTIONS

5.3.1 TESTER TRAINING AND TESTER CERTIFICATION SHOULD BE PERFORMED BY DIFFERENT IA STAFF

To avoid a conflict of interest, the local agency IA person should not train acceptance testers and also qualify them for the same tests. For example, the IA person should not teach acceptance testers how to calibrate testing equipment and then verify that the testing equipment is properly calibrated. The training activities should be conducted by a different person.

However, it is totally acceptable for an IA person from another agency to train the acceptance samplers and testers for your agency. If a local agency does not have adequate staff to train acceptance samplers and testers, excellent training personnel are usually available in the private sector. (i.e., American Concrete Institute, Asphalt Institute, National Institute of Certification of Engineering Technologies, etc.)

5.3.2 IA STAFF MUST REMAIN INDEPENDENT FROM ACCEPTANCE TESTING

The IA person should not perform both IA services and acceptance testing for an agency. The IA person should remain totally separate (or independent) from all elements of the specification compliance process. The main function of the IA Person is to "test the acceptance tester" and not be directly involved with the acceptance of materials.

5.3.3 USE SEPARATE TESTING EQUIPMENT FOR IA ACTIVITIES

When acceptance testers perform proficiency tests, the IA person should not use testing equipment that is also used for acceptance testing. Separate testing equipment should be used. This separate equipment should never be used by others, especially workers who perform acceptance testing for the local agency.

5.4 ISSUING CERTIFICATES OF PROFICIENCY FOR ACCEPTANCE SAMPLERS AND TESTERS

Annually the IA person should issue a Certificate of Proficiency to each local agency's sampler and tester to qualify the person to perform work for the local agency. To assist with this qualification process, samplers and/or testers may be asked to take a standard written examination to demonstrate knowledge of the test procedure. An example of standard test method questions is shown in Appendix R. In addition, the IA person should review the calibration status of the equipment used for acceptance testing.

The Certificate of Proficiency should include the following items:

- The printed full name of the acceptance sampler and/or tester
- The company and address of the qualified sampler and/or tester
- A list of the test methods the sampler and/or tester is qualified to perform
- The re-qualification date (month and year) for each test
- The printed name (and signature) of the IA person
- The date the certificate is issued

Each sampler and/or tester should receive a copy of the Certificate of Proficiency. Prior to sampling and testing on a local agency transportation project, the IA person should provide the Resident Engineer with a copy of the Certificate of Proficiency for each sampler and tester on the project. See Appendix Q for an example of a Certificate of Proficiency.

5.5 ISSUING LABORATORY ACCREDITATION CERTIFICATES

At least once during each calendar year, the IA person should review each materials testing laboratory that performs work for the local agency to verify the laboratory has the following:

- A current copy of the local agency's QAP (signed and dated by a city or county engineer).
- A current copy of all test methods used by the local agency.
- Proper test equipment (with firmly attached calibration stickers dated within 12 months of the current date), supporting calibration records and round-robin test results (from an accredited laboratory tied to AMRL, CCRL or Caltrans' RSP).
- Current Certificates of Proficiency for all samplers and/or testers expected to be on the project.

The Laboratory Accreditation Certificate should include the printed name and address of the laboratory, the accreditation date, a list of the tests the laboratory is accredited to perform and the full name of the IA person, and a statement that all of the above requirements have been met.

See Appendix S for an example of a Laboratory Accreditation Certificate for a materials testing laboratory.

5.6 PERFORMING WITNESS TESTS

At least once during each calendar year, the IA person should meet with the local agency acceptance sampler and tester, and observe the person perform the test (or tests) that the person is qualified to perform. The meeting location may be designated by the IA person. Materials used for the witness testing may be from any source or location determined by the IA person. If the IA person observes that the sampling and/or testing procedures are performed correctly, the successful witness test is documented. See Appendix T for an example of a Witness Test Report.

However, if a test is not performed correctly, or the equipment does not have a proper calibration sticker, the IA person is required to immediately notify the acceptance sampler and/or tester that they are disqualified for that test. The disqualified person should also be handed a notice stating the terms of the decertification. An example would be: “the acceptance tester improperly used a wooden stake instead of the required tamping rod to consolidate the concrete during fabrication of the test cylinders.” The disqualified person should then wait at least seven days before requesting another witness test for the test that was incorrectly performed. It should be noted, that when a person is disqualified for one or more tests, the person is still qualified to perform the other tests identified on the Certificate of Proficiency.

5.7 PERFORMING PROFICIENCY TESTS (ALSO KNOWN AS CORROBORATION TESTS, ROUND-ROBIN TESTS AND SPLIT-SAMPLE TESTS)

At least once during each calendar year, the local agency IA person should present each acceptance tester with a representative sample of soil or aggregate for proficiency testing. Corroboration samples are prepared by the IA person using materials either on or off the project site. One split sample is tested by the IA person, using test equipment not used for acceptance testing. These test results are used as a standard to evaluate the results obtained by the acceptance tester.

After a second split sample is presented to the acceptance tester, the acceptance tester is asked to go to the laboratory and perform the following tests: sand equivalent, cleanness value and sieve analysis.

The acceptance tester's results should be e-mailed or faxed to the IA person within three days after the split sample is presented. Test results from the acceptance tester are then compared to the test results of the IA person using the following table. An example of a Proficiency Test Report (corroboration) is shown in Appendix U.

	Degree of Corroboration		
Type of Test	Good **(Satisfactory)**	Fair **(Satisfactory)**	Poor **(Unsatisfactory)**
Sieve Analysis (Percent Passing)			
No. 4 Sieve and Larger	**2 or less**	**3 to 4**	**5 or more**
No. 8 – No. 30	**2 or less**	**3**	**4 or more**
No. 50 – No. 100	**2 or less**	**3**	**4 or more**
No. 200	**1 or less**	**2**	**3 or more**
Sand Equivalent (Nearest whole number)	**3 or less**	**4 to 5**	**6 or more**
Cleanness Value (Nearest whole number)	**3 or less**	**4 to 6**	**7 or more**

NOTE: When Caltrans performs IA services for a local agency, only three proficiency tests are evaluated. These tests include: sieve analysis, sand equivalent and cleanness value.

When an acceptance tester receives an "unsatisfactory rating", the IA person immediately meets with the tester, examines the test equipment, the equipment calibration scores, and the test procedures used by the acceptance tester and witnesses the acceptance tester perform the test using their own test equipment. If the non-corroboration can be resolved and a satisfactory score achieved by the acceptance tester, the acceptance tester may continue to perform testing on the project. If the non-corroboration cannot be resolved, both the tester and equipment cannot continue to be used for acceptance testing and the tester is disqualified for the test in question until the problem is resolved. Usually this is done by presenting a second split sample for testing. It should be noted, that when a tester is disqualified for one test, the tester is still qualified to perform the other tests identified on the Certificate of Proficiency. The disqualified tester should also be handed a notice stating the terms of the disqualification. The tester must wait at least seven days before requesting another witness test for the test that was incorrectly performed. All Resident Engineers or project engineers should immediately be notified once an acceptance tester becomes disqualified.

When a local agency wishes to perform additional proficiency tests (other than the standard soils or aggregate tests), the local agency is encouraged to include tests on fresh concrete and the compaction of hot mix asphalt using guidelines from the table below:

Degree of Corroboration			
Type of Test	**Good (Satisfactory)**	**Fair (Satisfactory)**	**Poor (Satisfactory)**
Air Content of Fresh Concrete (%)	1/4 or less	1/2 to 3/4	1 or more
Unit Weight of Fresh Concrete (lb/cu.ft.)	2 or less	3 to 4	5 or more
Slump (or Penetration) of Fresh Concrete (%)	Less than 1/4	1/4 to 1/2	3/4 more
Compaction of Hot Mix Asphalt (%)	Less than 1	1 to 2	3 or more

5.7.1 PROCEDURES FOR TESTER REINSTATEMENT

Once a tester has been disqualified, the tester must wait at least 7 days before contacting the IA person to request a meeting to become re-qualified. After the waiting period, the IA person may decide to give the acceptance tester another written examination, ask the acceptance tester to present test equipment with a current calibration sticker, perform another witness test, and/or conduct another split sample test. Once satisfied that the acceptance tester is now performing the test satisfactorily (using properly calibrated test equipment and correct test procedures), the IA person is required to reissue an updated Certificate of Proficiency. It is the responsibility of the IA person to record and maintain all IA documents pertaining to the reinstatement of the acceptance sampler and/or tester, (i.e., copy of the written disqualification notice, record of written examinations, recertification notice, etc.). It is the responsibility of the acceptance tester to immediately show their updated Certificate of Proficiency to the Resident Engineer or project engineer.

5.8 PROCEDURE FOR DISPUTE RESOLUTION

Dispute resolution refers to the process of denial, suspension, revocation, appeals, and reinstatement of an IA person, an acceptance sampler and tester, or a laboratory. If the contractor or member of a private laboratory has a dispute with the local agency involving a quality assurance item, a manager from the local agency shall be selected to review the dispute. The Resident Engineer and/or IA person and the party in dispute will submit his/her substantiating paperwork to the management person, within 10 days after requested to do so. In some cases, one or more meetings may be needed to resolve disputes. Within a 30-day period, the local agency management person should try to resolve the dispute, based on the evidence presented. Appeals by the contractor, Resident Engineer, the IA person, or acceptance sampler and tester may be made after the final decision by the local agency management person. The person making the appeal should be directed to contact the District Local Assistance Engineer no more than 14 days after receiving written notice of the final decision by the local agency management person.

The District Local Assistance Engineer will head up the appeal process. Again, evidence will be presented and a final decision should be made within 30 days after receipt of the appeal. For additional guidelines concerning the dispute resolution process, refer to Caltrans IA Manual.

5.9 MAINTAINING ACCURATE RECORDS

It is the responsibility of the local agency's IA person (consultant or employee of the local agency) and the Resident Engineer to create, and maintain accurate records for all IA and acceptance materials testing performed on local agency construction projects. Per CFR Title 49, Section 18.42, a local agency using federal funds for a transportation project must maintain pertinent construction records for three years subsequent to final project voucher reimbursement or through the period of litigation, whichever is later. A complete set of Resident Engineer records should include the following:

- A log summary of the acceptance tests taken on the project
- Copies of all tester qualification and lab certifications
- All acceptance tests taken on the project
- Copies of all IA testing performed on the project
- Copies of Certificates of Compliance
- Records of pre-manufactured materials (collection of release tags)
- Materials certificate (signed by the Resident Engineer at the completion of the project)
- A copy of the approved QAP with the date of approval

(See Appendices G, H, J.1, J.2, K, P, Q, S, T, U, V.I, V.2, and W for examples of these records.)

6.0 FHWA/CALTRANS PROCESS REVIEWS

FHWA and/or Caltrans process review teams randomly visit California local agencies to examine their materials records on selected Federal-aid construction projects. During a FHWA or Caltrans process review, the IA person and the Resident Engineer may only have five to seven days to retrieve all their project files and review the materials testing elements on their project. Under these conditions, it is imperative that all materials records for each construction project are accurate, well organized and stored in an easily retrievable place.

The process review team may typically ask several questions pertaining to the quality assurance process. They are especially interested in examining the written documentation collected during the construction of the project, to verify that proper amounts of sampling and testing were performed in accordance with the local agency's QAP and determine if all failed tests were resolved.

From project plans, quantities of materials used, and the local agency's QAP frequency tables, it is relatively easy to determine the minimum number of acceptance tests that are required on the project. In the past, California local agencies have not always had the proper number of acceptance tests and other required items in their project files. It should be noted that the role of the review team is to examine all areas of the local agency's QAP and observe whether or not the local agency has done what is required. Their main objectives are to assist state and local agencies with their control of materials and encourage them to fully document all required materials records as noted in their QAP. This manual is intended to help local agencies fulfill material testing and record requirements on their Federal-aid projects and to help ensure both state and federal compliance with future Caltrans or FHWA process reviews. See Appendix X for commonly asked questions during a Caltrans or FHWA process review.

Note: The following pages contain quality assurance forms and information to assist local agencies to maintain required quality assurance and independent assurance records. The pages include Appendices A to X. Appendices I and O have been purposely excluded from the appendices.

The City of

SANTA CLARA

California

STANDARD SPECIFICATIONS for PUBLIC WORKS CONSTRUCTION

Prepared by

Public Works Department

Rajeev Batra

Director of Public Works/City Engineer

E. City may terminate portions or parts of the Work for cause, provided these portions or parts (1) have separate geographic areas from parts or portions of the Work not terminated or (2) are limited to the work of one or more specific trades or Subcontractors. In such case, Contractor shall cooperate with a completing contractor as required under Article 6 of this Document 00700.

F. In the event a termination for cause is later determined to have been made wrongfully or without cause, then the termination shall be treated as a termination for convenience, and Contractor shall have the recovery rights specified in paragraph 13.8. Any Contractor claim arising out of a termination for cause, however, shall be made in accordance with Article 12 of this Document 00700. No other loss cost, damage, expense or liability may be claimed, requested or recovered by Contractor.

13.8. Termination of Contract for Convenience

A. City may terminate performance of the Work under the Contract Documents in accordance with this clause in whole, or from time to time in part, whenever City shall determine that termination is in City's best interest. Termination shall be effected by City delivering to Contractor notice of termination specifying the extent to which performance of the Work under the Contract Documents is terminated and the effective date of the termination.

B. After receiving a notice of termination under paragraph 13.8.A of this Document 00700, and except as otherwise directed by City, Contractor shall:

1. Stop Work under the Contract Documents on date and to extent specified in notice of termination;

2. Place no further orders or subcontracts for materials, services, or facilities except as necessary to complete portion of Work under the Contract Documents which is not terminated;

3. Terminate all orders and subcontracts to extent that they relate to performance of Work terminated by the notice of termination;

4. Assign to City in manner, at times, and to extent directed by City, all right, title, and interest of Contractor under orders and subcontracts so terminated. City shall have the right, in its sole discretion, to settle or pay any or all claims arising out of termination of orders and subcontracts;

5. Settle all outstanding liabilities and all claims arising out of such termination of orders and subcontracts, with approval or ratification of City to extent City may require. City's approval or ratification shall be final for purposes of this paragraph 13.8;

6. Transfer title to City, and deliver in the manner, at the times, and to the extent, if any, directed by City, all fabricated or unfabricated parts, Work in process, completed Work, supplies, and all other material produced as part of, or acquired in connection with performance of, Work terminated by the notice of termination, and completed or partially completed drawings, drawings, specifications, information, and other property which, if the Project had been completed, would have been required to be furnished to City;

7. Use its best efforts to sell, in manner, at times, to extent, and at price or prices that City directs or authorizes, any property of types referred to in paragraph 13.8.B.6 of this Document 00700, but Contractor shall not be required to extend credit to any purchaser, and may acquire any such property under conditions prescribed and at price or prices approved by City. Proceeds of transfer or disposition shall be applied to reduce payments to be made by City to Contractor under the Contract Documents or shall otherwise be credited to the price or cost of Work covered by Contract Documents or paid in such other manner as City may direct;

8. Complete performance of the part of the Work which was not terminated by the notice of termination; and

9. Take such action as may be necessary, or as City may direct, to protect and preserve all property related to Contract Documents which is in Contractor's possession and in which City has or may acquire interest.

C. After receipt of a notice of termination under paragraph 13.8A of this Document 00700, Contractor shall submit to City its termination claim, in form and with all certifications required by Article 12 of this Document 00700. Contractor's termination claim shall be submitted promptly, but in no event later than 6 months from effective date of the termination. Contractor and City may agree upon the whole or part of the amount or amounts to be paid to Contractor because of a total or partial termination of Work under this paragraph 13.8. If Contractor and City fail to agree on the whole amount to be paid to Contractor because of the termination of the Work under this paragraph 13.8, City's total liability to Contractor by reason of the termination shall be the total (without duplication of any items) of:

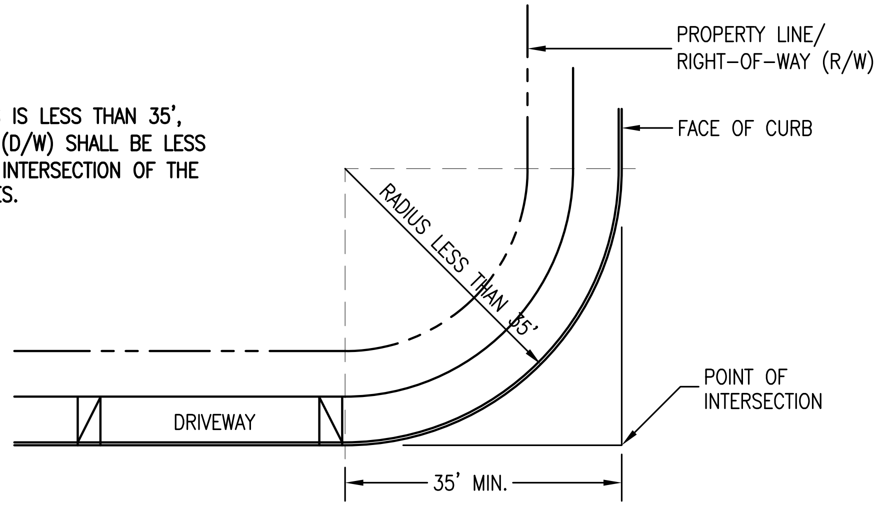
1. The reasonable cost to Contractor, without profit, for all Work performed prior to the effective date of the termination, including Work done to secure the Project for termination. Reasonable cost may not exceed the applicable percentage completion values derived from the progress schedule and the schedule of values. Deductions shall be made for cost of materials to be retained by Contractor, cost of Work defectively performed, amounts realized by sale of materials, and for other appropriate credits against cost of Work. Reasonable cost will include reasonable allowance for Project overhead and general administrative overhead not to exceed a total of ten percent of direct costs of such Work. When, in City's opinion, the cost of any item of Work is excessively high due to costs incurred to remedy or replace defective or rejected Work, reasonable cost to be allowed will be the estimated reasonable cost of performing the Work in compliance with requirements of Contract Documents and excessive actual cost shall be disallowed.

2. A reasonable allowance for profit on cost of Work performed as determined under paragraph 13.8.C.1 of this Document 00700, provided that Contractor establishes to City's satisfaction that Contractor would have made a profit had the Project been completed, and provided further that the profit allowed shall not exceed 5 percent of cost.

3. Reasonable costs to Contractor of handling material returned to vendors, delivered to City or otherwise disposed of as directed by City.

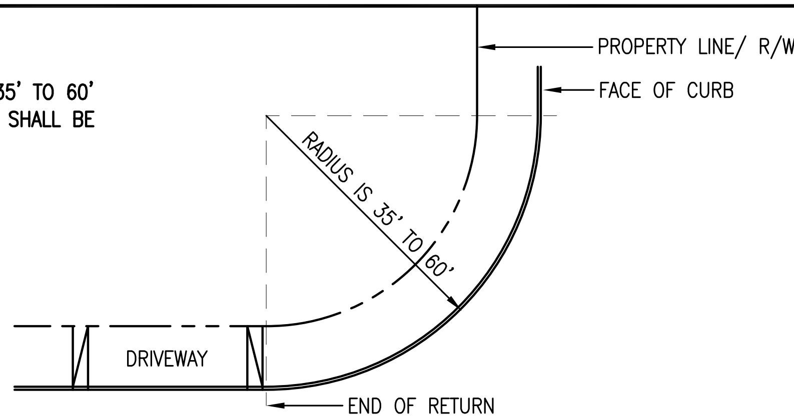
CONDITION 1

WHERE A CURB RETURN RADIUS IS LESS THAN 35', NO PORTION OF ANY DRIVEWAY (D/W) SHALL BE LESS THAN 35' FROM THE POINT OF INTERSECTION OF THE PROJECTED FACE OF CURB LINES.



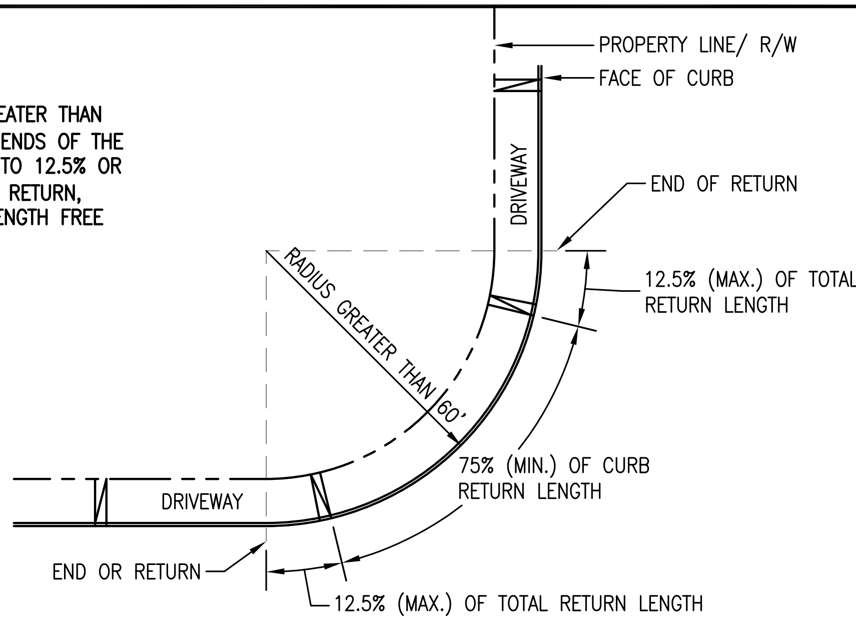
CONDITION 2

WHERE THE CURB RETURN RADIUS IS 35' TO 60' (INCLUSIVE), NO PORTION OF ANY D/W SHALL BE PERMITTED WITHIN THE CURB RETURN.



CONDITION 3

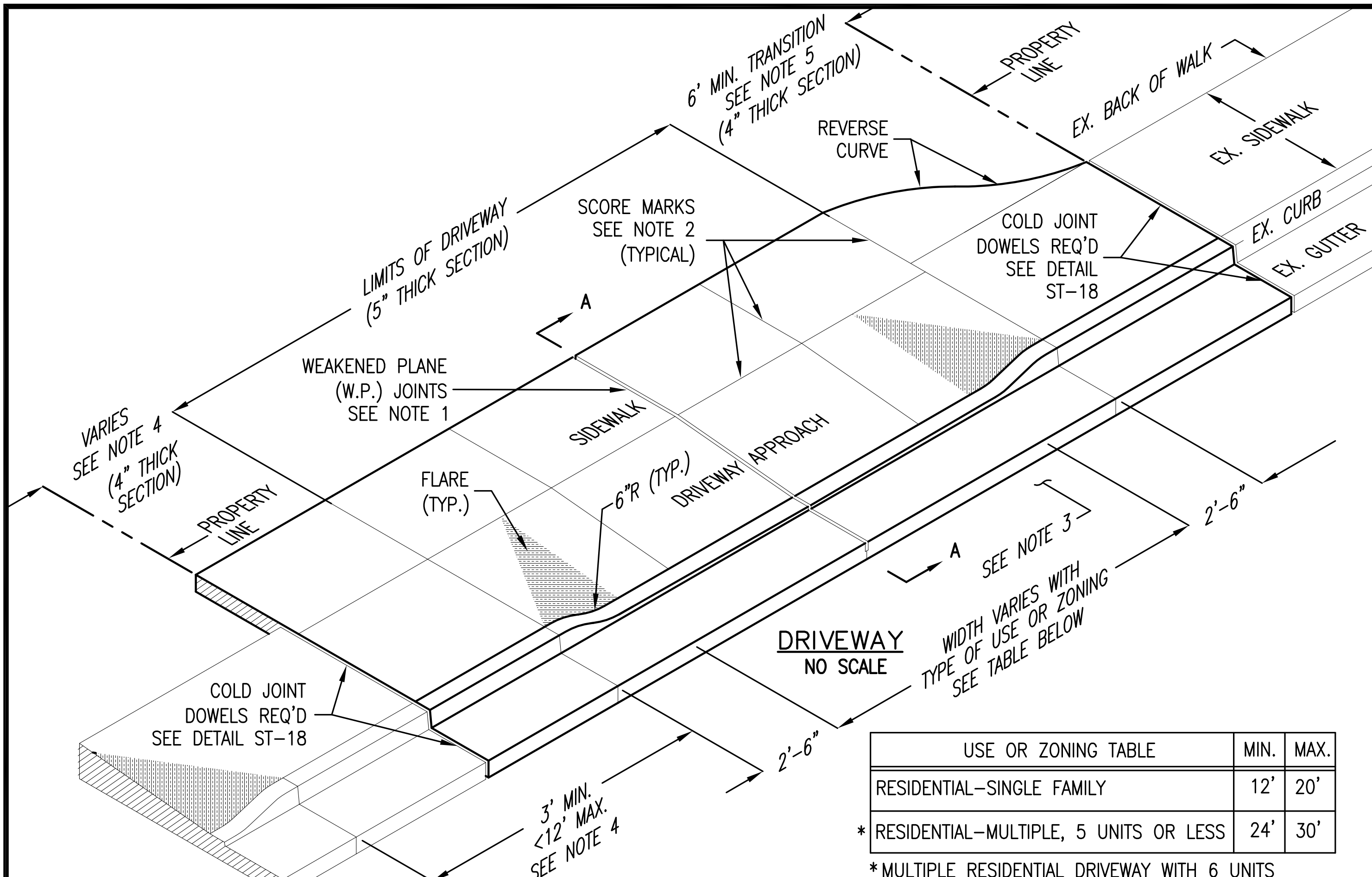
WHERE A CURB RETURN RADIUS IS GREATER THAN 60', D/W MAY ENCROACH UPON EACH ENDS OF THE RETURNS A MAXIMUM DISTANCE EQUAL TO 12.5% OR 1/8TH THE ARC LENGTH OF THE CURB RETURN, LEAVING 75% OF THE CURB RETURN LENGTH FREE FROM D/W ENCROACHMENTS.



CONDITION 4

ON ALL CURB RETURNS WHERE CHANNELIZATION AND/OR COMPOUND CURVES EXIST, D/W LOCATION SHALL BE SUBJECT TO APPROVAL BY THE CITY ENGINEER.

DRAWN BY: K. TRAN	DRIVEWAY LOCATIONS AT CURB RETURNS	ST-3
CHECKED BY: F. AMIN		
APPROVED BY: G. GOMEZ		
DATE: OCTOBER 2013	CITY OF SANTA CLARA	PAGE: 3



USE OR ZONING TABLE	MIN.	MAX.
RESIDENTIAL–SINGLE FAMILY	12'	20'
* RESIDENTIAL–MULTIPLE, 5 UNITS OR LESS	24'	30'

*MULTIPLE RESIDENTIAL DRIVEWAY WITH 6 UNITS OR MORE SHALL USE COMMERCIAL DRIVEWAY.

NOTES:

1. W.P. JOINTS REQUIRED ON CENTERLINE FOR DRIVEWAYS 12' TO 20' WIDE. DRIVEWAYS 24' TO 30' WIDE SHALL HAVE 2 W.P. JOINTS EVENLY SPACED (AT 1/3 AND 2/3 POINTS).

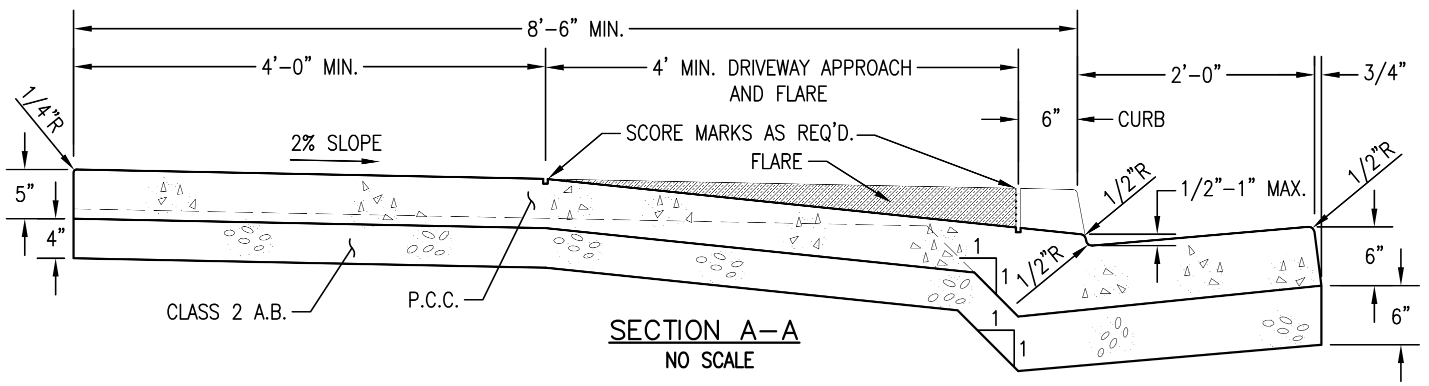
2. PLACE SCORE MARKS AT 1/4 POINTS ON DRIVEWAYS 12' TO 20' WIDE AND AT 1/6 POINTS ON DRIVEWAYS 24' TO 30' WIDE. SCORE MARK REQUIRED AT DRIVEWAY SLOPE BREAK PARALLEL TO EXISTING FACE OF CURB.

3. 18" WIDE BAND OF PAVEMENT SHALL BE REMOVED AND REPLACED. SEE NOTE 5 OF GENERAL NOTES (APPENDIX) FOR REQUIREMENTS.

4. WHERE THE DISTANCE BETWEEN NEW DRIVEWAY LIMIT AND PROPERTY LINE IS LESS THAN 6 FEET AT THE BACK OF DRIVEWAY AND THERE IS AN ADJACENT DRIVEWAY LESS THAN 12 FEET DISTANCE AWAY, THE SIDEWALK SHALL NOT TRANSITION. NEW SIDEWALK SHALL TERMINATE AT PROPERTY LINE OR ADJACENT DRIVEWAY TO MAINTAIN ADA PATHWAY.

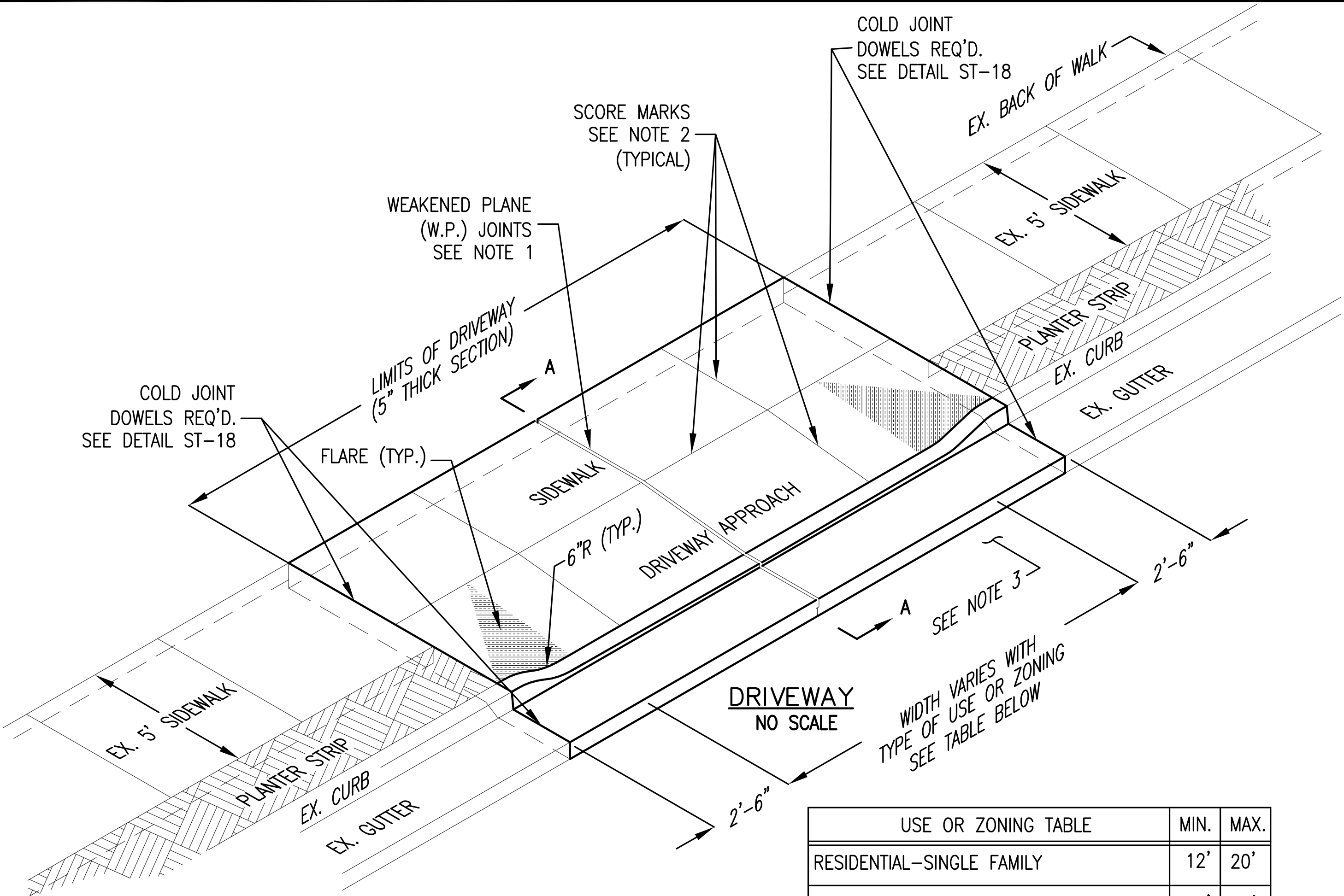
5. WHERE THE DISTANCE BETWEEN NEW DRIVEWAY LIMIT AND PROPERTY LINE IS EQUAL TO OR GREATER THAN 6 FEET AT THE BACK OF DRIVEWAY AND THERE IS NO ADJACENT DRIVEWAY WITHIN 12 FEET DISTANCE OF NEW DRIVEWAY, THE SIDEWALK SHALL TRANSITION FROM BACK OF DRIVEWAY TO EXISTING SIDEWALK.

6. IF THE EXISTING ON-SITE IMPROVEMENTS DO NOT MATCH THE GRADE OF THE REAR OF THE NEW DRIVEWAY, SUFFICIENT EXISTING IMPROVEMENTS SHALL BE RECONSTRUCTED TO PRODUCE A SMOOTH, USABLE SURFACE WITH A CHANGE IN GRADE NOT EXCEEDING 10%.



SECTION A–A
NO SCALE

DRAWN BY: K. TRAN	RESIDENTIAL DRIVEWAY WITH ATTACHED SIDEWALK		ST-4
CHECKED BY: F. AMIN			
APPROVED BY: G. GOMEZ			
DATE: MAY 2015	CITY OF SANTA CLARA		PAGE: 4



DRIVEWAY
NO SCALE

USE OR ZONING TABLE	MIN.	MAX.
RESIDENTIAL-SINGLE FAMILY	12'	20'
* RESIDENTIAL-MULTIPLE, 5 UNITS OR LESS	24'	30'

* MULTIPLE RESIDENTIAL DRIVEWAY WITH 6 UNITS OR MORE SHALL USE COMMERCIAL DRIVEWAY.

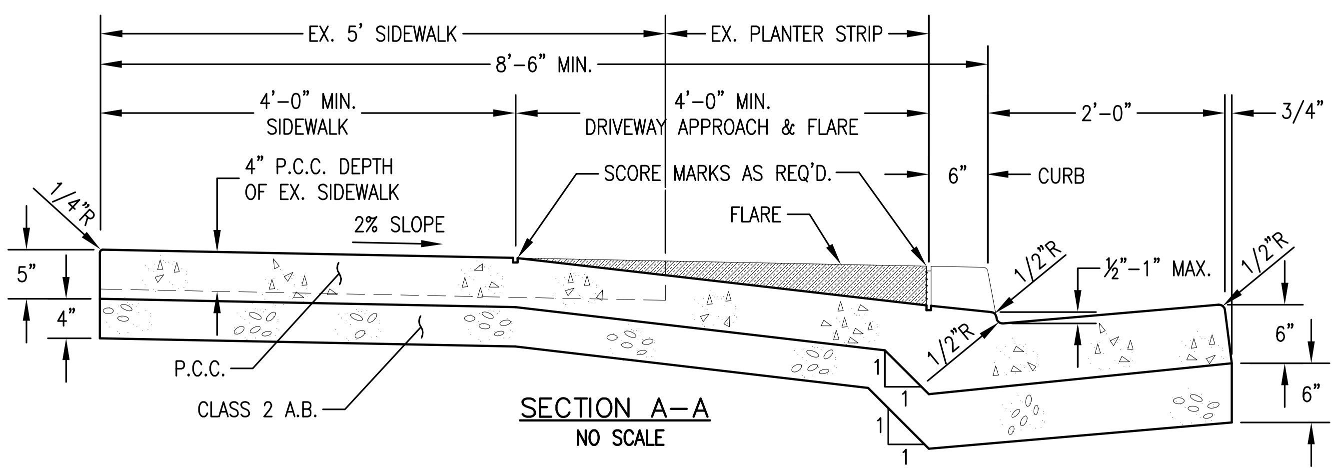
NOTES:

1. W.P. JOINTS REQUIRED ON CENTERLINE FOR DRIVEWAYS 12' TO 20' WIDE. DRIVEWAYS 24' TO 30' WIDE SHALL HAVE 2 W.P. JOINTS EVENLY SPACED (AT 1/3 AND 2/3 POINTS).

2. PLACE SCORE MARKS AT 1/4 POINTS ON DRIVEWAYS 12' TO 20' WIDE AND AT 1/6 POINTS ON DRIVEWAYS 24' TO 30' WIDE. SCORE MARK REQUIRED AT DRIVEWAY SLOPE BREAK PARALLEL TO EXISTING FACE OF CURB.

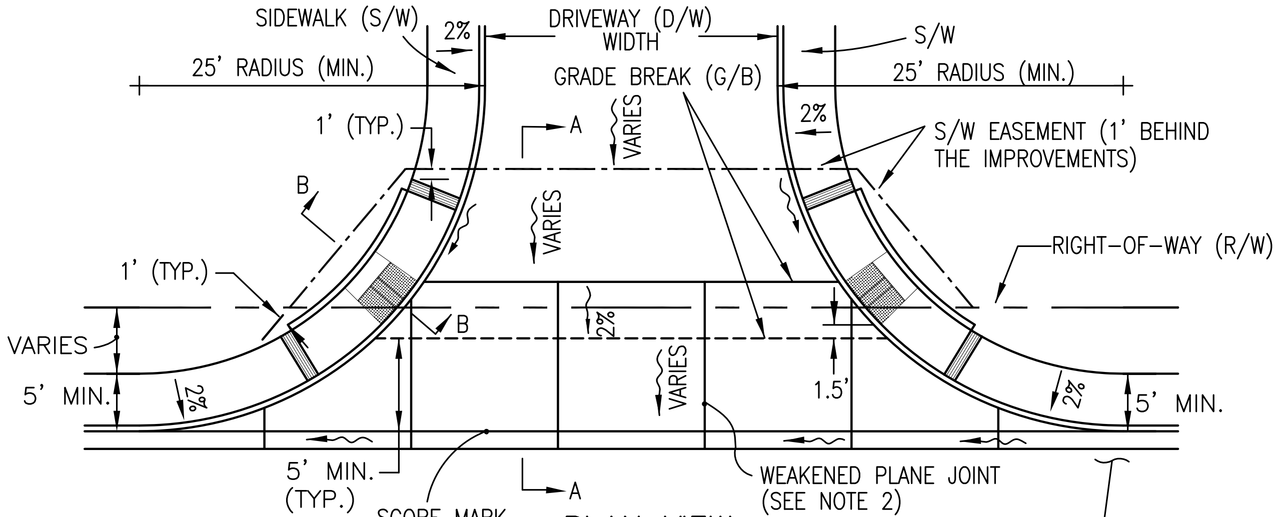
3. 18" WIDE BAND OF PAVEMENT SHALL BE REMOVED AND REPLACED. SEE NOTE 5 OF GENERAL NOTES (APPENDIX) FOR REQUIREMENTS.

4. IF THE EXISTING ON-SITE IMPROVEMENTS DO NOT MATCH THE GRADE OF THE REAR OF THE NEW DRIVEWAY, SUFFICIENT EXISTING IMPROVEMENTS SHALL BE RECONSTRUCTED TO PRODUCE A SMOOTH, USABLE SURFACE WITH A CHANGE IN GRADE NOT EXCEEDING 10%.

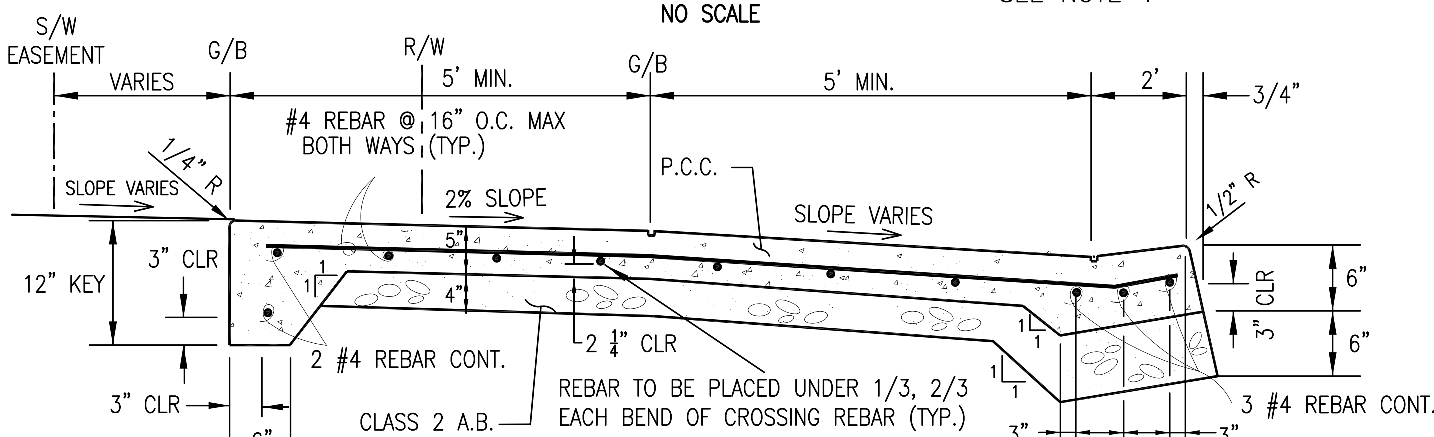


SECTION A-A
NO SCALE

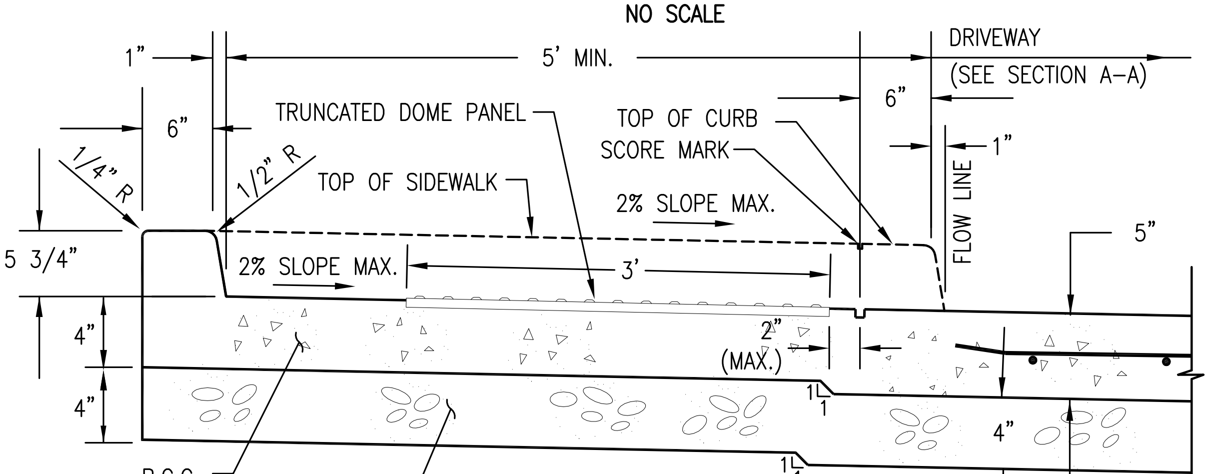
DRAWN BY: K. TRAN	RESIDENTIAL DRIVEWAY WITH SEPARATED SIDEWALK	ST-5
CHECKED BY: F. AMIN		
APPROVED BY: G. GOMEZ		
DATE: MAY 2015	CITY OF SANTA CLARA	PAGE: 5



PLAN VIEW
NO SCALE



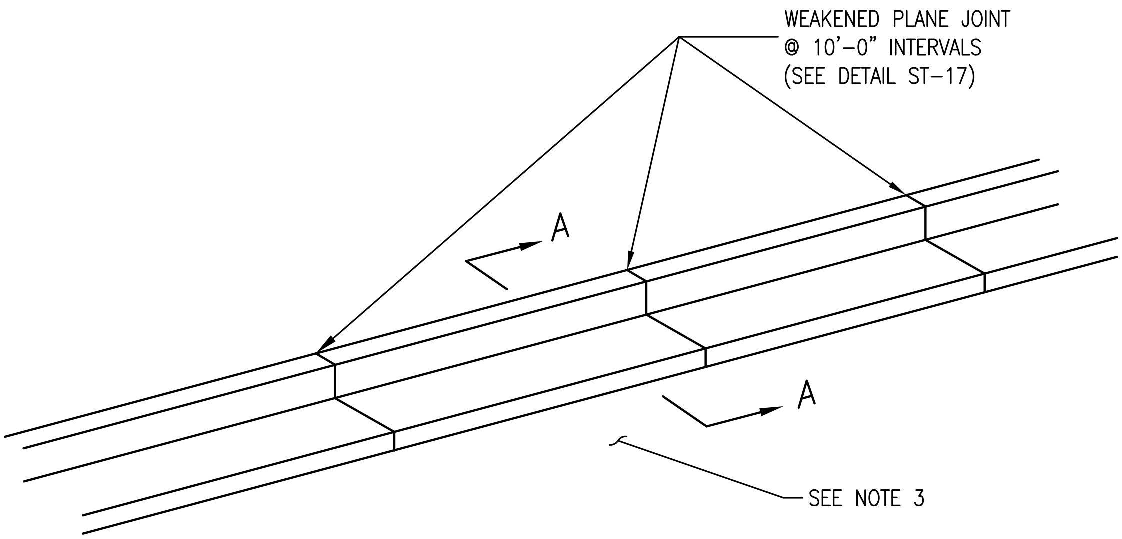
SECTION A–A
NO SCALE



SECTION B–B
NO SCALE

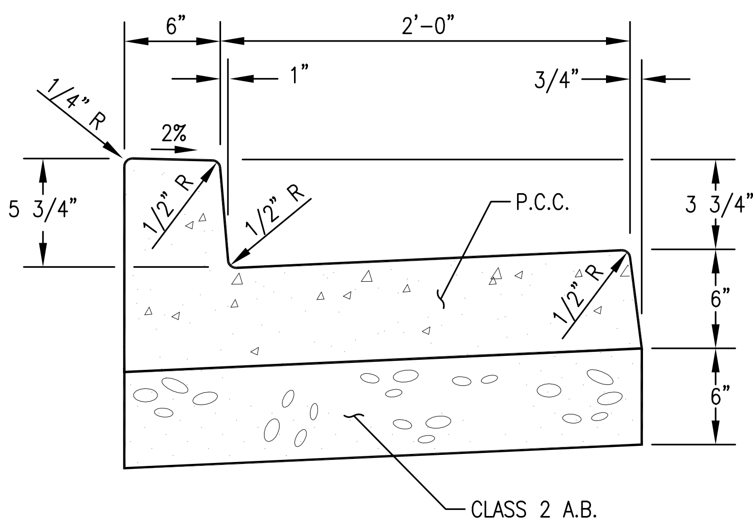
NOTES:
1. USE OF CURB-RETURN DRIVEWAY ALLOWED ONLY WITH WRITTEN APPROVAL OF CITY ENGINEER.
2. SEE DETAIL ST-8 FOR D/W WIDTH, JOINTS, AND SCORE MARKS. JOINTS/SCORE MARKS PATTERNS SHALL CONTINUE TO THE AREA OUTSIDE OF D/W WIDTH.
3. SEE DETAIL ST-14 FOR CURB RAMP CONSTRUCTION AND NOTES.
4. 18" WIDE BAND OF PAVEMENT SHALL BE REMOVED AND REPLACED. SEE NOTE 5 OF GENERAL NOTES (APPENDIX) FOR REQUIREMENTS.

DRAWN BY:	K. TRAN	CURB-RETURN DRIVEWAY	ST-10
CHECKED BY:	F. AMIN		
APPROVED BY:	F. AMIN		
DATE:	JANUARY 2016	CITY OF SANTA CLARA	PAGE: 10



CURB GUTTER

NO SCALE



SECTION A-A

NO SCALE

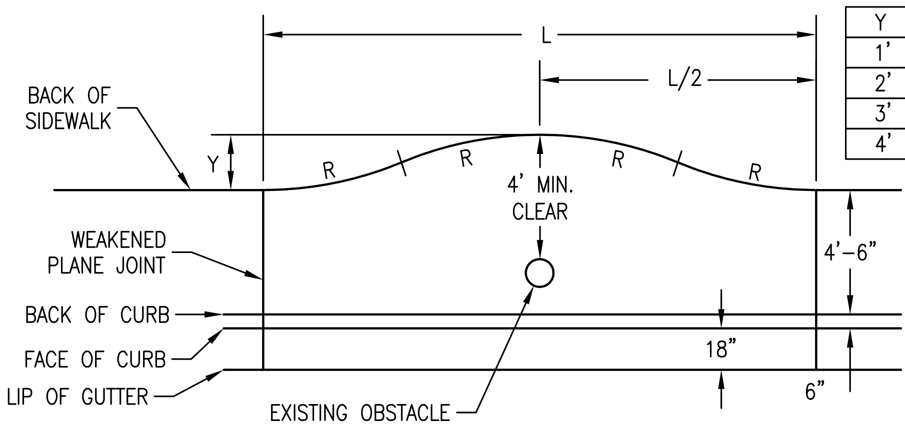
NOTES:

1. EXPANSION JOINTS (SEE DETAIL ST-17) SHALL BE INSTALLED AT MAJOR STRUCTURES AND CURB RETURNS.

2. TOLERANCE OF THE VERTICAL DIMENSION AT FACE OF CURB AND LIP OF GUTTER SHALL BE 1/4"±.

3. 18" WIDE BAND OF PAVEMENT SHALL BE REMOVED AND REPLACED. SEE NOTE 5 OF GENERAL NOTES (APPENDIX) FOR REQUIREMENTS.

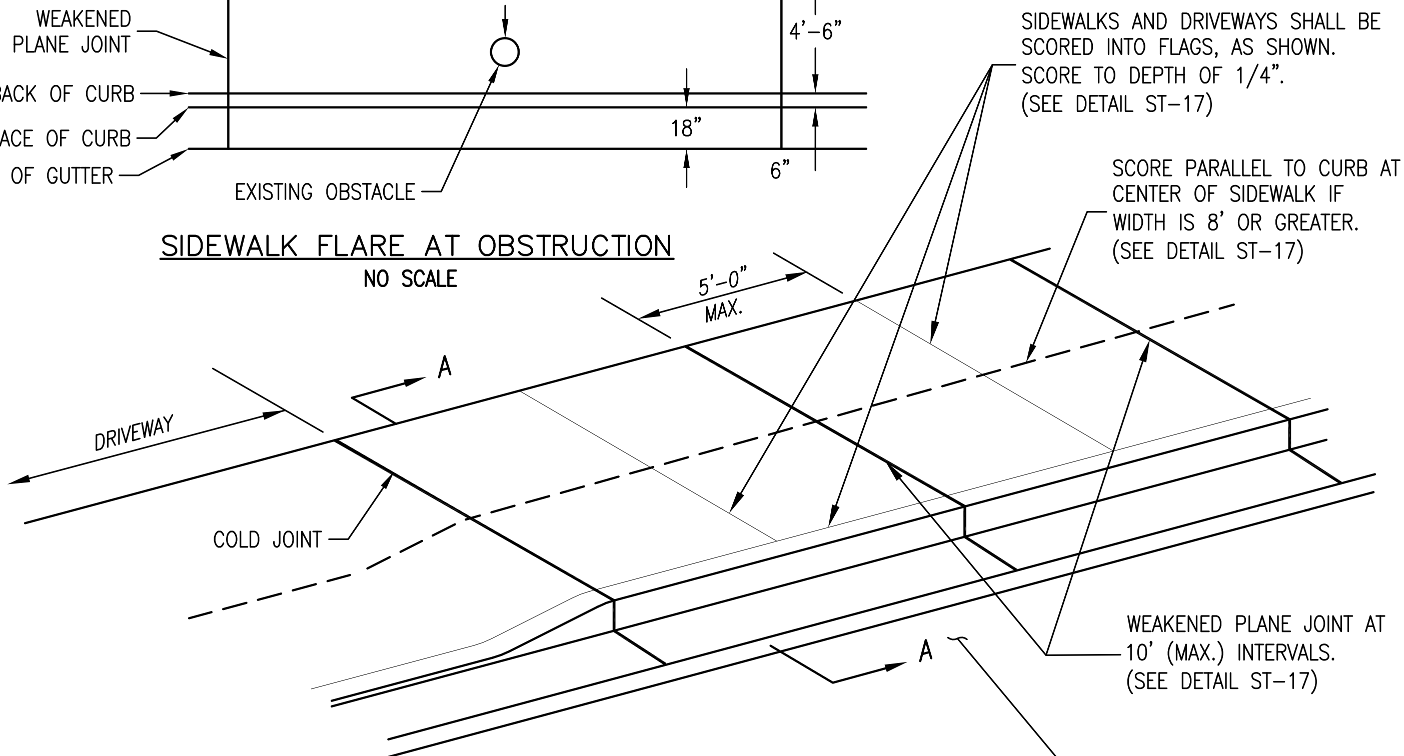
DRAWN BY:	K. TRAN	MONOLITHIC CURB AND GUTTER	ST-11
CHECKED BY:	F. AMIN		
APPROVED BY:	G. GOMEZ		
DATE:	OCTOBER 2013	CITY OF SANTA CLARA	PAGE: 11



Y	L	R
1'	20'	25'
2'	20'	13'
3'	20'	9'
4'	25'	11'

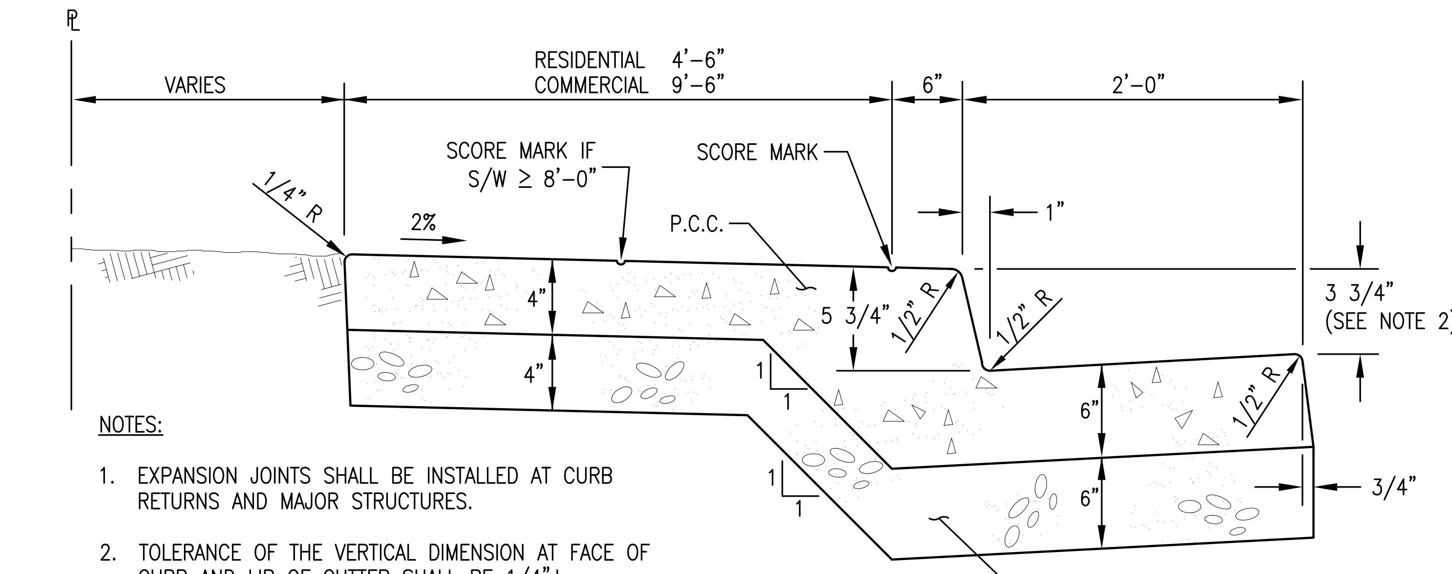
SIDEWALK FLARE AT OBSTRUCTION

NO SCALE



CURB, GUTTER & SIDEWALK

NO SCALE



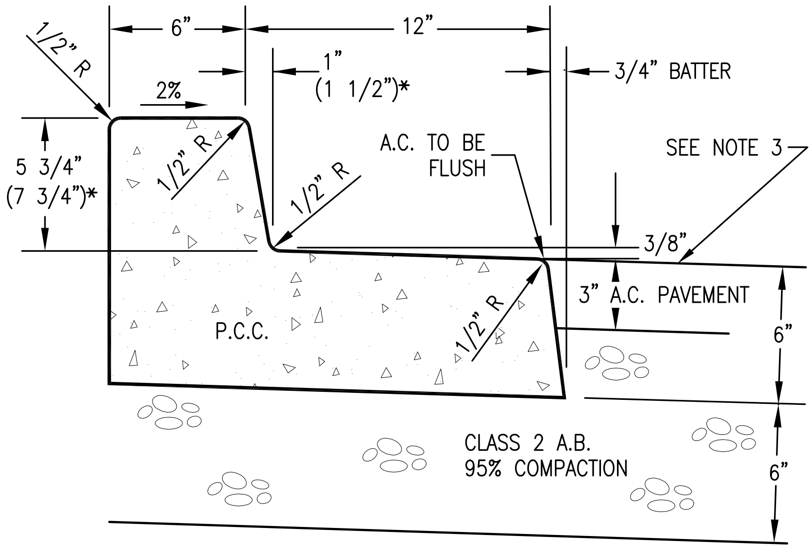
SECTION A–A

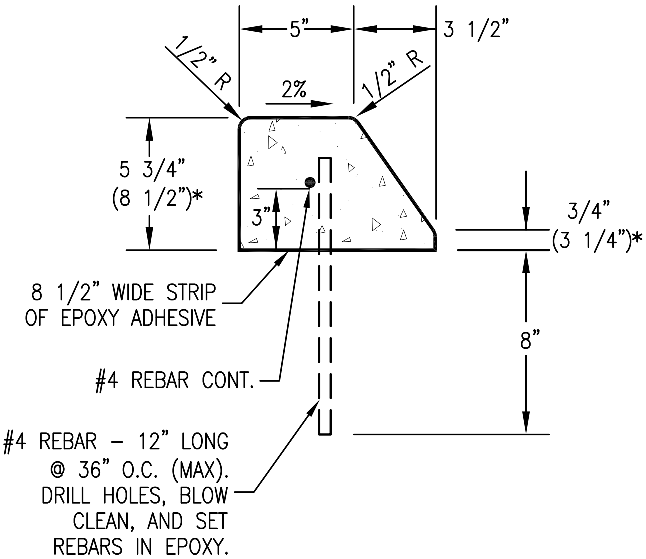
NO SCALE

NOTES:

1. EXPANSION JOINTS SHALL BE INSTALLED AT CURB RETURNS AND MAJOR STRUCTURES.
2. TOLERANCE OF THE VERTICAL DIMENSION AT FACE OF CURB AND LIP OF GUTTER SHALL BE 1/4"±.
3. 18" WIDE BAND OF PAVEMENT SHALL BE REMOVED AND REPLACED. SEE NOTE 5 OF GENERAL NOTES (APPENDIX) FOR REQUIREMENTS.

DRAWN BY: K. TRAN	MONOLITHIC CURB, GUTTER AND SIDEWALK	ST-12	
CHECKED BY: F. AMIN			
APPROVED BY: G. GOMEZ			
DATE: OCTOBER 2013	CITY OF SANTA CLARA	PAGE: 12	





TYPE A–6 & A–8 CURBS

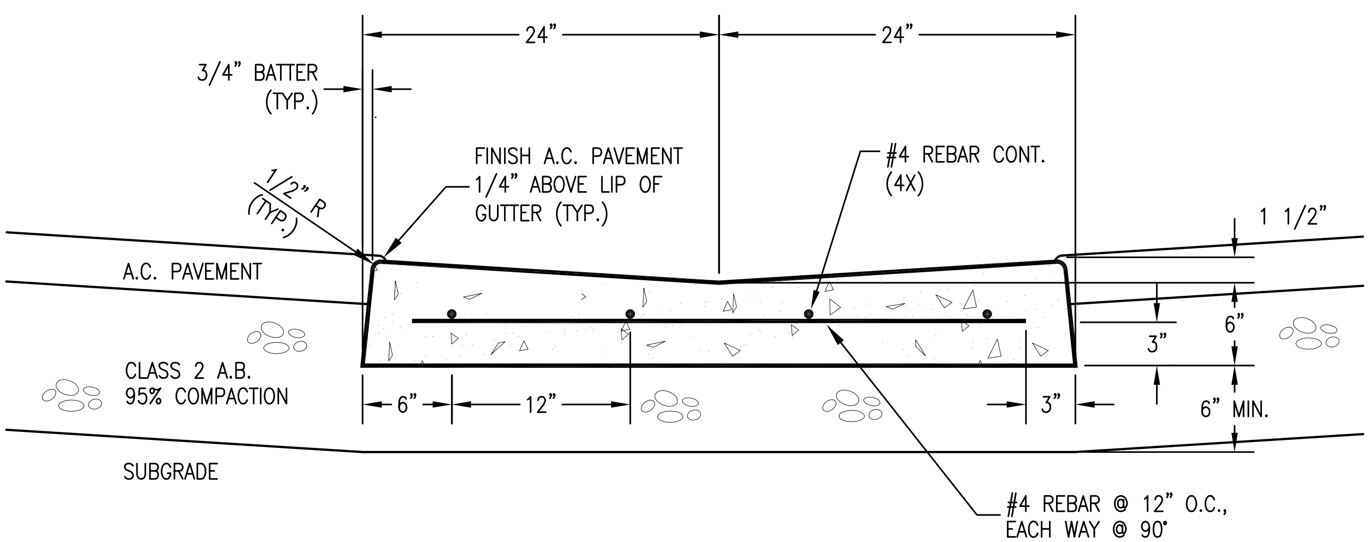
NO SCALE

NOTE: *DIMENSIONS SHOWN IN PARENTHESES ABOVE ARE FOR TYPE A–8 CURB ONLY.

TYPE B–6 & B–8 CURBS

NO SCALE

NOTE: *DIMENSIONS SHOWN IN PARENTHESES ABOVE ARE FOR TYPE B–8 CURB ONLY.



VALLEY GUTTER

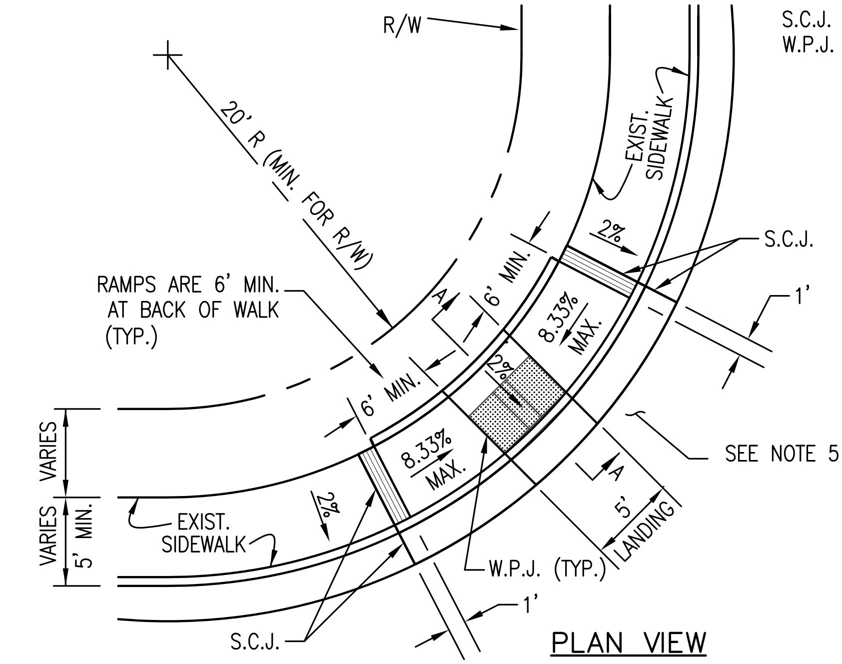
NO SCALE

NOTES:

1. CONCRETE VALLEY GUTTER SHALL BE INSTALLED PRIOR TO PAVING.
2. INSTALL WEAKENED PLANE JOINTS AT 10' INTERVALS (MAX).
3. 18" WIDE BANDS OF PAVEMENT ON EACH SIDE OF NEW VALLEY GUTTER SHALL BE REMOVED AND REPLACED. SEE NOTE 5 OF GENERAL NOTES (APPENDIX) FOR REQUIREMENTS.

DRAWN BY:	K. TRAN	CONCRETE MEDIAN CURBS AND VALLEY GUTTER	ST-13
CHECKED BY:	F. AMIN		
APPROVED BY:	G. GOMEZ		
DATE:	OCTOBER 2013	CITY OF SANTA CLARA	PAGE: 13

S.C.J. = SIDEWALK CONTACT JOINT
W.P.J. = WEAKENED PLANE JOINT



PLAN VIEW
NO SCALE

NOTES:

1. CURB RAMPS SHALL HAVE DETECTABLE WARNING SURFACES (GROOVING AND TRUNCATED DOMES). SEE DETAIL ST-16 FOR GROOVING DETAILS AND TRUNCATED DOME DETAILS.

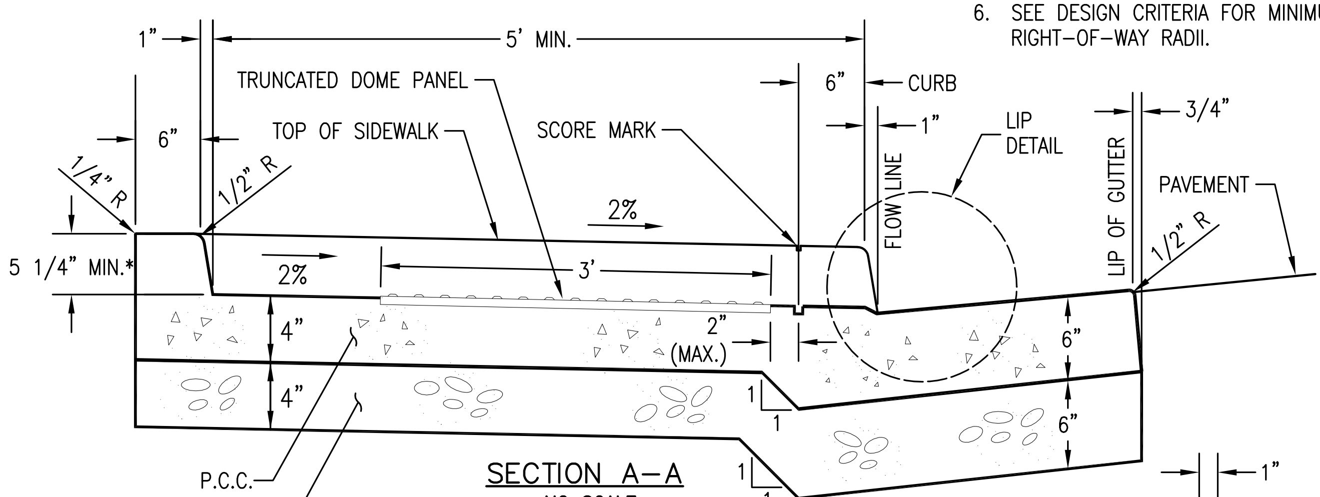
2. AT THE DISCRETION OF CITY ENGINEER, TWO CURB RAMPS SHALL BE REQUIRED WHERE THERE ARE TWO CROSS WALKS AT A CORNER.

3. CURB RAMPS FOR SEPARATED SIDEWALKS SHALL BE DESIGNED ON AN INDIVIDUAL BASIS.

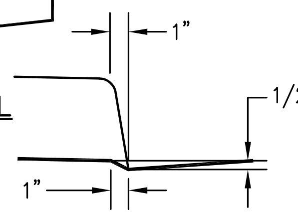
4. THE SURFACE OF RAMP SHALL HAVE A TRANSVERSE BROOMED SURFACE TEXTURE ROUGHER THAN THE SURROUNDING SIDEWALK.

5. 18" WIDE BAND OF PAVEMENT SHALL BE REMOVED AND REPLACED. SEE NOTE 5 OF GENERAL NOTES (APPENDIX) FOR REQUIREMENTS.

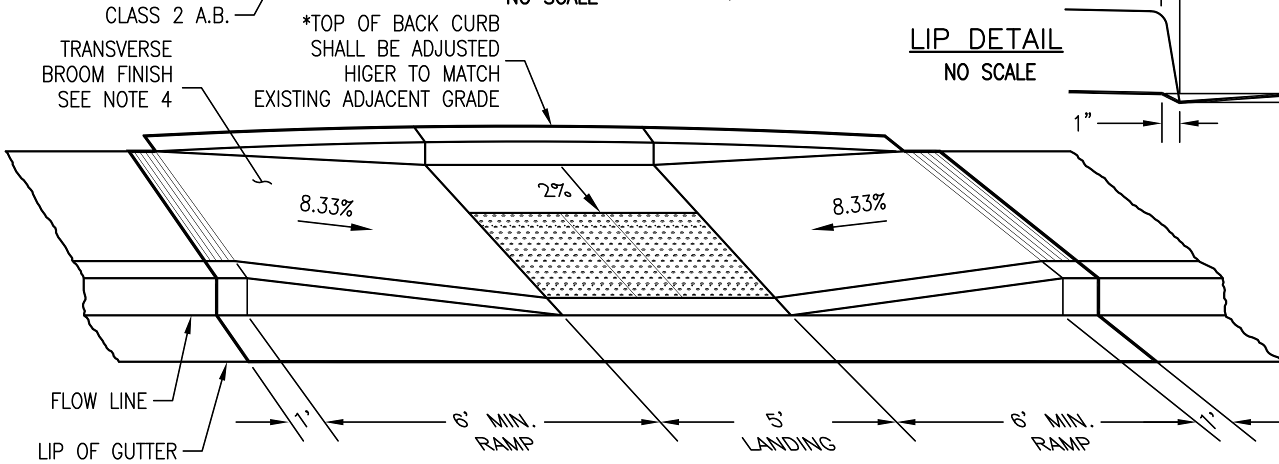
6. SEE DESIGN CRITERIA FOR MINIMUM RIGHT-OF-WAY RADII.



SECTION A–A
NO SCALE



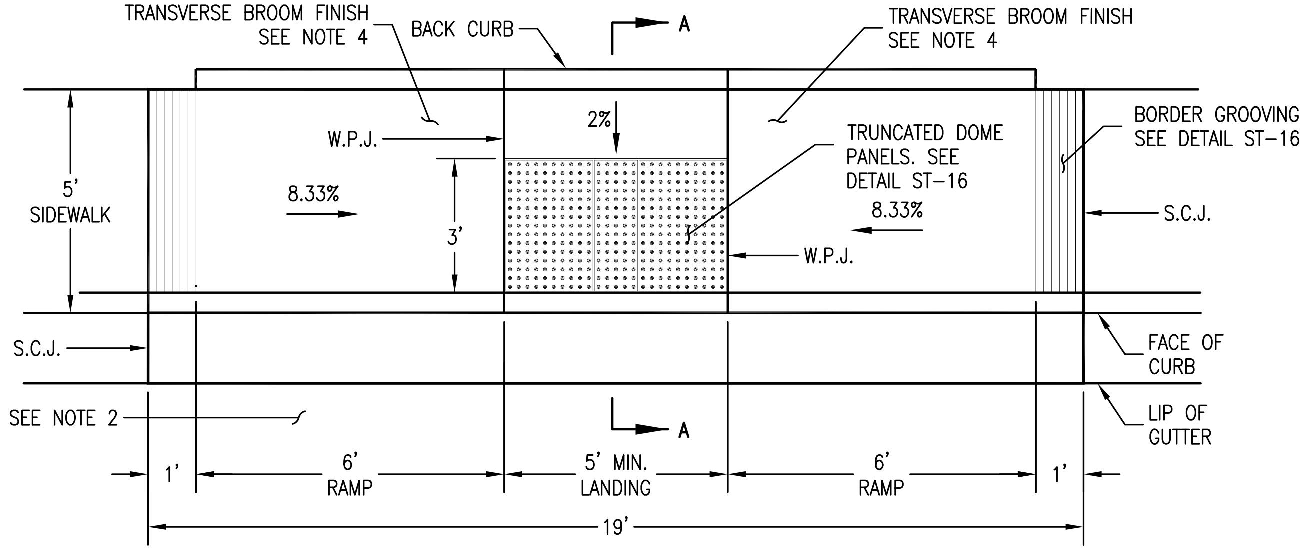
LIP DETAIL
NO SCALE



ELEVATION VIEW
NO SCALE

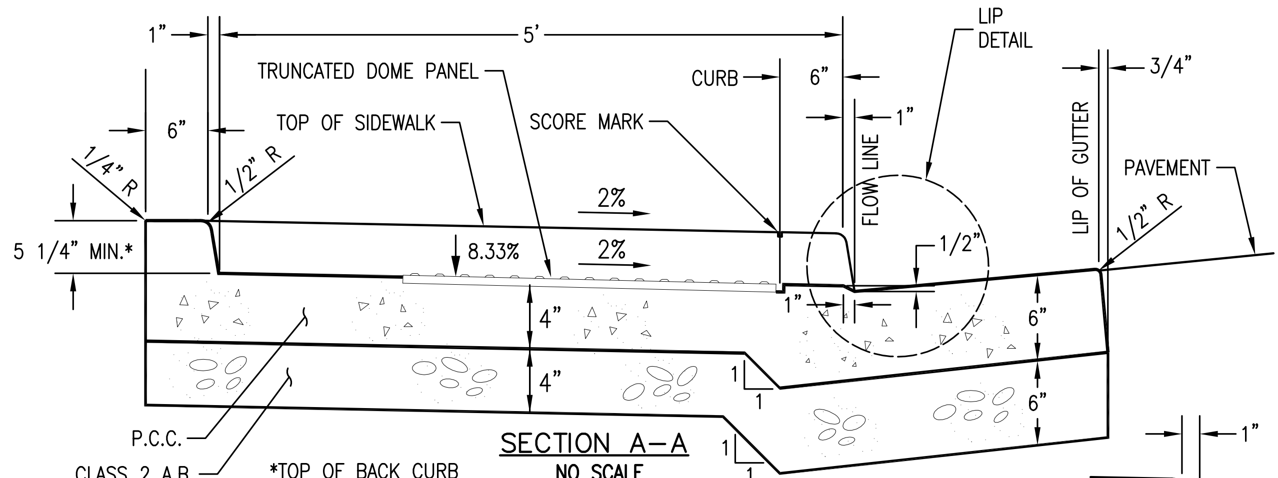
DRAWN BY: K. TRAN		CURVED CURB RAMP	ST-14
CHECKED BY: F. AMIN			
APPROVED BY: G. GOMEZ			
DATE: OCTOBER 2013		CITY OF SANTA CLARA	PAGE: 14

THE CITY OF SANTA CLARA CALIFORNIA
The Mission City
INCORPORATED 1852



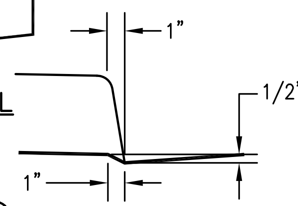
PLAN VIEW
NO SCALE

S.C.J. = SIDEWALK CONTACT JOINT
W.P.J. = WEAKENED PLANE JOINT

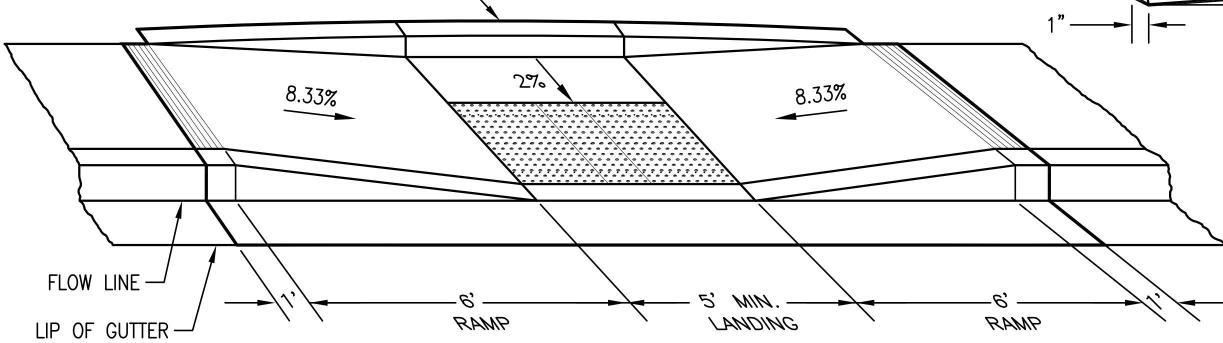


SECTION A-A
NO SCALE

*TOP OF BACK CURB SHALL BE ADJUSTED HIGHER TO MATCH EXISTING ADJACENT GRADE



LIP DETAIL
NO SCALE

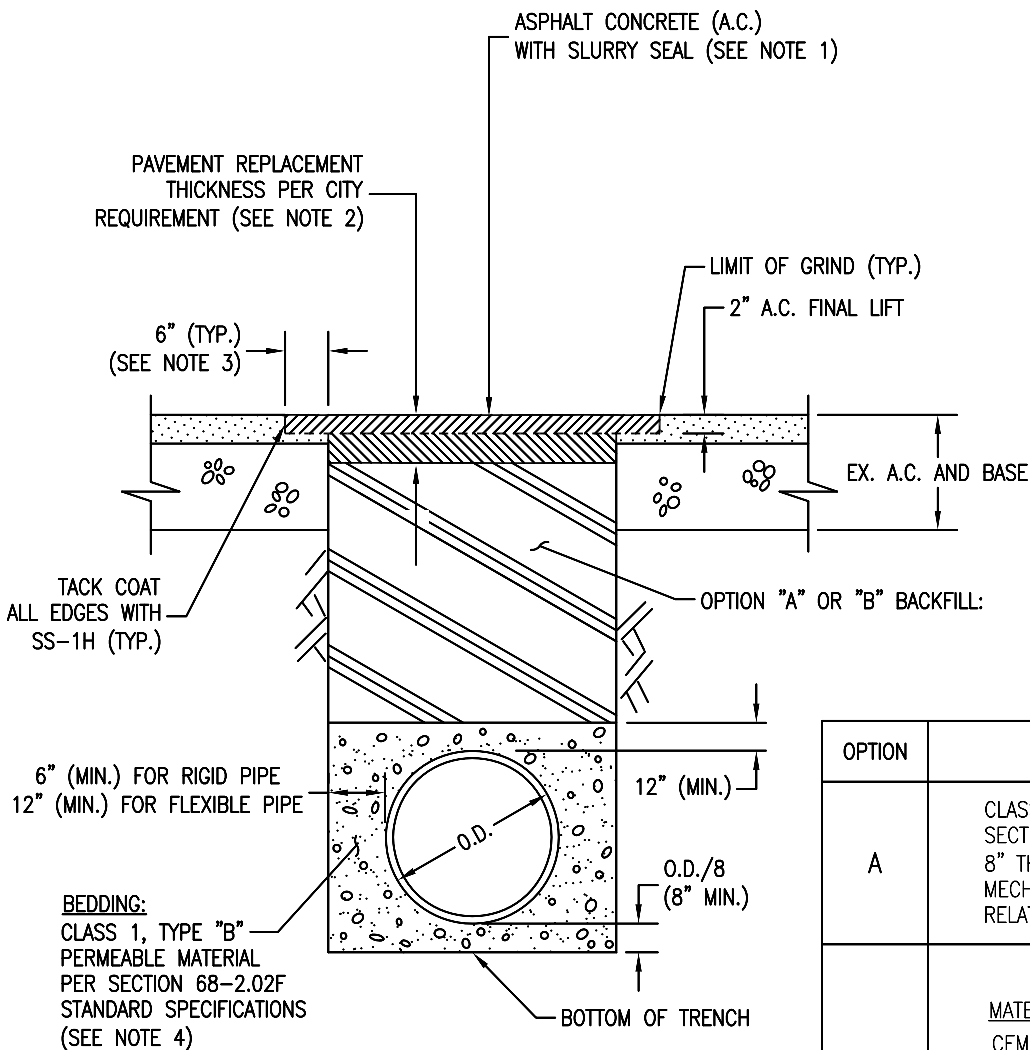


ELEVATION VIEW
NO SCALE

NOTES:

1. CURB RAMPS SHALL HAVE DETECTABLE WARNING SURFACES (GROOVING AND TRUNCATED DOMES). SEE DETAIL ST-16 FOR GROOVING DETAILS AND TRUNCATED DOME DETAILS.
2. 18" WIDE BAND OF PAVEMENT SHALL BE REMOVED AND REPLACED. SEE NOTE 5 OF GENERAL NOTES (APPENDIX) FOR REQUIREMENTS.
3. CURB RAMPS FOR SEPARATED SIDEWALKS SHALL BE DESIGNED ON AN INDIVIDUAL BASIS.
4. THE SURFACE OF RAMP SHALL HAVE A TRANSVERSE BROOMED SURFACE TEXTURE ROUGHER THAN THE SURROUNDING SIDEWALK.

DRAWN BY: K. TRAN		STRAIGHT CURB RAMP	ST-15
CHECKED BY: F. AMIN			
APPROVED BY: G. GOMEZ			
DATE: OCTOBER 2013		CITY OF SANTA CLARA	PAGE: 15



CROSS SECTION VIEW

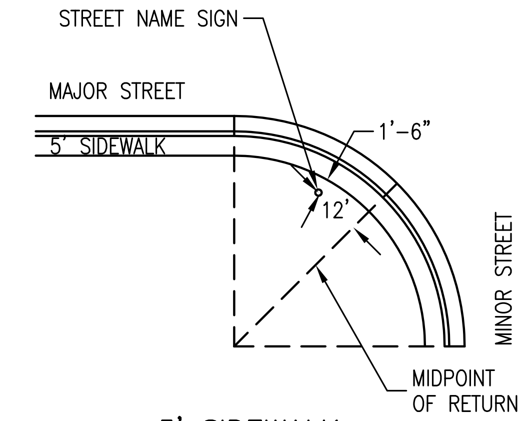
NO SCALE

OPTION	DESCRIPTION
A	CLASS 2 AGGREGATE BASE (3/4") PER SECTION 26 OF CALTRANS SPECIFICATIONS. 8" THICK (MAX.) UNCOMPACTED LIFTS. MECHANICALLY COMPACT TO AT LEAST 95% RELATIVE COMPACTION.
B	CONTROLLED DENSITY FILL (CDF) MATERIAL — ABS. VOL. CEMENT — 0.15 FLYASH — 1.98 #8 AGGREGATE — 8.97 SAND — 8.27 WATER — 6.02 AIR — 1.61 TOTAL — 27.00

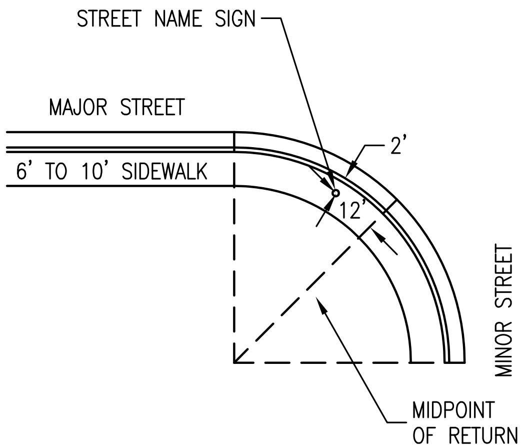
NOTES:

1. SLURRY SEAL SHALL BE EXTENDED 12" BEYOND THE A.C. PAVEMENT REPLACEMENT LIMIT.
2. A.C. PAVEMENT REPLACEMENT SHALL BE FULL DEPTH A.C. WITH THICKNESS PER CITY REQUIREMENT. SEE DETAIL ST-26 FOR TRENCH PAVEMENT THICKNESS REQUIREMENTS OF A PARTICULAR STREET.
3. THE 6" BENCH SECTION FOR A.C. SHALL BE GROUND AND REMOVED IMMEDIATELY PRIOR TO FINISH PAVING OPERATIONS.
4. BEDDING MATERIAL SHALL CONSIST ENTIRELY OF CRUSHED, ANGULAR ROCK (NO ROUNDED PEA GRAVEL ALLOWED) FOR FLEXIBLE PIPE. FOR WATER MAINS AND LATERALS, BEDDING SHALL BE SAND. MATERIAL SHALL BE INSTALLED IN MAX. 8" LIFTS AND COMPACTED WITH VIBRATORY COMPACTOR.

DRAWN BY:	K. TRAN	TRENCH BACKFILL AND PAVEMENT REPLACEMENT	ST-24
CHECKED BY:	F. AMIN		
APPROVED BY:	G. GOMEZ		
DATE:	DECEMBER 2014	CITY OF SANTA CLARA	PAGE: 24



5' SIDEWALK



6' TO 10' SIDEWALK

STREET NAME SIGN LOCATION DETAILS

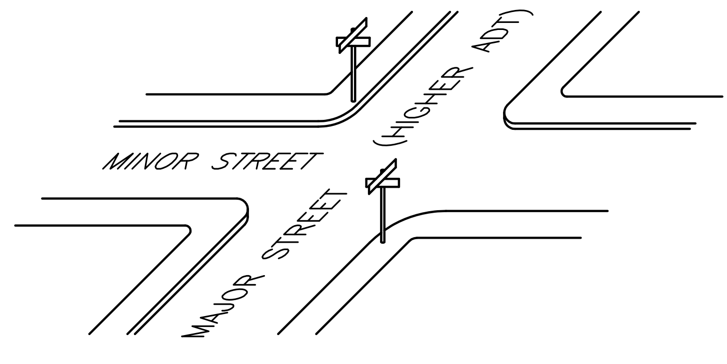
NO SCALE

NOTES:

1. TWO STREET NAME SIGNS LOCATED DIAGONALLY ACROSS FROM EACH OTHER ARE REQUIRED WHERE ONE OF THE TWO INTERSECTING STREETS' WIDTH (CURB TO CURB) IS 64' OR MORE.

2. ONLY ONE STREET NAME SIGN IS REQUIRED IF BOTH INTERSECTING STREETS' WIDTHS (CURB TO CURB) ARE LESS THAN 64'.

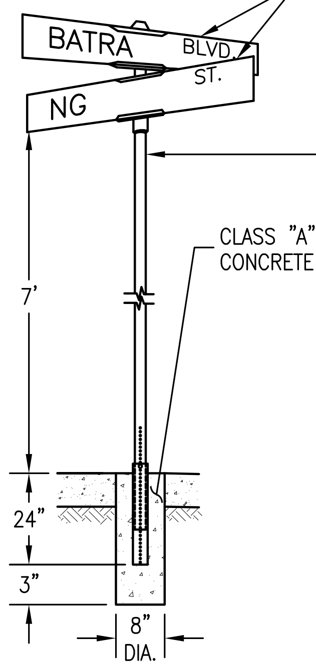
3. PRIVATE STREET NAME SIGN SHALL BE WHITE LETTERING ON BROWN BACKGROUND AND SHALL BE PLACED OUTSIDE PUBLIC ROW.



TYPICAL STREET NAME SIGN LOCATIONS

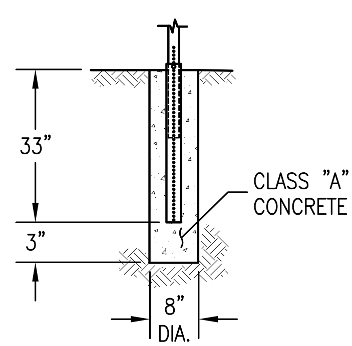
NO SCALE

2 STREET NAME PLATES DOUBLE SIDED TO SHOW TWO STREET NAMES



GALVANIZED STEEL POST 2" 2"

FOOTING IN SIDEWALK



FOOTING IN DIRT

SPECIFICATIONS

SIGN SHEETING SHALL BE "3M WHITE HIP" REFLECTIVE SHEETING OR APPROVED EQUAL WITH GREEN 1177 SERIES "ELECTROCUT" OVERLAY FILM. SHEETING SHALL BE APPLIED TO DEGREASED AND ETCHED 6061-T6, 0.080-INCH THICK ALUMINUM PLATE WITH A 1.5" RADIUS.

PLATES SHALL BE 30" X 9" MIN. OR 48" X 9" MAX., AND HAVE WHITE LETTERS ON A GREEN BACKGROUND, WITHOUT BORDERS.

STREET NAME SHALL BE FHWA CLEARVIEW 2B STYLE 6-INCH HIGH UPPER CASE LETTERS WITH CORRESPONDING LOWER CASE LETTERS. 2.5-INCH LETTERS SHALL BE USED FOR "AVE., BLVD., CT., DR., PL., RD., ST., LN." "WAY" SHALL NOT BE ABBREVIATED.

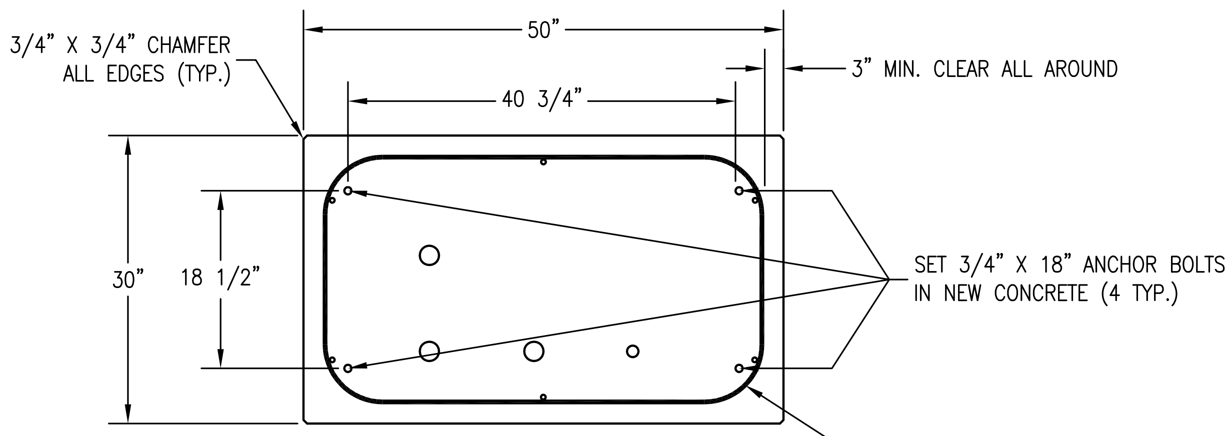
ASSEMBLY HARDWARE SHALL BE "WESTERN HIGHWAY PRODUCTS" (WHP) NO. (812F/ 12" FOR FLAT BLADES) OR NO. (812F-90% CROSSPIECE FOR FLAT BLADES) OR APPROVED EQUAL.

2" X 2" GALVANIZED STEEL POST SHALL BE INSTALLED WITH WHP "ANCHOR-MATE" SIGN POST SUPPORT ANCHOR OR APPROVED EQUAL.

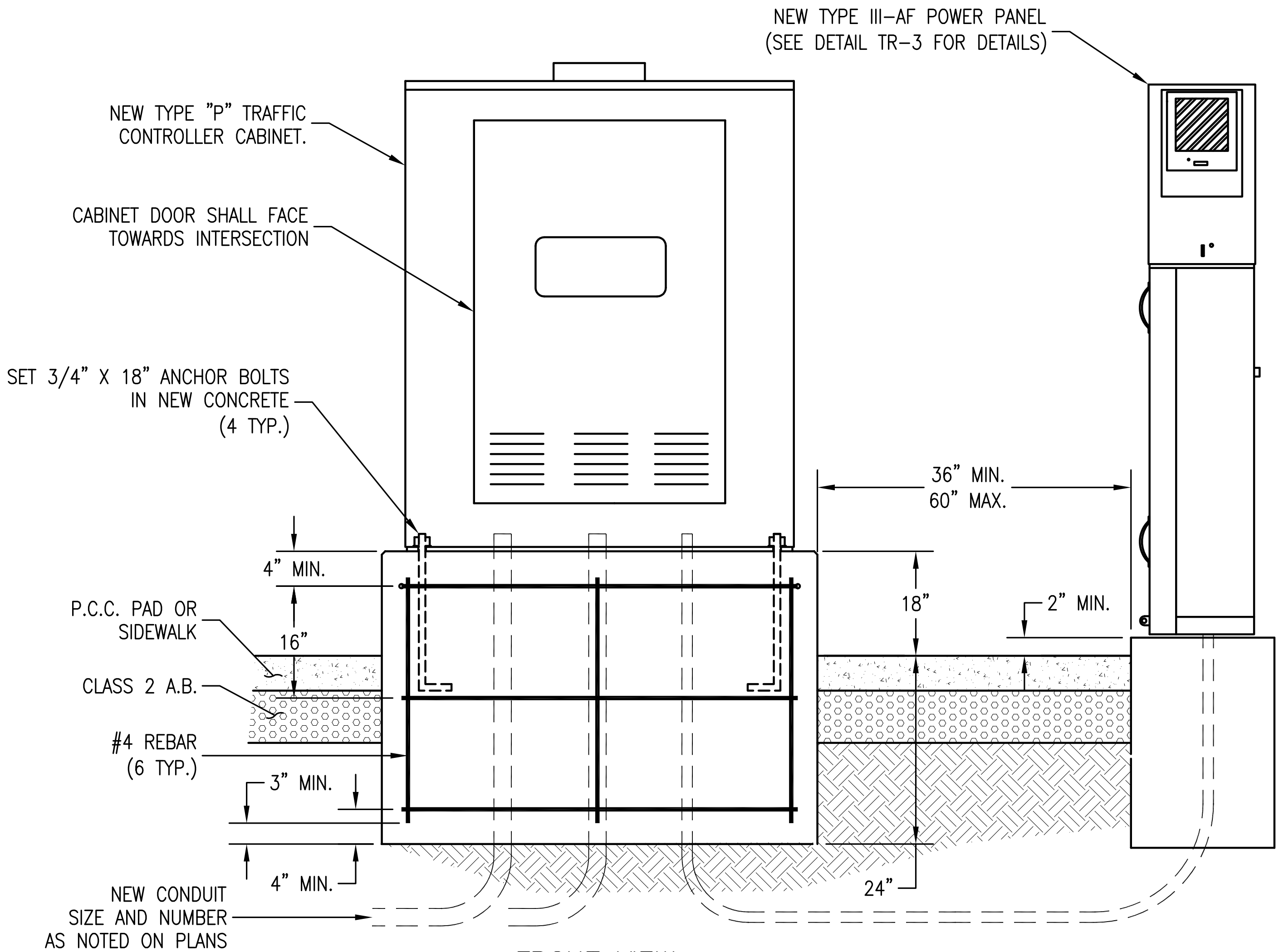
STREET NAME SIGN

NO SCALE

DRAWN BY:	K. TRAN	STREET NAME SIGN AND LOCATION	TR-1
CHECKED BY:	P. BHATIA		
APPROVED BY:	D. NG		
DATE:	OCTOBER 2015	CITY OF SANTA CLARA	PAGE: 49



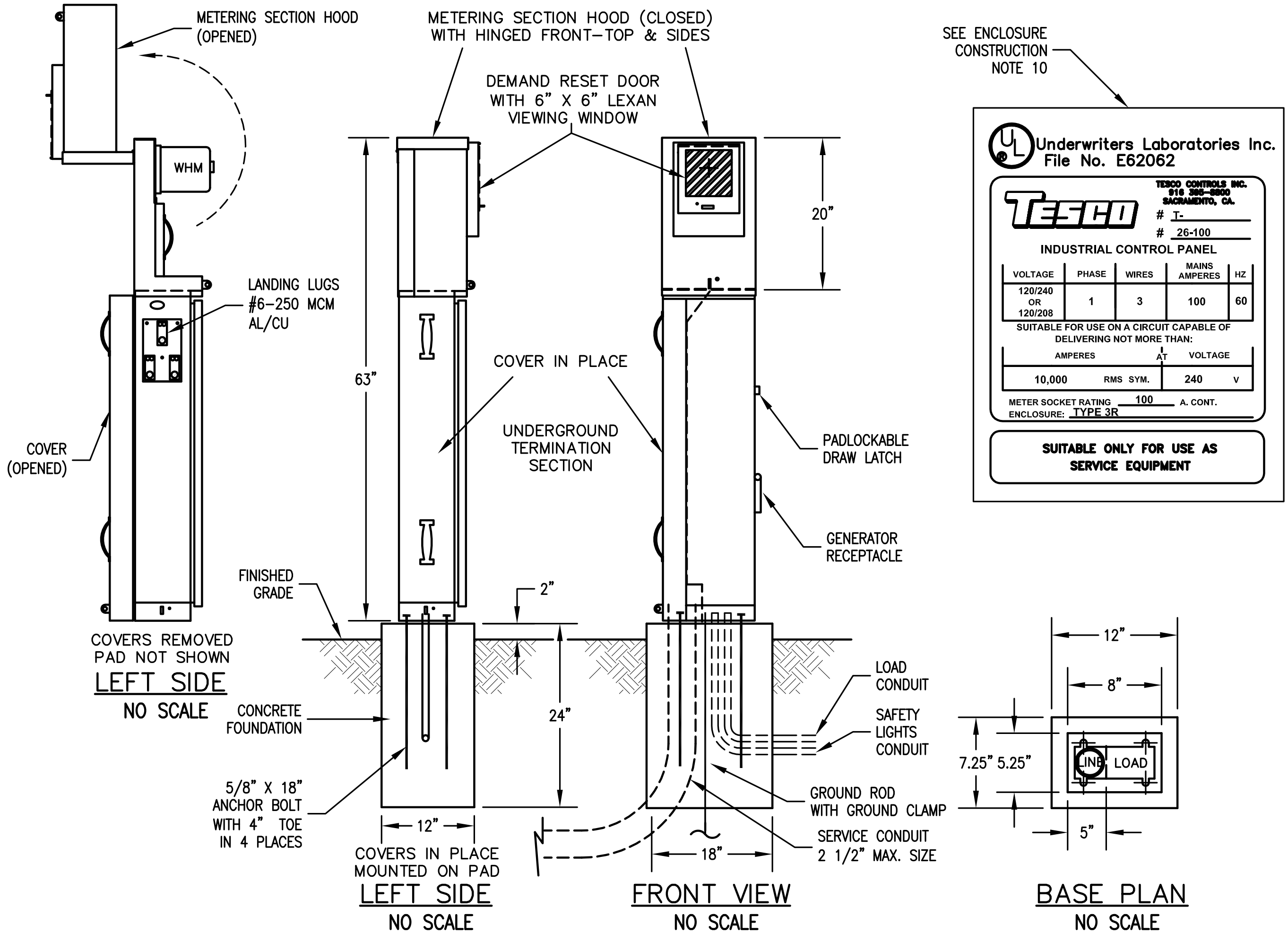
TOP VIEW
NO SCALE

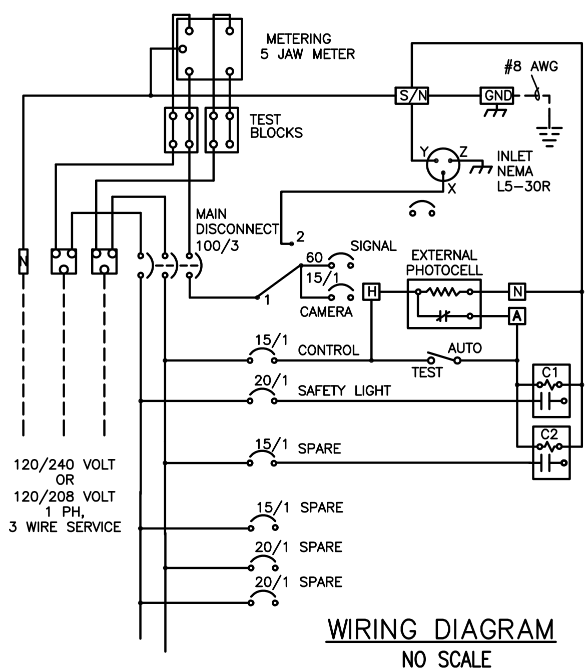


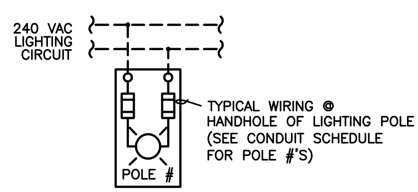
FRONT VIEW
NO SCALE

NOTE: GROUND ROD TO BE IN PULL BOX NEXT TO CABINET.

DRAWN BY:	K. TRAN	TRAFFIC SIGNAL CONTROLLER CABINET	TR-2
CHECKED BY:	B. TRAN		
APPROVED BY:	D. NG		
DATE:	OCTOBER 2013	CITY OF SANTA CLARA	DATE: 50



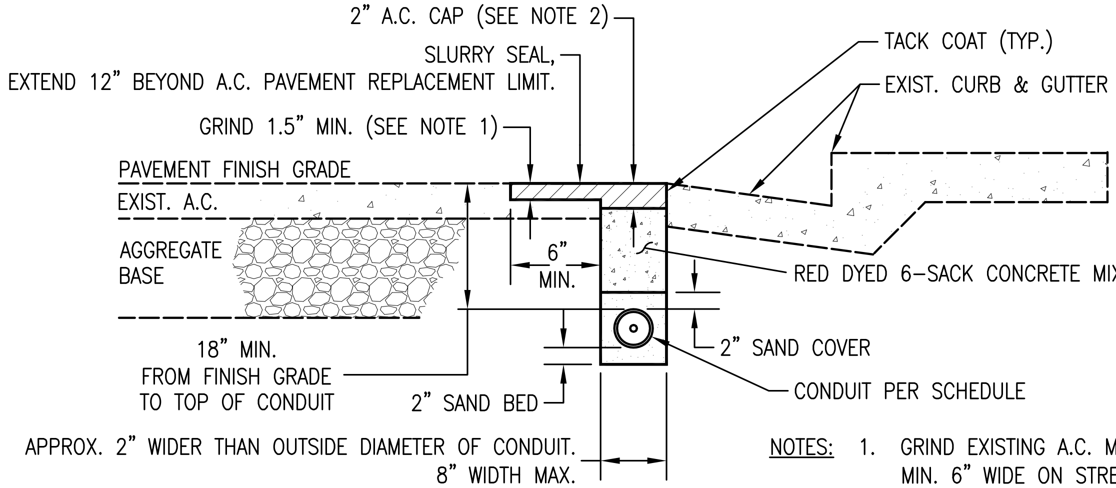




ENCLOSURE CONSTRUCTION NOTES:

1. FABRICATED FROM 1/8" ALUMINUM SHEET STOCK ELECTRICALLY WELDED AND REINFORCED WHERE REQUIRED.
2. CONSTRUCTION WILL BE NEMA 3R AND 12, RAINTIGHT AND DUST TIGHT.
3. ALL NUTS, BOLTS, SCREWS AND HINGES SHALL BE STAINLESS STEEL.
4. NUTS, BOLTS & SCREWS SHALL NOT BE VISIBLE FROM OUTSIDE OF ENCLOSURE.
5. PHENOLIC NAMEPLATES SHALL BE PROVIDED AS REQUIRED.
6. CONTROL WIRING SHALL BE MARKED AT BOTH ENDS BY PERMANENT WIRE MARKERS.
7. A PLASTIC COVERED WIRING DIAGRAM SHALL BE ATTACHED TO THE INSIDE OF THE FRONT DOOR.
8. ENCLOSURE WILL BE FACTORY WIRED AND CONFORM TO REQUIRED NEMA STANDARD.
9. FINISH: ANODIZED ALUMINUM
10. PANEL SHALL BE TESCO TYPE III AF OR APPROVED EQUAL.

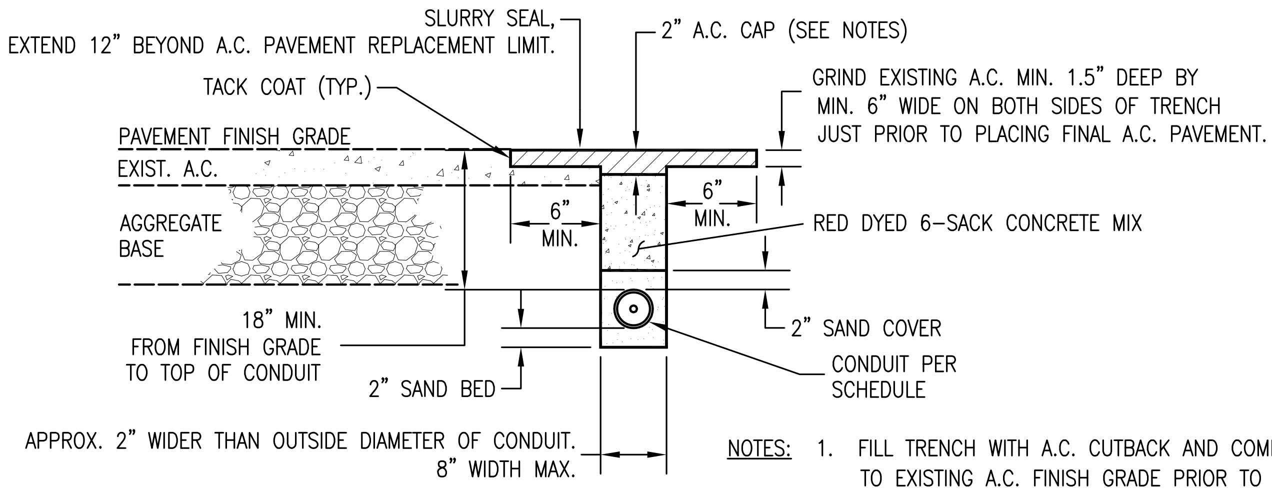
DRAWN BY: K. TRAN	TRAFFIC SIGNAL POWER PANEL	TR-3
CHECKED BY: B. TRAN		
APPROVED BY: D. NG		
DATE: OCTOBER 2013	CITY OF SANTA CLARA	PAGE: 51



NOTES:
1. GRIND EXISTING A.C. MIN 1.5" DEEP BY MIN. 6" WIDE ON STREET SIDE OF TRENCH JUST PRIOR TO PLACING FINAL A.C. PAVEMENT.
2. FINAL A.C. PAVEMENT SHALL BE PLACED WITHIN 5 WORKING DAYS OF EXCAVATION.

TRENCH AT LIP OF GUTTER

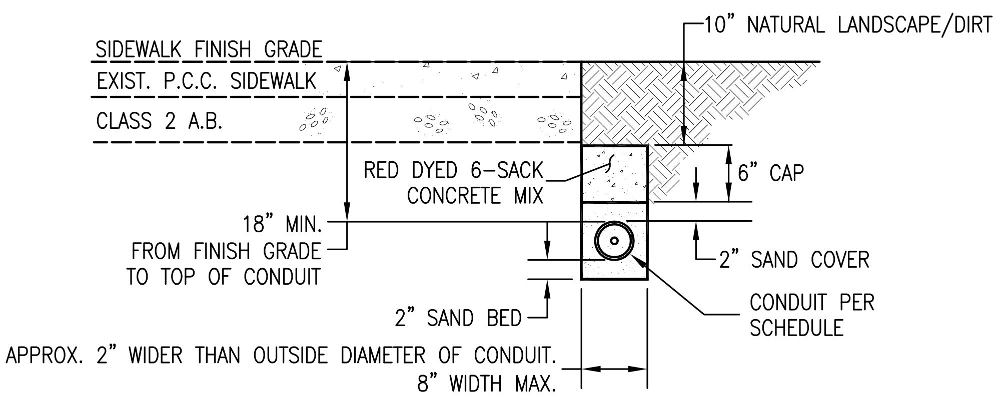
NO SCALE



NOTES:
1. FILL TRENCH WITH A.C. CUTBACK AND COMPACTED TO EXISTING A.C. FINISH GRADE PRIOR TO OPENING THE LANE TO TRAFFIC.
2. FINAL A.C. PAVEMENT SHALL BE PLACED WITHIN 48 HOURS OF EXCAVATION.

TRENCH IN ROADWAY

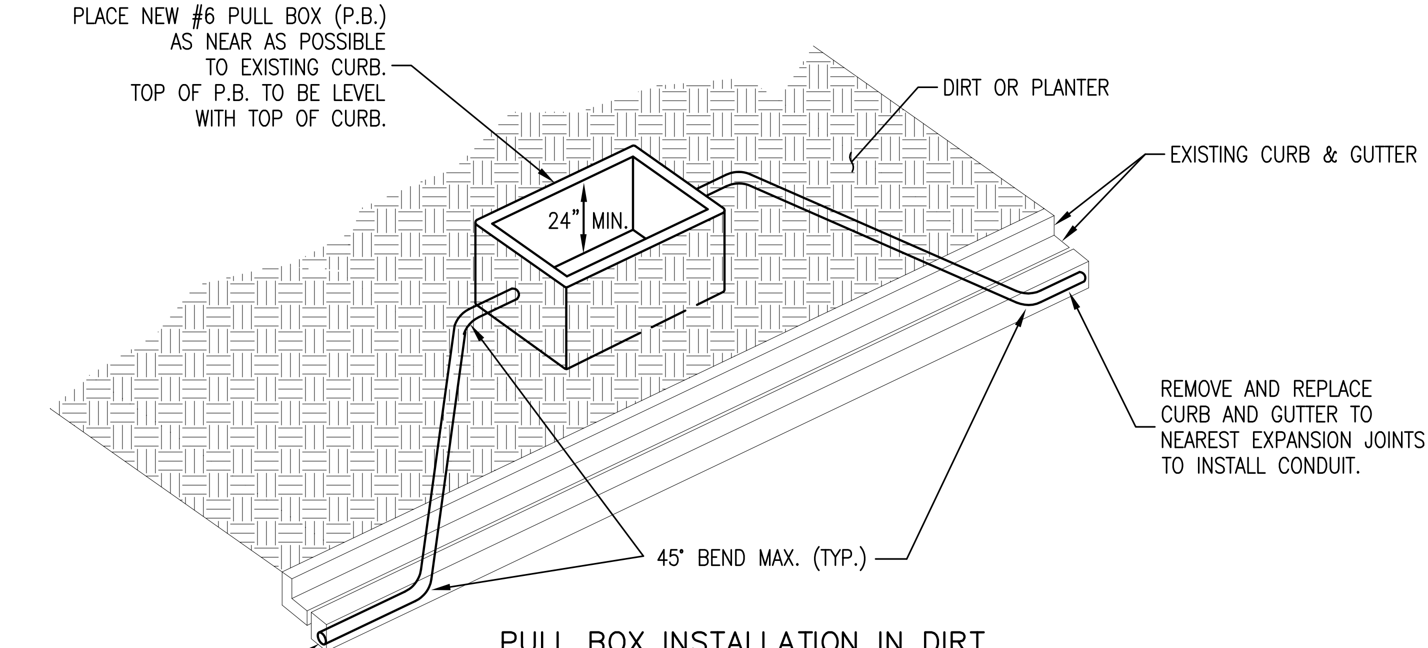
NO SCALE



TRENCH AT BACK OF SIDEWALK

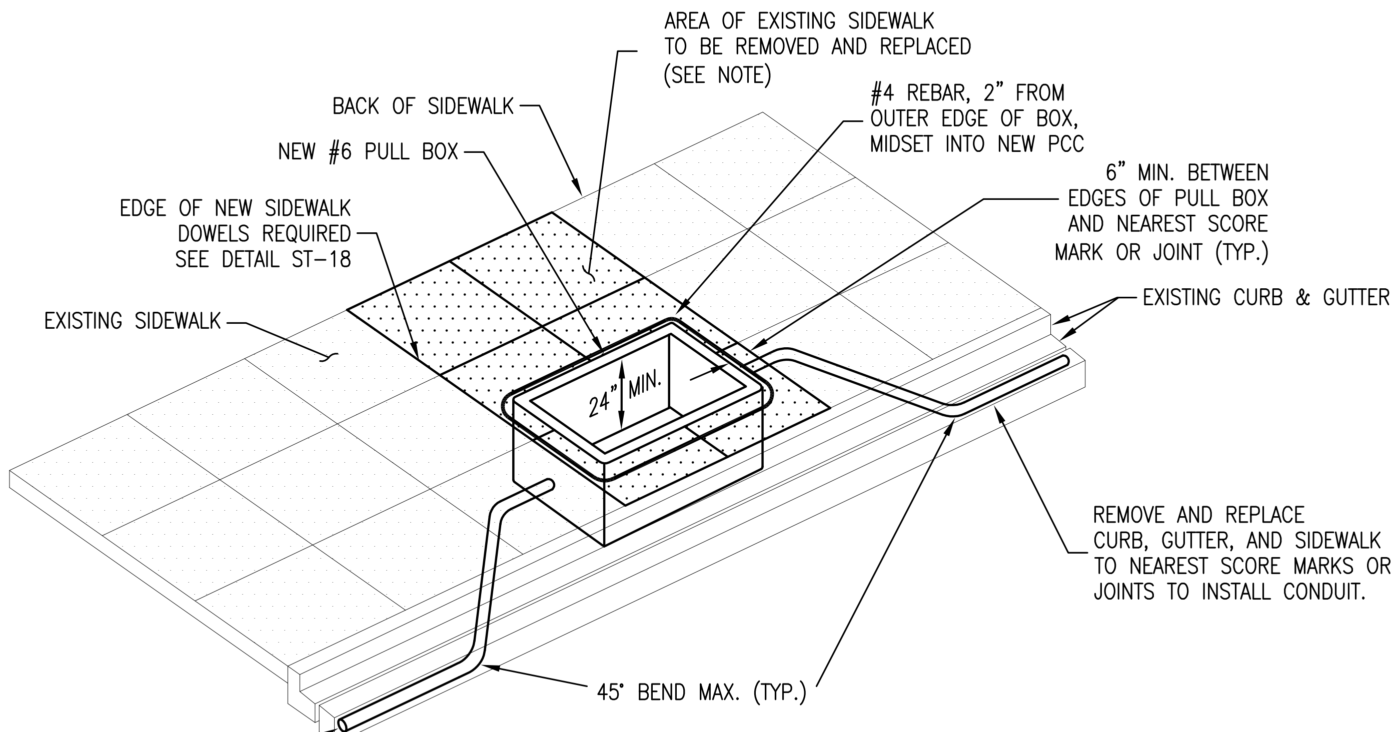
NO SCALE

DRAWN BY: K. TRAN	TRAFFIC SIGNAL TRENCH DETAILS	TR-5
CHECKED BY: B. TRAN		
APPROVED BY: D. NG		
DATE: OCTOBER 2013	CITY OF SANTA CLARA	PAGE: 53



PULL BOX INSTALLATION IN DIRT

NO SCALE

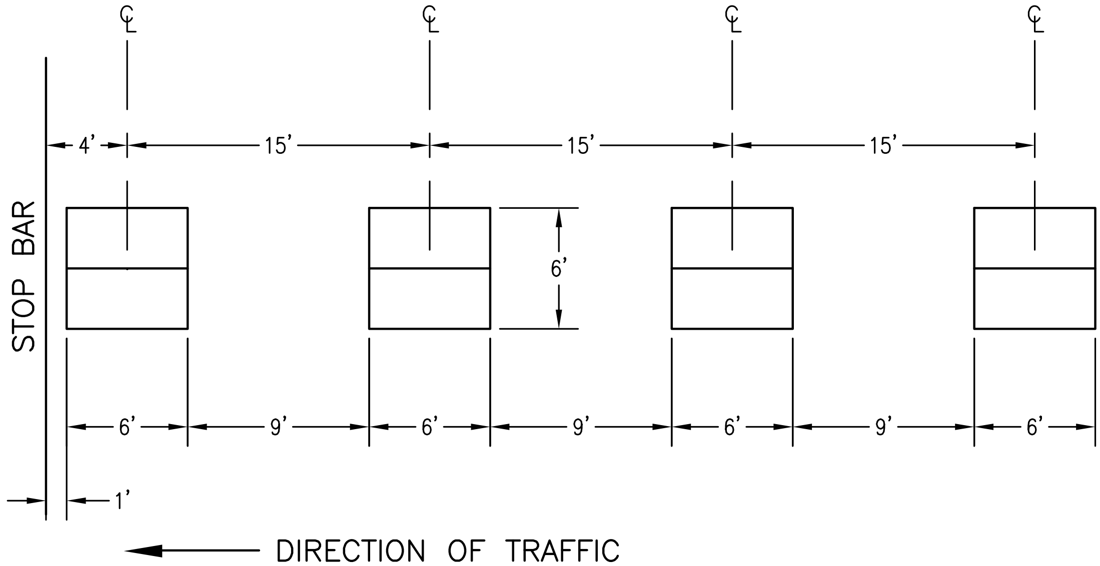


PULL BOX INSTALLATION IN SIDEWALK

NO SCALE

NOTE: IF SIDEWALK IS GREATER THAN 9', REMOVE AND REPLACE TO MIDDLE SCORE MARK.

DRAWN BY: K. TRAN	TRAFFIC SIGNAL PULL BOX	TR-6
CHECKED BY: B. TRAN		
APPROVED BY: D. NG		
DATE: DECEMBER 2014	CITY OF SANTA CLARA	PAGE: 54



NOTES:

1. FOUR (4) LOOPS FOR LEFT AND RIGHT TURN LANES. THREE (3) LOOPS FOR STRAIGHT THROUGH LANES.

2. LOOPS TO BE CUT IN A 6'x6' QUAD CONFIGURATION. LOOP MARKS SHALL BE VERIFIED BY CITY TRAFFIC STAFF (72 HOURS ADVANCE NOTIFICATION REQUIRED) UNLESS OTHERWISE NOTED.

3. DETECTOR LOOPS SHALL BE TYPE "Q". DETECTOR LOOP WIRE SHALL BE TYPE 1. LEAD IN CABLE SHALL CONFORM TO TYPE B. LOOP WIRING IS TO BE WRAPPED IN A 3–6–3 CONFIGURATION.

4. EACH LANE SHALL HAVE ITS INDIVIDUAL LOOP CONNECTED IN SERIES, AND ITS WIRING SHALL BE BROUGHT INTO PROPER PULLBOX FOR CONNECTION TO TYPE B DETECTOR LEAD IN CABLE (DLC). LOOP WIRING IN STREET SHALL ENTER A (G5 BOX) DETECTOR HANDHOLE AT THE LIP OF GUTTER.

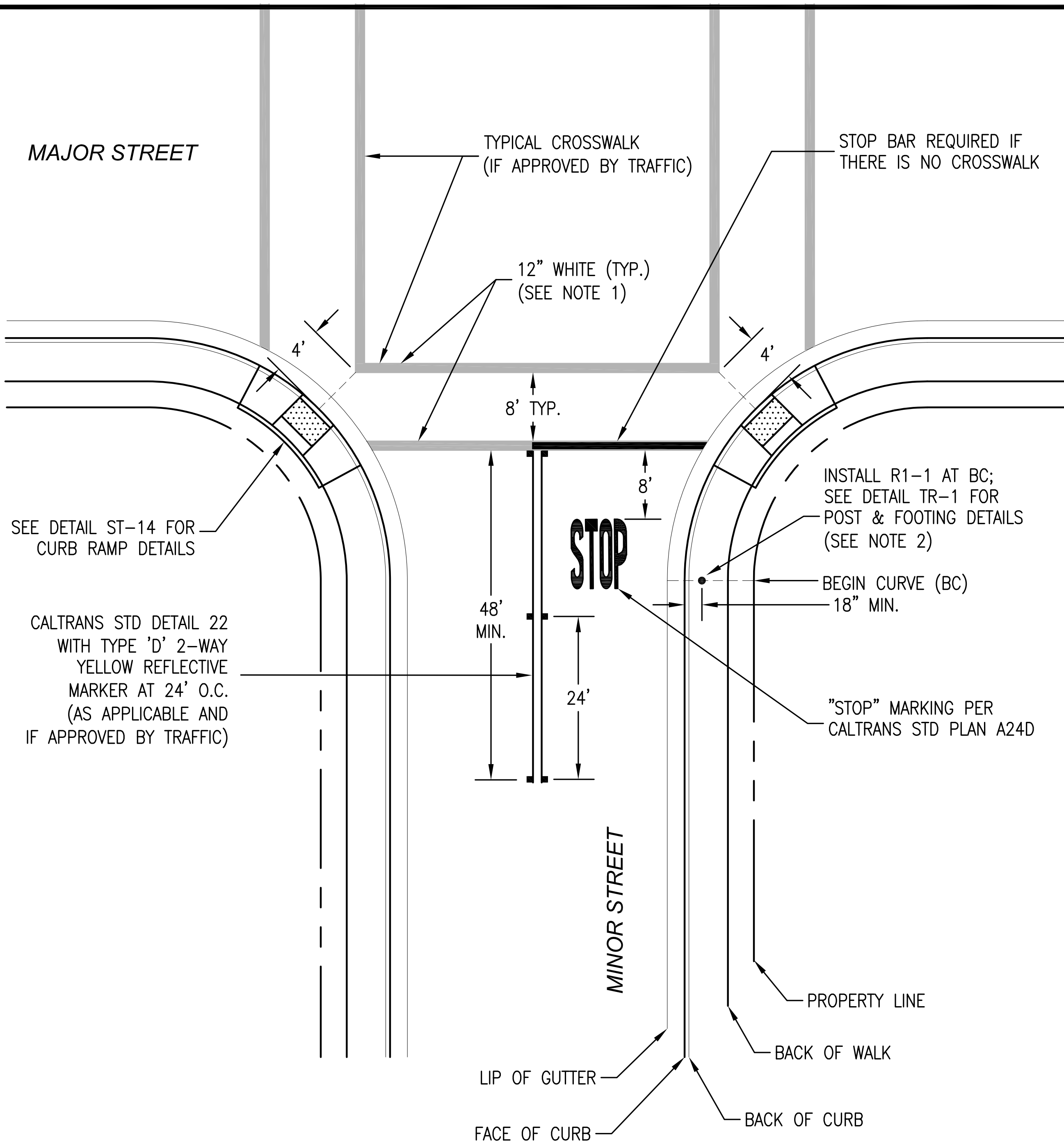
5. SEALANT SHALL BE HOT MELT RUBBERIZED ASPHALT. FINISHED PRODUCT MUST BE AT A MINIMUM STREET LEVEL OR ABOVE.

6. ANY TRAFFIC LOOP WIRE CONNECTION(S) TO BE LAID DOWN IN SIGNAL CABINET SHALL BE SOLDERED. DLC SHIELD CONDUCTORS ARE NOT TO BE BONDED TO THE GROUND, BUT WRAPPED AROUND AND SECURED TO RESPECTIVE OWNER. THEY ARE NOT TO BE SHORTER THAN SIX INCHES (6").

7. ACCEPTABLE TESTING RESULTS FOR EACH INDIVIDUAL LOOP PAIR SHALL BE 126 MICRO–HENRIES INDUCTANCE AND INFINITE MEG–OHMS TO GROUND. NO LOOP WIRING SHALL BE CONNECTED UNTIL TESTED AND APPROVED BY SILICON VALLEY POWER STAFF (72 HOURS ADVANCE NOTIFICATION REQUIRED).

8. SEE STATE OF CALIFORNIA, DEPARTMENT OF TRANSPORTATION (CALTRANS) STANDARD PLANS, PAGES ES–5A AND ES–5B, FOR INSTALLATION DETAILS.

DRAWN BY: K. TRAN	TRAFFIC SIGNAL DETECTOR LOOPS SPACING	TR-7
CHECKED BY: B. TRAN		
APPROVED BY: D. NG		
DATE: DECEMBER 2014	CITY OF SANTA CLARA	PAGE: 55



NOTES:

1. ALL PAVEMENT MARKINGS SHALL BE THERMOPLASTIC OR PRE-FORMED THERMOPLASTIC PER SPECIFICATIONS.

2. INSTALL R1-1 MINIMUM OF 18" FROM FACE OF CURB, 7' FROM GROUND TO BOTTOM OF SIGN. EDGE OF INSTALLED R1-1 SHALL BE 4" BEHIND FACE OF CURB (OFFSET AS NEEDED).

3. NO PERMANENT MARKINGS OR SIGNS SHALL BE PLACED UNTIL THE CITY TRAFFIC ENGINEER OR HIS REPRESENTATIVE APPROVES THE CAT-TRACKING OR PRE-MARKINGS IN THE FIELD.

DRAWN BY: K. TRAN		TYPICAL STOP INTERSECTION	TR-8
CHECKED BY: B. TRAN			
APPROVED BY: D. NG			
DATE: OCTOBER 2013		CITY OF SANTA CLARA	PAGE: 56

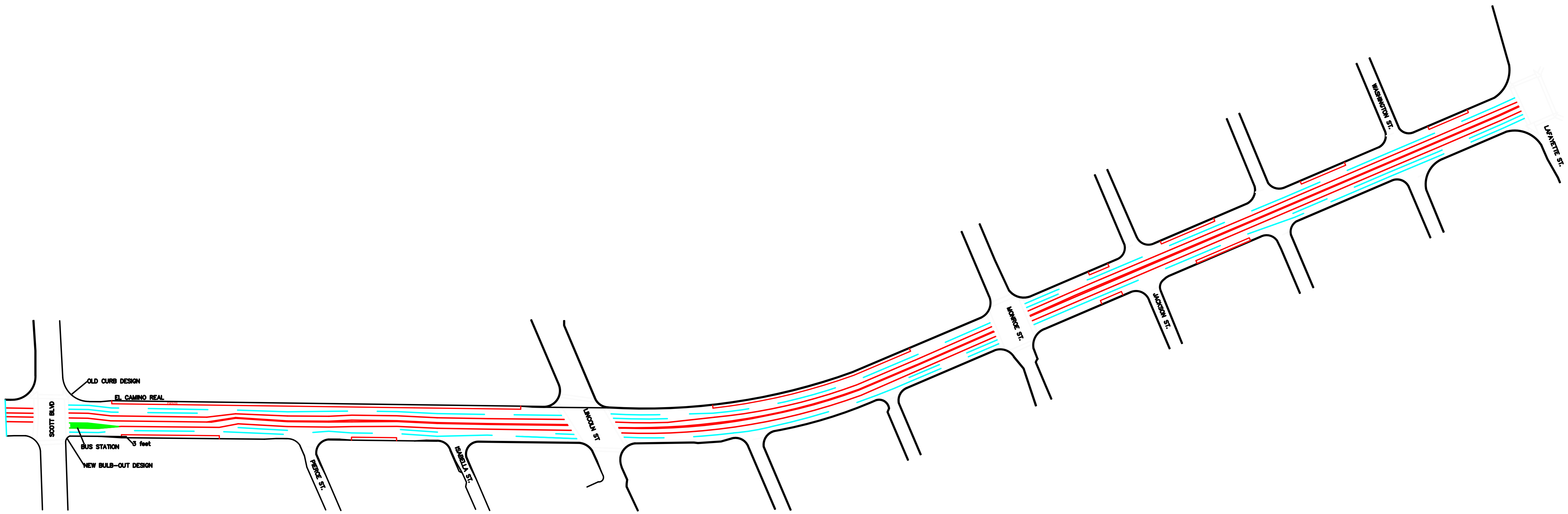
APPENDIX D

Detailed Design Drawings for El Camino Real Renovation Project

Santa Clara University

DEPARTMENT OF CIVIL ENGINEERING

PROJECT TITLE:	EL CAMINO REAL RENOVATION
DESIGNED BY:	THAO NGUYEN-PHAM
	JOHN GARZEE
INSTRUCTOR:	RACHEL HE
DATE: APRIL 18, 2016	SCALE: 1:50
SHEET NAME: OVERVIEW	SHEET NO.: 1 OF: 5

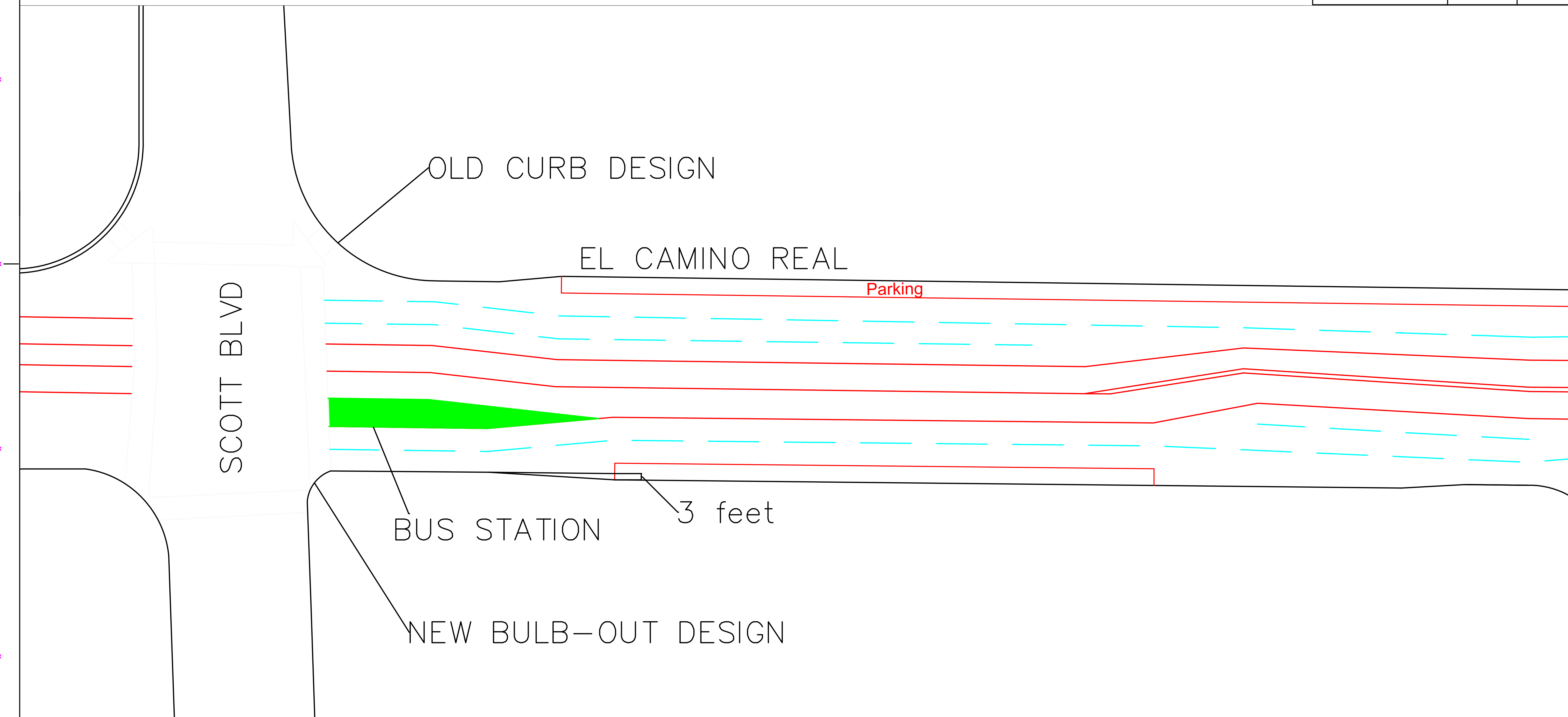


LAST REVISION

Santa Clara University

DEPARTMENT OF CIVIL ENGINEERING

PROJECT TITLE:	EL CAMINO REAL RENOVATION
DESIGNED BY:	THAO NGUYEN-PHAM
	JOHN GARZEE
INSTRUCTOR:	RACHEL HE
DATE: APRIL 18, 2016	SCALE: 1:50
SHEET NAME: SCOTT BLVD.	SHEET NO.: 2 OF: 5



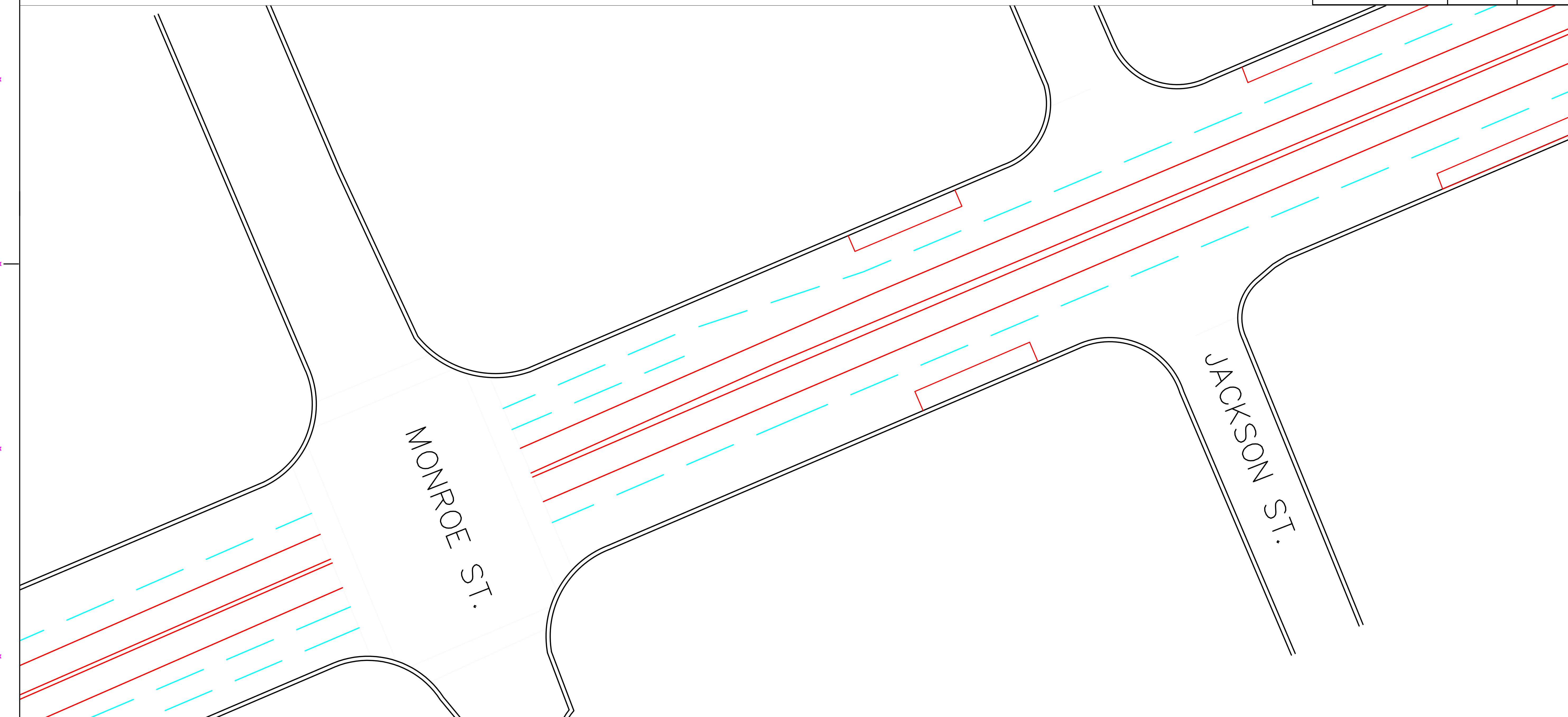
LAST REVISION

Santa Clara University

DEPARTMENT OF CIVIL ENGINEERING

PROJECT TITLE: EL CAMINO REAL RENOVATION			
DESIGNED BY:	THAO NGUYEN-PHAM		
	JOHN GARZEE		
INSTRUCTOR: RACHEL HE			
DATE: APRIL 18, 2016		SCALE: 1:50	
SHEET NAME: LINCOLN ST.		SHEET NO.: 3	OF: 5

LAST REVISION



Santa Clara University

DEPARTMENT OF CIVIL ENGINEERING

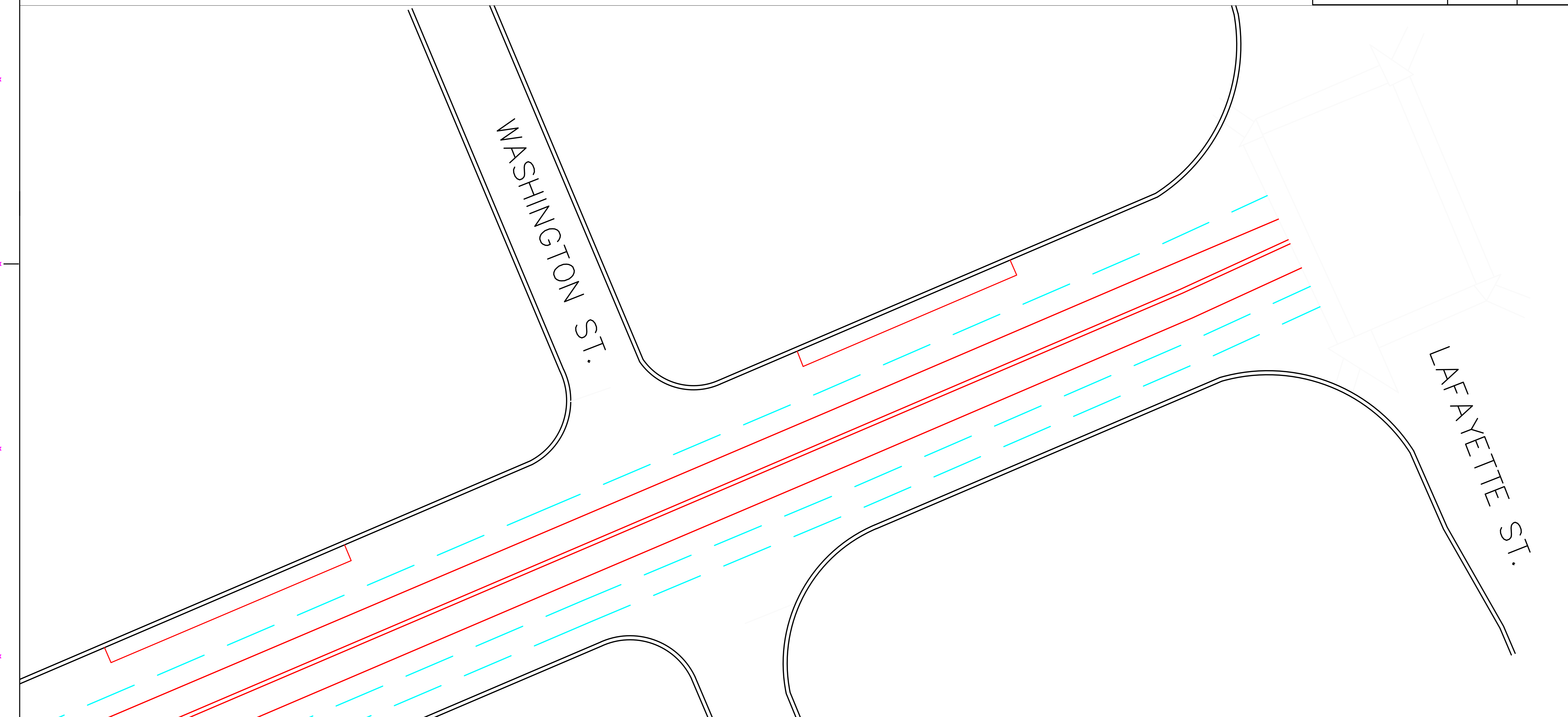
PROJECT TITLE: EL CAMINO REAL RENOVATION			
DESIGNED BY:	THAO NGUYEN-PHAM		
	JOHN GARZEE		
INSTRUCTOR: RACHEL HE			
DATE: APRIL 18, 2016		SCALE: 1:50	
SHEET NAME: MONROE & JACKSON		SHEET NO.: 4	OF: 5

LAST REVISION

Santa Clara University

DEPARTMENT OF CIVIL ENGINEERING

PROJECT TITLE:	EL CAMINO REAL RENOVATION
DESIGNED BY:	THAO NGUYEN-PHAM
	JOHN GARZEE
INSTRUCTOR:	RACHEL HE
DATE: APRIL 18, 2016	SCALE: 1:50
SHEET NAME: LAFAYETTE ST.	SHEET NO.: 5 OF: 5

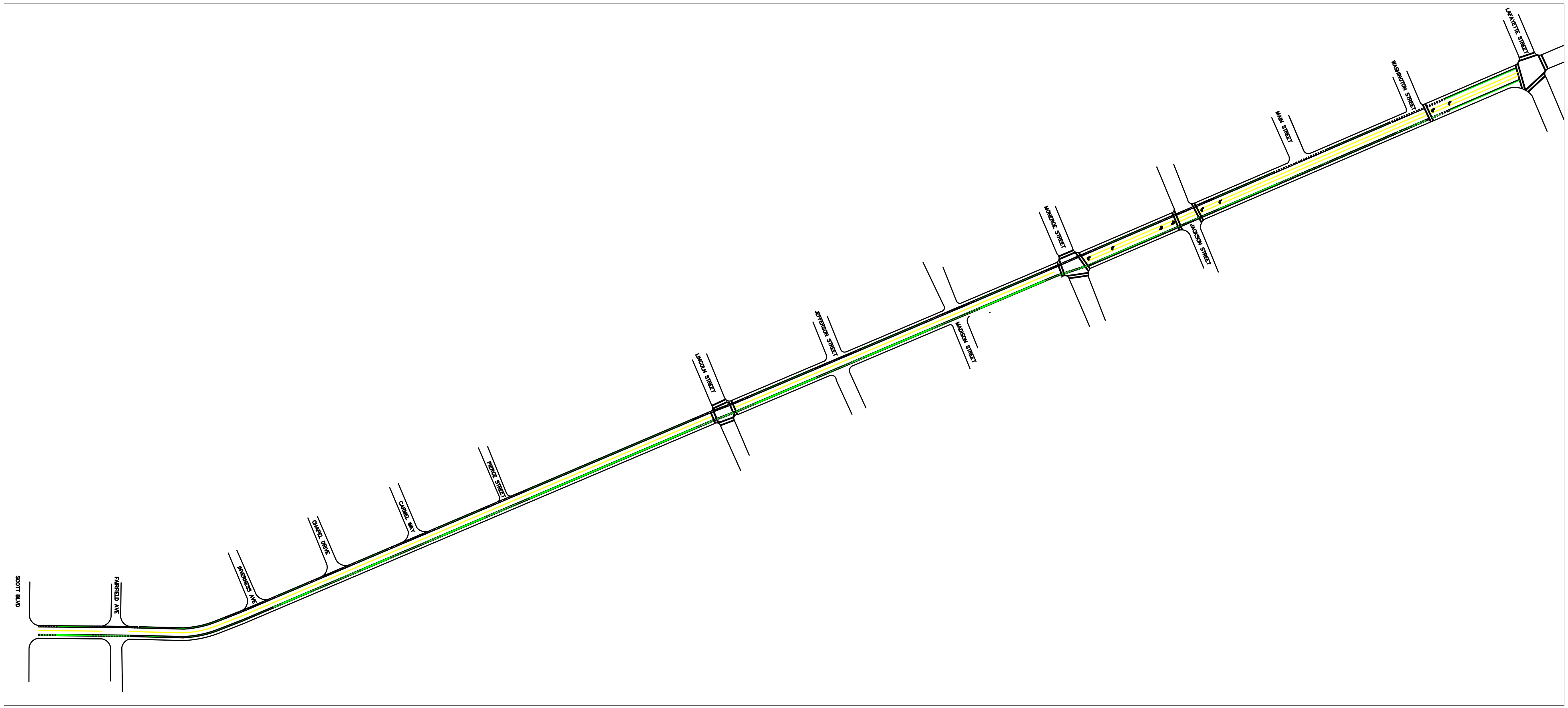


LAST REVISION

Santa Clara University

DEPARTMENT OF CIVIL ENGINEERING

PROJECT TITLE: EL CAMINO REAL RENOVATION – BENTON ST			
DESIGNED BY:	THAO NGUYEN-PHAM		
	JOHN GARZEE		
INSTRUCTOR: RACHEL HE			
DATE: APRIL 18, 2016		SCALE: 1:50	
SHEET NAME: OVERVIEW		SHEET NO.: 1	OF: 10



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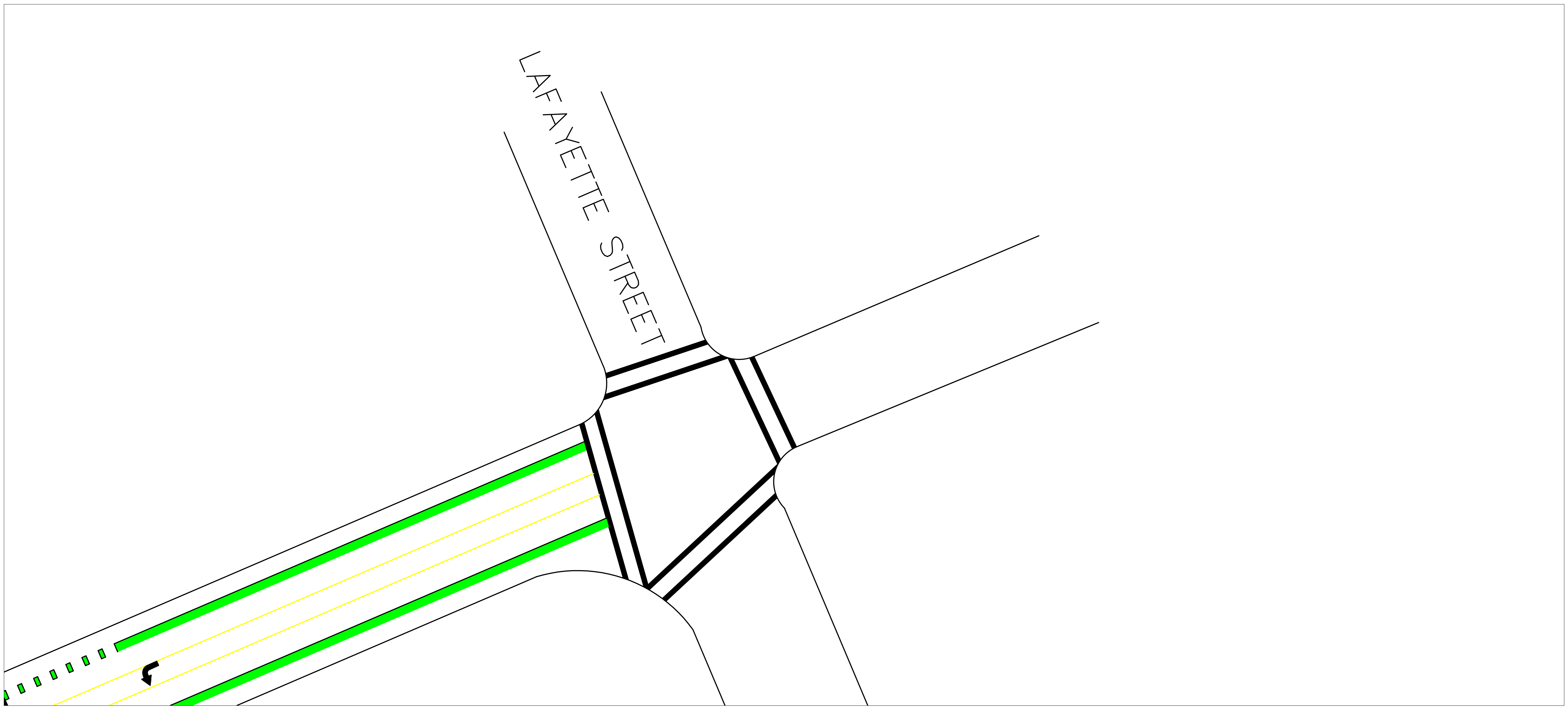
Santa Clara University

DEPARTMENT OF CIVIL ENGINEERING

PROJECT TITLE: EL CAMINO REAL RENOVATION – BENTON ST			
DESIGNED BY:	THAO NGUYEN-PHAM		
	JOHN GARZEE		
INSTRUCTOR: RACHEL HE			
DATE: APRIL 18, 2016	SCALE: 1:50		
SHEET NAME: LAFAYETTE	SHEET NO.: 2	OF: 10	



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DEPARTMENT OF CIVIL ENGINEERING

PROJECT TITLE: EL CAMINO REAL RENOVATION – BENTON ST

DESIGNED BY: THAO NGUYEN–PHAM
JOHN GARZEE

INSTRUCTOR: RACHEL HE

DATE: APRIL 18, 2016 | SCALE: 1:50

SHEET NAME: WASHINGTON | SHEET NO.: 3 | OF: 10

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DEPARTMENT OF CIVIL ENGINEERING			
PROJECT TITLE: EL CAMINO REAL RENOVATION – BENTON ST			
DESIGNED BY:	THAO NGUYEN–PHAM		
	JOHN GARZEE		
INSTRUCTOR: RACHEL HE			
DATE: APRIL 18, 2016	SCALE: 1:50		
SHEET NAME: MAIN STREET	SHEET NO.: 4	OF: 10	

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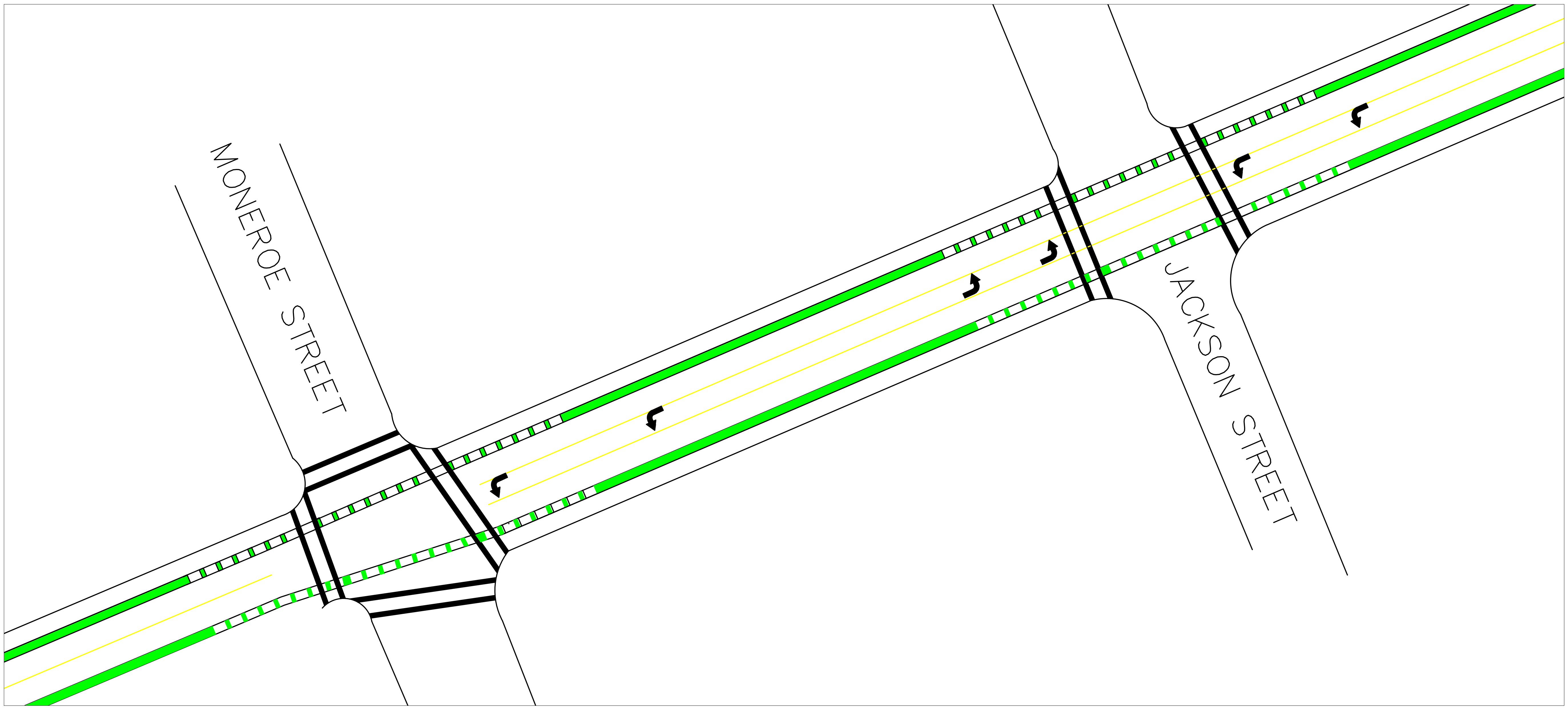


Santa Clara University

DEPARTMENT OF CIVIL ENGINEERING

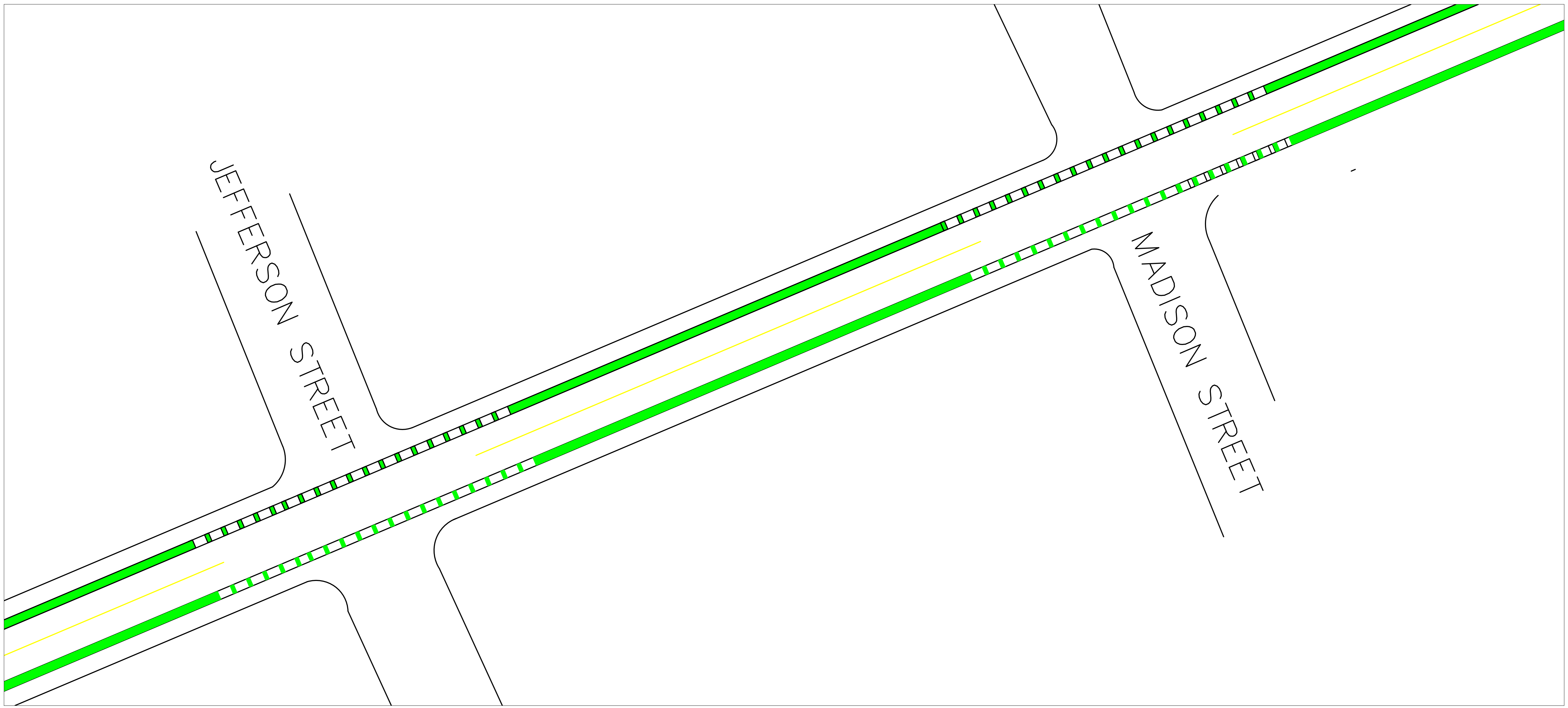
PROJECT TITLE:	EL CAMINO REAL RENOVATION – BENTON ST
DESIGNED BY:	THAO NGUYEN-PHAM
	JOHN GARZEE
INSTRUCTOR:	RACHEL HE
DATE: APRIL 18, 2016	SCALE: 1:50
SHEET NAME: MONEROE & JACKSON	SHEET NO.: 5 OF: 10

LAST REVISION

Santa Clara University

DEPARTMENT OF CIVIL ENGINEERING

PROJECT TITLE: EL CAMINO REAL RENOVATION – BENTON ST			
DESIGNED BY:	THAO NGUYEN–PHAM		
	JOHN GARZEE		
INSTRUCTOR: RACHEL HE			
DATE: APRIL 18, 2016		SCALE: 1:50	
SHEET NAME: MADISON & JEFFERSON		SHEET NO.: 6	OF: 10



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DEPARTMENT OF CIVIL ENGINEERING

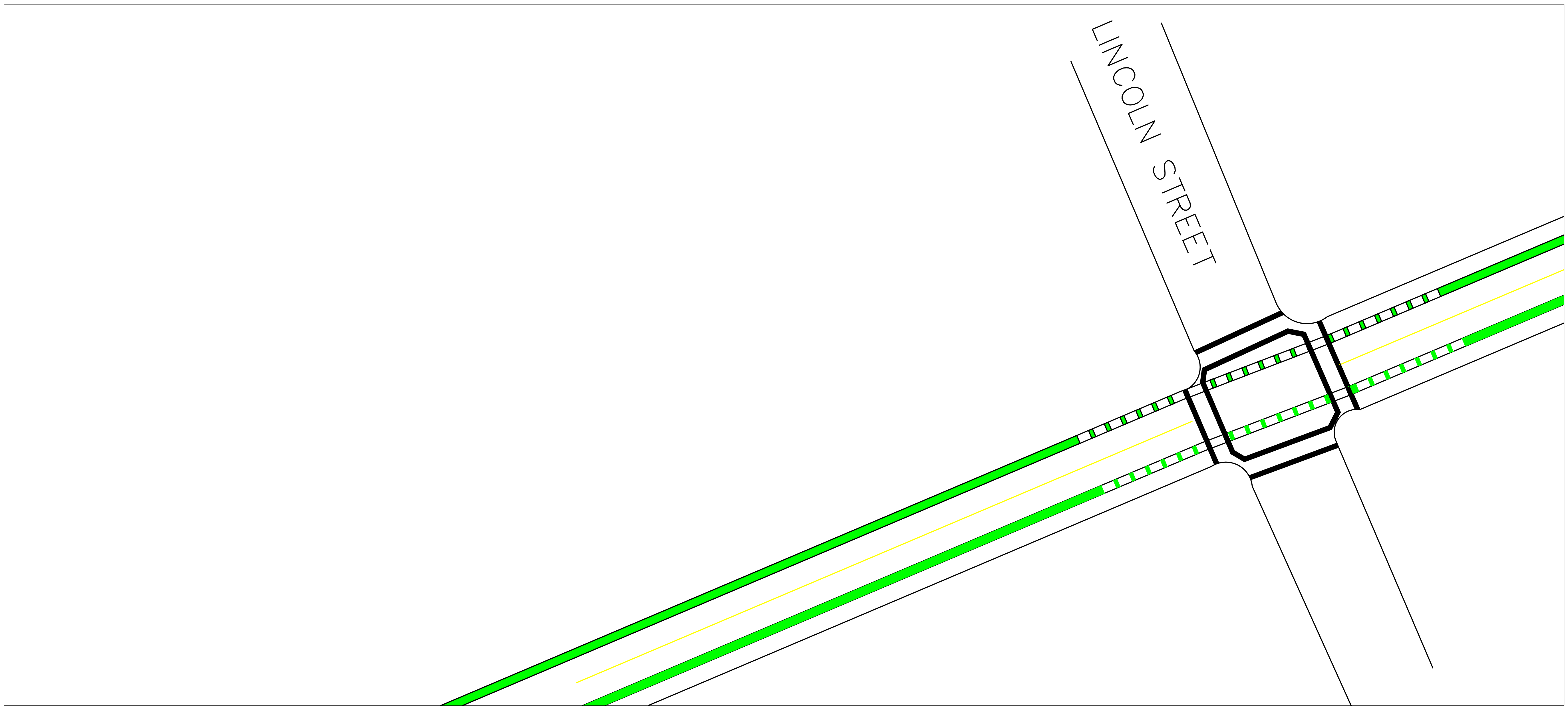
PROJECT TITLE: EL CAMINO REAL RENOVATION – BENTON ST

DESIGNED BY: THAO NGUYEN–PHAM
JOHN GARZEE

INSTRUCTOR: RACHEL HE

DATE: APRIL 18, 2016 | SCALE: 1:50

SHEET NAME: LINCOLN | SHEET NO.: 7 | OF: 10



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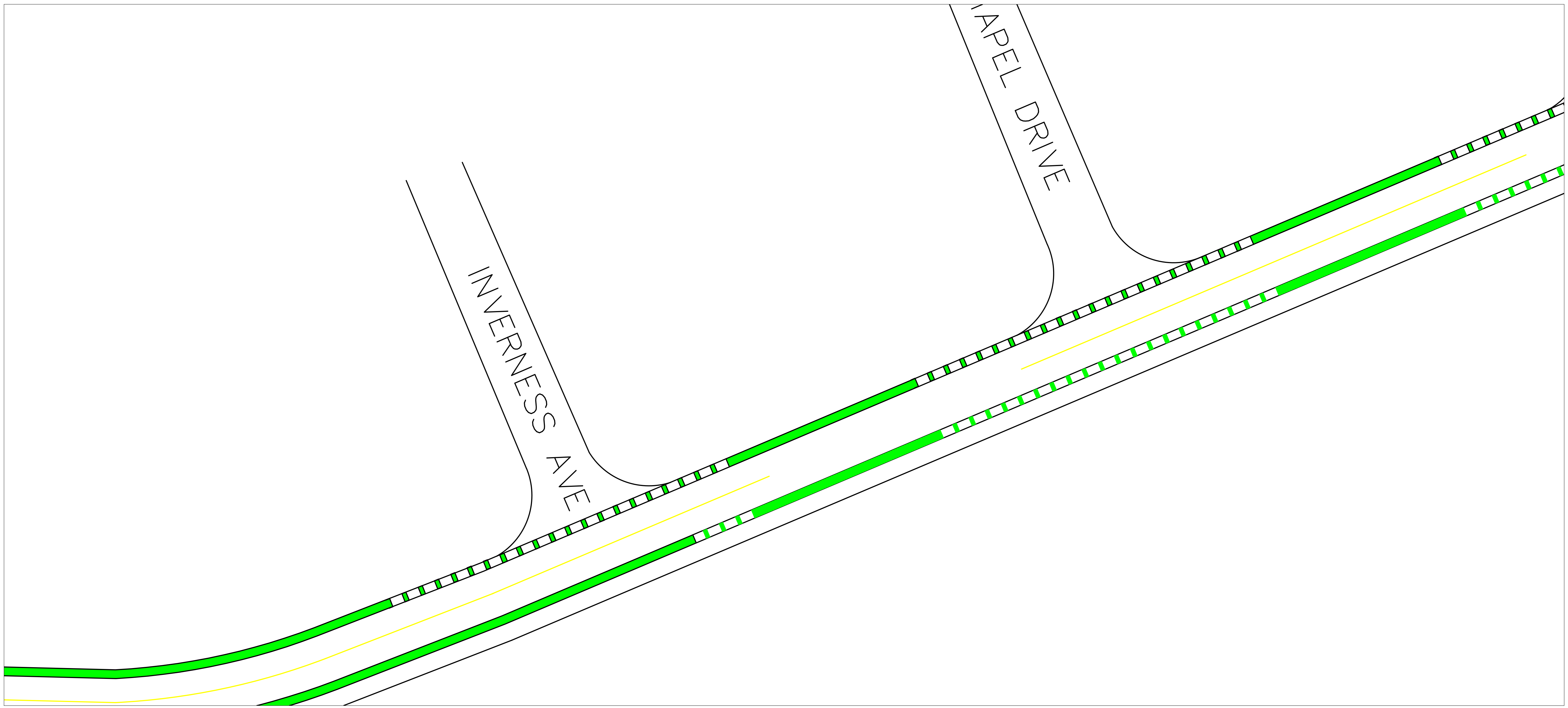
DEPARTMENT OF CIVIL ENGINEERING	
PROJECT TITLE: EL CAMINO REAL RENOVATION – BENTON ST	
DESIGNED BY:	THAO NGUYEN–PHAM
	JOHN GARZEE
INSTRUCTOR: RACHEL HE	
DATE: APRIL 18, 2016	SCALE: 1:50
SHEET NAME: CHAPEL & INVERNESS	SHEET NO.: 8 — OF: 10



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PROJECT TITLE:	EL CAMINO REAL RENOVATION – BENTON ST
DESIGNED BY:	THAO NGUYEN-PHAM
	JOHN GARZEE
INSTRUCTOR:	RACHEL HE
DATE: APRIL 18, 2016	SCALE: 1:50
SHEET NAME: PIERCE & CARMEL	SHEET NO.: 9 OF: 10

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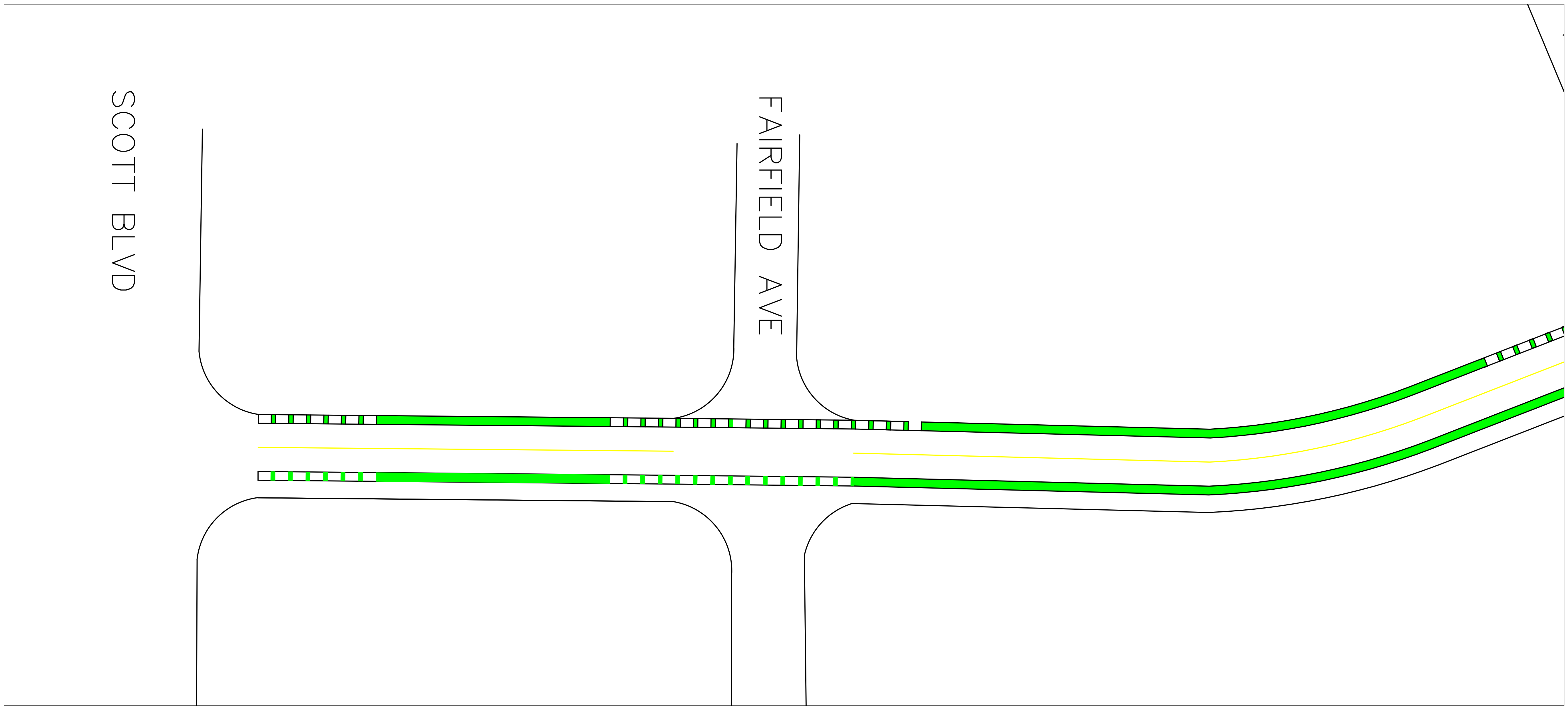
PROJECT TITLE: EL CAMINO REAL RENOVATION – BENTON ST			
DESIGNED BY:	THAO NGUYEN-PHAM		
	JOHN GARZEE		
INSTRUCTOR: RACHEL HE			
DATE: APRIL 18, 2016		SCALE: 1:50	
SHEET NAME: SCOTT & FAIRFIELD		SHEET NO.: 10	OF: 10



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