

building the emBIKEadero waterfront bike path



a master plan + design toolkit for remaking
the Embarcadero waterfront
for all modes of transportation

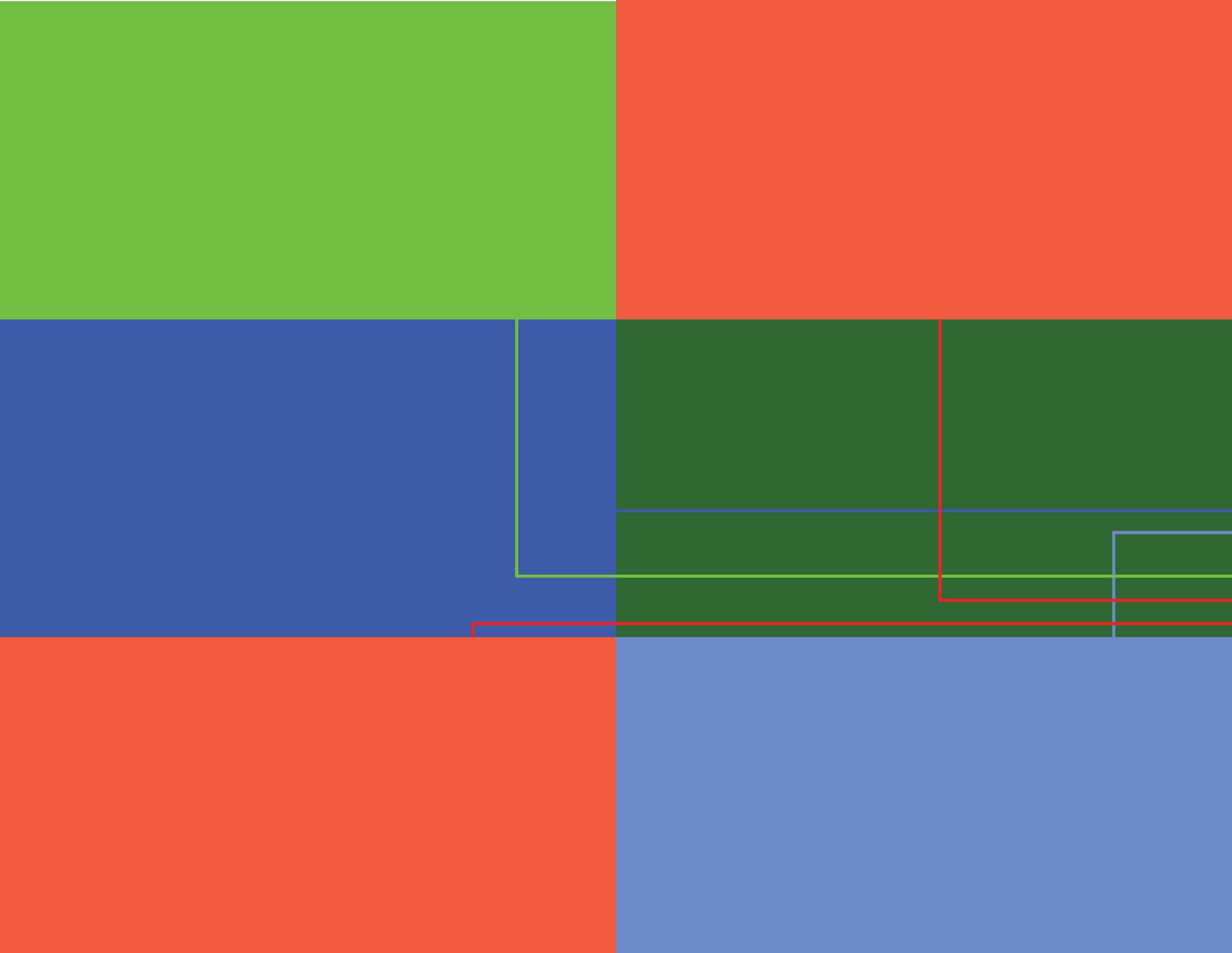
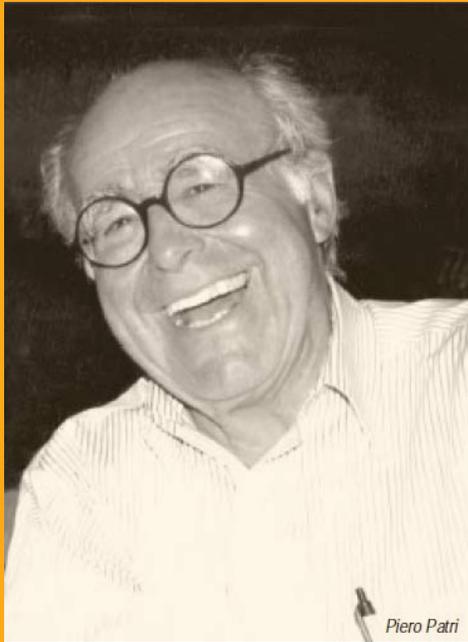


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the Piero N. Patri fellowship in urban design at SPUR



The Piero N. Patri Fellowship in Urban Design at SPUR is an annual hands-on position for a graduate student in urban design, landscape architecture, architecture or urban planning, giving the fellow a unique summertime opportunity to gain firsthand experience working in the urban-design and planning field on a project that will have a positive impact on the city of San Francisco and the Bay Area. The endowed Piero N. Patri Fellowship was established by Piero's brother, Remo, his wife Johanna Patri, his brother Tito, and his wife, Bobby Reich Patri, in honor of Piero's commitment to good planning and urban design. Major contributions to the endowment were also made by Patri.Merker.Architects and dozens of Piero's friends, clients and colleagues.

Piero N. Patri, FAIA (1929 – 2006), an architect, urban designer and planner born and raised in San Francisco, dedicated his

life to his work and the improvement of the city. Piero was the first chairman of the SPUR Environmental Design Committee, and in 1961 was the principal author, along with a team including his brothers Remo and Tito, of one of SPUR's first community plans: the Montgomery Center Plan, a visionary scheme that rethought the interconnection of the Financial District to the city, and which resulted, in a different form, in the ultimate siting of the Transamerica Pyramid. Piero N. Patri's life was filled with notable accomplishments, both in projects produced by his firm and in his pro bono work.

For the 2009 project, working with SPUR and EDAW, the Piero N. Patri Fellow was tasked with examining a particularly challenging gap in the network that is needed to link the southeast part of the city with the northeast: the area from Mission Bay, across Mission Creek and the Third Street Bridge and north along the Embarcadero Boulevard. This is also the route of the Blue Greenway, which is evolving out of work by SPUR and the Neighborhood Parks Council, and which the Mayor supports. The aim of this work is to stimulate real and substantive change by enabling safer and lower-cost travel from the southeastern city to existing job centers. The fellow was asked to first examine existing, approved, and planned conditions from the vicinity of Mission Bay to some point on the north Embarcadero and to then consider options for closing the gap. The last phase of the fellowship consisted of developing one or more alternative proposal for addressing the gap closure at Third Street Bridge as well retrofitting a Class I bicycle path along the Embarcadero.

Dave Snyder, former SPUR Transportation Policy Director (and former Executive Director of the San Francisco Bicycle Coalition); Jim Chappell, former SPUR Citizens Planning Institute Director; and Scott Preston of EDAW provided supervision and direction. As in past years, work was undertaken in the San Francisco office of EDAW.



introduction

This document lays out the research and design proposal of 2009 Piero N. Patri Fellow Carrie Nielson, a graduate student in the departments of Landscape Architecture and Urban Planning and Design at the Harvard University Graduate School of Design. The goal of this project is to encourage the development of a two-way bicycle path along the Embarcadero in order to improve the connection between the northeast and southeast portions of San Francisco. It is the hope that the success of this project will encourage further development of separated bikeways throughout San Francisco.

the embarcadero: history

After extensive damage to the Embarcadero freeway in the 1989 Loma Prieta earthquake, San Francisco visionaries grabbed the opportunity to create a multi-modal boulevard along the waterfront, tearing the freeway down instead of replacing it. At the center of the boulevard is a wide San Francisco Municipal Railway (Muni) right-of-way, running light-rail trains, framed by the now iconic palm trees. On the bay side is the promenade, an often wide sidewalk space that is occupied by both bicyclists and pedestrians. While a separated bike path was considered in the 1992 redesign, bike lanes were the preferred facility at the time. Cyclists who wanted to stay off the street would be permitted to ride on the Promenade. A cultural shift coupled with a renewed momentum in alternative transportation have come to pass in the nearly two decades since the Embarcadero's last redesign.

the embarcadero: today

Thousands of pedestrians now enjoy use of the Promenade each day, with dense crowds during morning and afternoon rush hours as well as on the weekends. At the same time, bicycling has reached a new kind of critical mass, becoming a more viable alternative mode of transportation and increasingly appealing



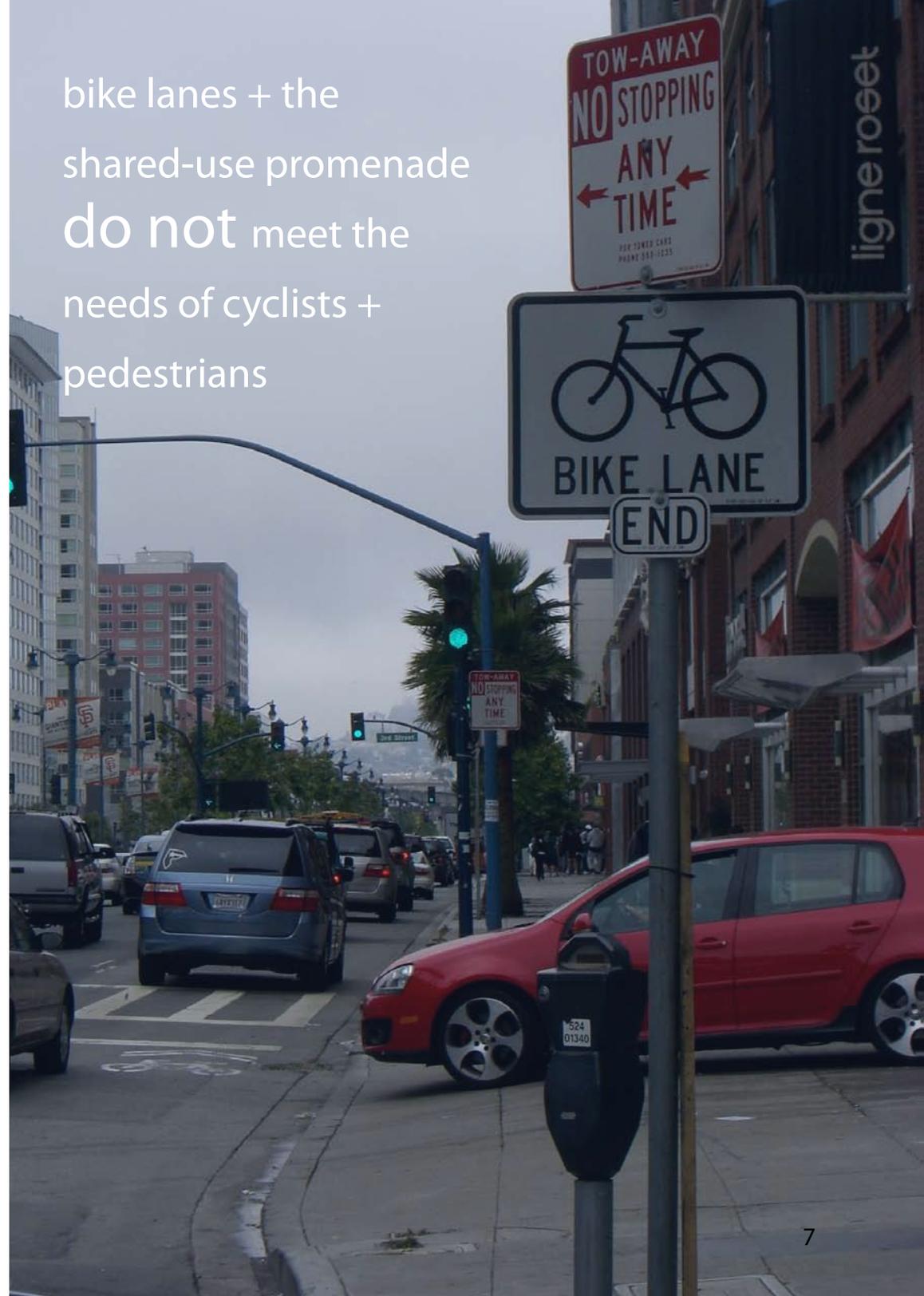
to a far broader audience of Americans. Bicycling to work has more than doubled in the last decade, and bicycle tourism has flourished in northeast San Francisco. From families pedaling along the Embarcadero, to queues of cyclists waiting at stoplights on Market Street and to folding commute bikes on BART, the renewed interest in bicycling is easy to see. This new level of bicycling and walking, in turn, demands facilities which represent the best practices in non-motorized planning. On busy streets such as the Embarcadero, with its hundreds of cyclists during the peak commute hours and relatively fast traffic, bicycle lanes are no longer appropriate. Casting a wider field of vision toward practices in the Netherlands and Denmark, as many bike-friendly American cities have already begun to do, San Francisco now has the opportunity to build a cutting-edge separated bikeway that can accommodate the large number of riders that already use the Embarcadero while capturing new bicyclists. Recent research has shown that bike paths have a larger ability to capture new ridership than bike lanes. Many people who do not yet cycle are keenly interested in doing so, but concern over sharing the roadway with fast traffic prevents them from making the switch to bicycle.

the embarcadero: future

The goal of this project is to create a truly multi-modal Embarcadero, making it safer and enjoyable for all modes of transportation. Through the construction of a two-way, separated bikeway along the bay side of the Embarcadero, the Promenade will become a more secure place for pedestrians, free of the danger and irritation of cyclists.

This project acknowledges the fact that any changes to the Embarcadero must be a joint effort between city interests and those of the Port of San Francisco, which owns the land. Consideration has been given to this interaction with the objective of serving the best interests of the Port as well as the bicycling community.

bike lanes + the
shared-use promenade
do not meet the
needs of cyclists +
pedestrians



1. create **big**

create an SF perimeter path





and small connections

provide crossing facilities onto and off of bike lanes and bike routes

San Francisco needs connections. Mobility is about making choices, going in different directions, and, eventually, getting to a particular destination. In this way, bicyclists operate no differently than drivers or pedestrians: they need bike facilities in order to get safely to their destinations. A successful bike path that serves the needs of a wide variety of user groups needs to connect to other bike facilities: It needs to make bicycling easy and stress-free. While the creation of a two-way bike path along the Embarcadero will certainly aid in that endeavour, it needs to have both big and small connections. On the big scale,

the emBIKEadero path provides 2.6 miles of continuous off-street bike facility for San Francisco, which represents almost a third of the perimeter of the San Francisco peninsula. Linking with paths through Discovery Park, the Presidio, and the Great Highway, San Francisco may be able to one day have a continuous perimeter path. At the small scale, it must offer opportunities to easily turn onto and off of the bike path, creating a north-south bike arterial which is connected to a series of feeder streets with bike lanes.

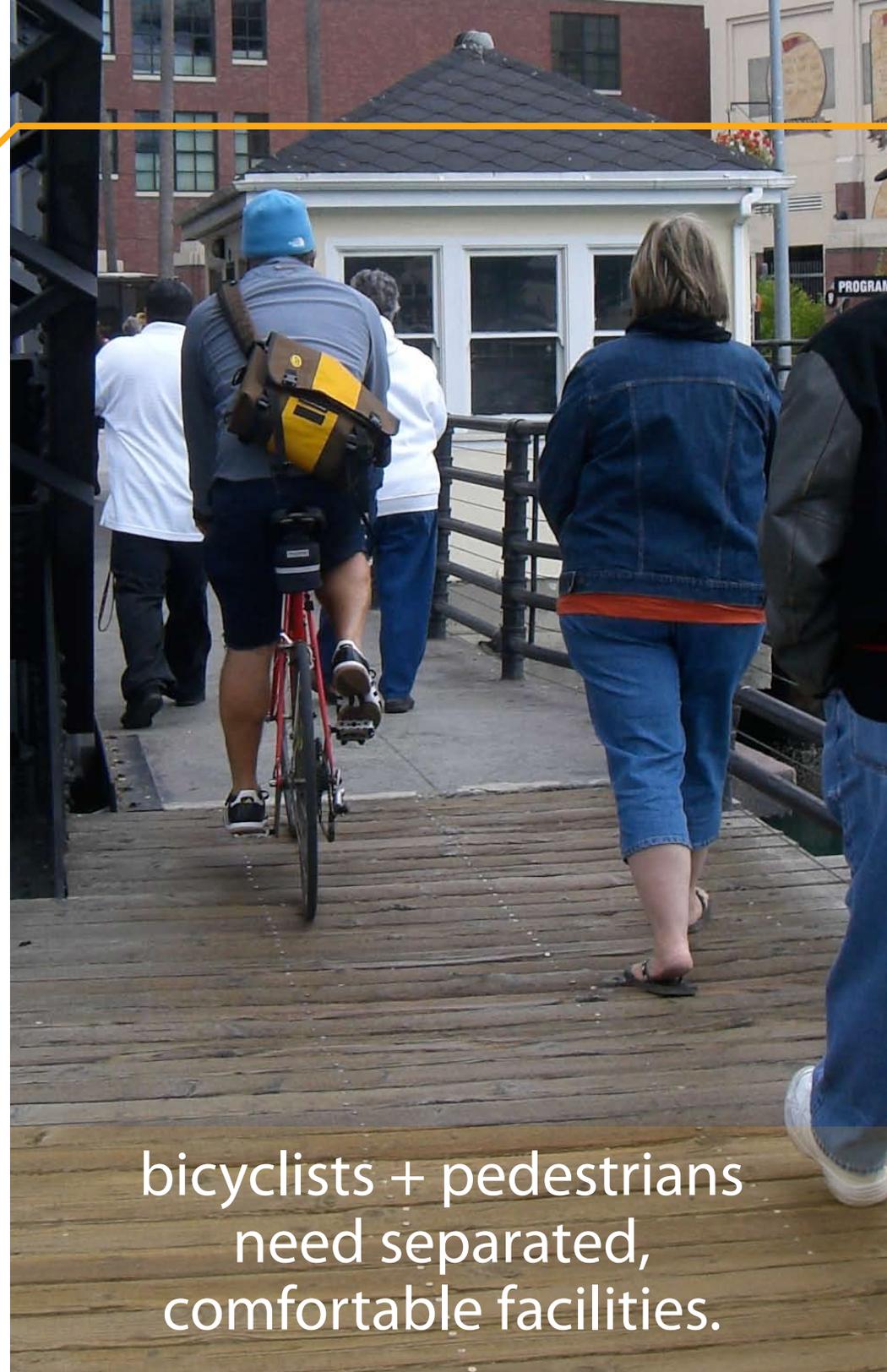
2. make the embarcadero a true “multi-modal” boulevard

In its existing form, the Embarcadero has all of the elements of a multi-modal boulevard without some of the necessary provisions for ensuring safety and enjoyment of those facilities. Neither the Third Street bridge, shown at right, nor Third Street have on-street bicycle facilities, although Third Street is designated as a Class III facility, meaning that it is considered a bicycle route. On Third Street, bicycles must brave high volumes of cars and trucks and cycle in the street or, as shown here, bike slowly next to pedestrians walking on the already narrow sidewalk. Neither solution is safe and neither solution benefits all parties involved.

The same situation can be found on the promenade, where bicyclists travel in both directions, weaving between pedestrians and other bicyclists, creating a free-for-all of bike and pedestrian movement. Though bicyclists can legally bike on the Promenade, it is not an ideal place to get from one location to another, and it is often frustratingly crowded for both bicyclists and pedestrians.

However, for many cyclists the Promenade is marginally better than traveling in the bike lanes on the Embarcadero, which are not suitable for such high speed and high volume roadways. In the southbound direction, the bike lane ends abruptly between Second and Third Street. The southbound bike line is narrow and tight against the parking lane, putting cyclists at risk of being doored for much of its length.

With the Embarcadero’s cultural and aesthetic draws and a widespread renewed increase in alternative modes of transportation, the Embarcadero waterfront has reached a tipping point. A new, truly multi-modal boulevard needs to be envisioned. Many of the pieces are already there--transit down the center of the street and lines of trees flanking the boulevard, but there is still a need to separate bicyclists and pedestrians in order to adequately address their needs as users. Bicyclists and pedestrians need separated, comfortable facilities in order to make the Embarcadero truly multi-modal.



bicyclists + pedestrians
need separated,
comfortable facilities.

3. create a premier bike facility for san francisco



build a separated bikeway in SF's most visible area, employing best practices in bike planning + design

In creating a separated bikeway, San Francisco will be pushing the envelope on what it means to bicycle in San Francisco. Employing best practices in bicycle facility planning and design, San Francisco will be able to create a world-class bike facility located in one of the city's most prominent areas.

The high-visibility location of the path will help bring returns on the path's success. At the mixing point of tourists, commuters from other

parts of the Bay Area, and locals, a Class I bicycle facility will be a source of pride and show a commitment to alternative modes of transportation in the city. It will also serve to draw even more people to the area, bringing locals out for a Sunday bike ride, new residents going to work from Mission Bay, tourists who want to more comfortably explore San Francisco, and commuters jumping off BART and onto the bike path.



in order to promote tourism

attract world-class tourists with biking facilities

photo: flickr.com/asmythie

The creation of a Class I facility will also help boost tourism in the area. The emBIKEadero proposal seeks to connect the waterfront between North Point Street and Terry A. Francois Boulevard, providing 2.6 miles of off-street bike facility. This will create a safer, longer facility for cycle-tourists to explore, allowing them to bike all the way to a Giant's game, explore new parts of San Francisco such as Mission Bay, and connect back to Pier 39.

The emBIKEadero path design accommodates those who want to ride together, such as families and friends vacationing together. The path is designed to have an ideal width of 15 feet, allowing two cyclists to bike side-by-side in the same direction. The design of the bike path seeks to make cycling as social event for those travelling in groups and allows those who choose to travel faster to safely pass other cyclists.



and
in order to
capture new
cyclists

make a facility that feels safe and is safe

Recent research on bicycling has shown that there is a large interest in bicycling among those who do not currently bike. One of the primary reasons for their hesitance is often safety concerns. Between the often chaotic situation on the Promenade and the unpleasant and discontinuous experience of riding in the bike lanes, San Francisco can do more to make facilities that make people excited about bicycling

indeed safe, San Francisco may be able to increase its mode share for bicycling. The feeling of safety on the facility will not only improve the experience of for current riders and for tourists but it may also help to attract a whole new group to cycling. The literature suggests that bike paths are a far more powerful draw to getting people to switch to bicycling than are bike lanes.

By creating a bike path that both feels and looks safe and is

BICYCLING IN SAN FRANCISCO

why we bicycle



According to MTA's 2008 *State of Cycling* report, almost 6 percent of all trips in San Francisco are completed by bicycle each day. Of those trips, 36% are for recreation or exercise, 28% are for work or work related purposes, 25% are shopping related, and 8% are school or education related. San Francisco's mode share for bicycling is much higher than the rest of the nation, especially considering the city's hilly topography.

With improved bicycle facilities and new bicycle facilities, San Francisco can help to address the growing bike community in the city. Cycling

along the San Francisco Bay is not only a beautiful ride for pleasure or recreation but it also provides opportunities to get to and from shopping and work destinations.

Ensuring connections to popular destinations by providing a long off-street bike path and adequate crossing facilities onto side streets with bike lanes, San Francisco can make their bicycle network more accessible and more successful and will help to make bicycling an increasingly equitable form of transportation.

BICYCLING ON THE WATERFRONT stakeholders

Stakeholder involvement is critical to the success of a Class I bicycle facility on the Embarcadero.

The Port of San Francisco owns the land in question, making it crucial group in envisioning the future of a dedicated bikeway. Many other groups also have a considerable stake in any reenvisioning process.

The Neighborhood Parks Council has done a great deal of planning in the area pertaining the Blue Greenway.

The San Francisco Bicycle Coalition and Livable City were also involved with the design process leading to this document, providing a comprehensive primer on the Embarcadero as well as subsequent design critiques and recommendations.

SPUR, as the organization organizing this proposal, has been involved in shaping this proposal at every step of the way.

Continued input and feedback from stakeholders is critical to this project. The emBIKEadero bike path must be a coalition effort in order maximize benefits for all users and, ideally, to promote intermodality.



envision the embarcadero as a north-south bike arterial





existing embarcadero waterfront bike network

- Class II facility (bike lane)
- - - Class III facility (bike route and/or wide curb lane)
- off-street shared-use path (Embarcadero Promenade, Bay Trail)



EXISTING CONDITIONS

on-street facilities analysis: northbound + southbound bike lanes



With almost 6 percent of daily trips in San Francisco completed by bicycle, San Francisco's bicycle facilities must meet the needs of not only its existing cyclists but also the increasing number of riders who are new to cycling.

While a new bike facility for the Embarcadero should further promote bicycling as an alternative mode of transportation, it must also adequately treat current cyclists. The existing bicycle facilities on the Embarcadero do not meet the needs of cyclists. Both the on-street bike lanes and the promenade pose safety concerns to cyclists and pedestrians.

As shown above, the bike lanes, especially in the southbound direction, can be treacherous to navigate. Shifts in the alignment of the lanes come with insufficient warning. At Battery, the bike lane disappears through an intersection where the Embarcadero hits the city's street grid at difficult angles.

Near the Giant's stadium, the southbound bike lane ends mid-block between Second and Third Streets on King Street, forcing cyclists to share the lane with vehicles moving upwards of 30 miles per hour.

Cyclists heading south toward Mission Bay are then forced to merge across three lanes of traffic to make a left onto Third Street. There, cyclists on the Third Street Bridge must either ride on the extremely narrow sidewalk or in the street in order to get to the southeastern portion of the city.

Both sanctioned and unsanctioned parking and loading activities further provide a threat to the safety of cyclists. Parking lane widths on the city-side of the Embarcadero and on King Street are uncomfortably narrow. Even small trucks do not always fit into these spaces, rendering the whole of the bike lane the "door zone". This makes cycling in the southbound direction particularly dangerous for those who use the facility. Indeed, many cyclists do not use the southbound lanes as a result of the inadequacy of bike facilities in that direction.

Throughout the Embarcadero, but especially on the waterside, loading commonly takes place in the bike lane even into the curb lane. As shown above, limousines, trucks with cargo, and even buses routinely do not use the pullout spaces provided. Instead, these vehicles double-park in the whole width of the bike lane and routinely also block a portion of the curbside



narrow bike + parking lanes



ambiguous lane configurations



dropped bike facilities

travel lane. This creates an impediment to not only bicyclists but to through motor vehicle traffic as well. While designated loading zone areas could be impacted with future proposals, it is important to understand that existing loading areas do currently meet the needs of motor vehicle drivers.

The designated loading areas that do exist consist of pullouts for private cars and buses. These facilities are primarily located on the waterside of the Embarcadero. Frequently, cars do not completely pull into these spaces, blocking the travel of bicyclists and other vehicles. Muni buses also often stop partially in one of the travel lanes and the bike lane when pulling over at a bus stop, creating problems for bicyclists and car drivers alike.

Any new proposal must accordingly seek to ensure that the bike facility cannot be easily blocked by motor vehicle traffic.

EXISTING CONDITIONS

off-street facilities analysis: the promenade



Mixed, often high-volume traffic on the Embarcadero Promenade poses problems for pedestrians as well as cyclists. The promenade is the name for the, at times, wide shared-use path that runs the length of the Embarcadero. At King Street, this facility gets narrower, more similar to a typical sidewalk, widening slightly in the blocks of King in front of the Giants stadium.

Between the current renewed interest in walking and biking in addition to the constant development of SOMA and Mission Bay, the Embarcadero sees very high pedestrian volumes throughout its length. While a mixed-use path once addressed the needs of pedestrians and bicyclists who did not feel comfortable cycling in the on-street facilities, the high cyclist and pedestrian volumes on the promenade no longer create ideal situation for either user group.

In some segments, the actual usable space of the promenade is quite narrow. With signage, the art ribbon, and the street lamps, the amount of space left to walk and bike in is significantly reduced. Navigating around street furniture and around groups of pedestrians can be tricky for bicyclists, especially for those

with less experience. This situation is also problematic for those who use the promenade as an opportunity to cycle at high speeds to get to their destinations. Other cyclists prefer the promenade because it allows for a more meandering path, taking in views of the water and the city.

Unlike more traditional shared-use paths that are common in waterfront areas with their signage and suggested separation of bicyclists and pedestrians, there is no indication of appropriate directionality or divisions of bicyclists and pedestrians. This creates a situation in which bicyclists freely weave through throngs of northbound and southbound pedestrians who are, in turn, freely spread out across the width of the promenade. Collisions and near misses are especially common near the Ferry Building, where cyclists often do not dismount despite large slow-moving crowds of pedestrians. The area is also excessively crowded during the weekday morning and evening commute. Recreational riders and rental bike riders often travel in larger groups, making it even more difficult to work their way through large crowds of pedestrians.

Many southbound cyclists will not use the on-street facilities,



safer for southbound cyclists



weaving + high speeds



no directional separation

because they are forced to stop at traffic lights, increasing their trip time. On the promenade, this is not a concern. Those who ride on the promenade have no traffic signals to follow until the turn onto a side street.

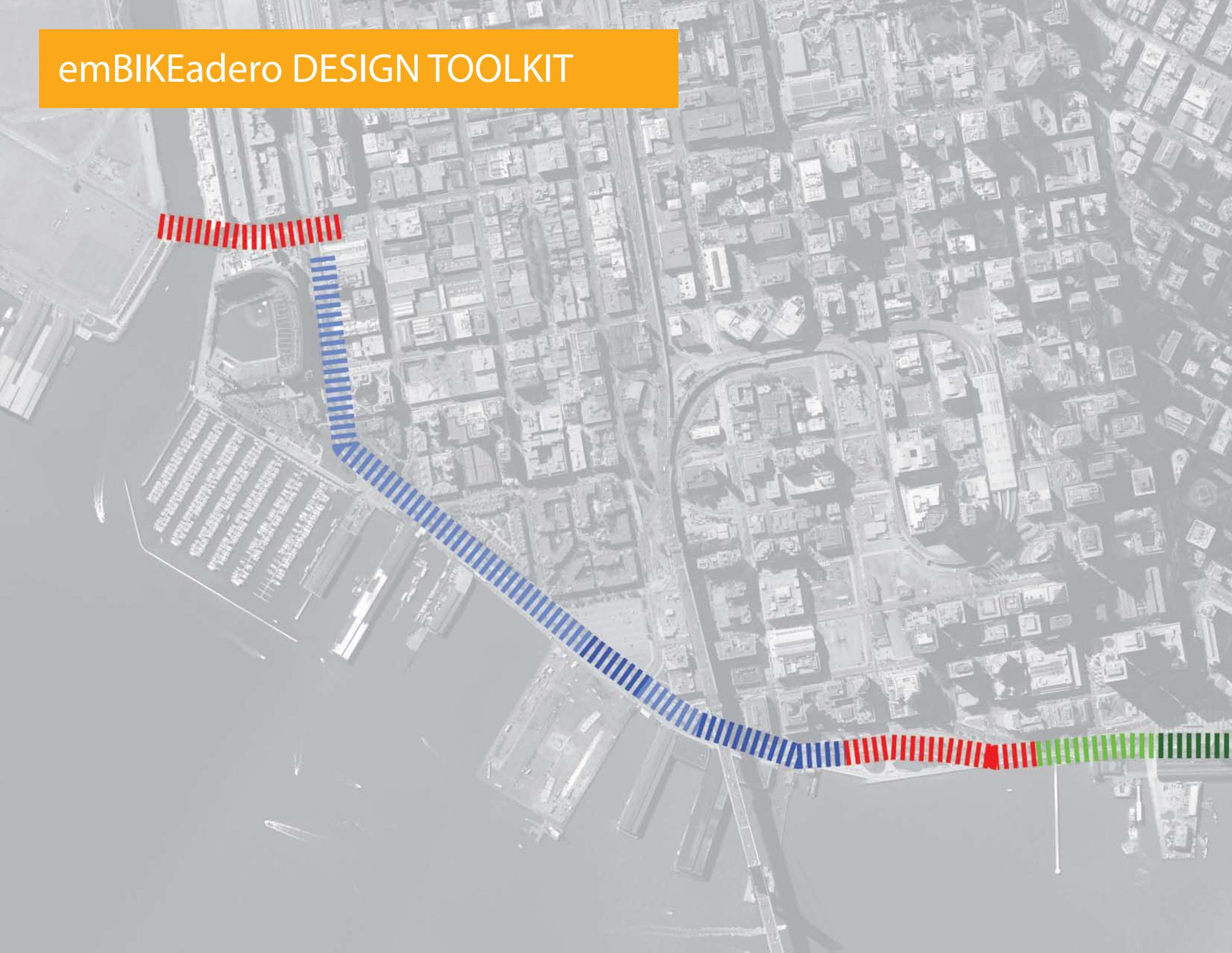
In some stretches of the southern waterfront, the promenade serves as the only bicycle facility in the southbound direction. Local cyclists know that when traveling southbound, they must cross-over and merge onto the Promenade before the bike lanes ends on King Street. If not, cyclists are forced to merge across three lanes of traffic to make a left onto Third Street from King Street.

Many cyclists find the promenade preferable simply because the bike lanes on the southern portion of the Embarcadero and King Street are typically more narrow than other stretches of the Embarcadero bike lanes. Parking lanes in the area significantly increase the risk of being doored. In addition to concerns over the on-street facility abruptly ending, these unsatisfactory existing facilities also cause many cyclists to switch over to the promenade early in their southbound direction.

While the promenade provides an off-street shared-use facilities

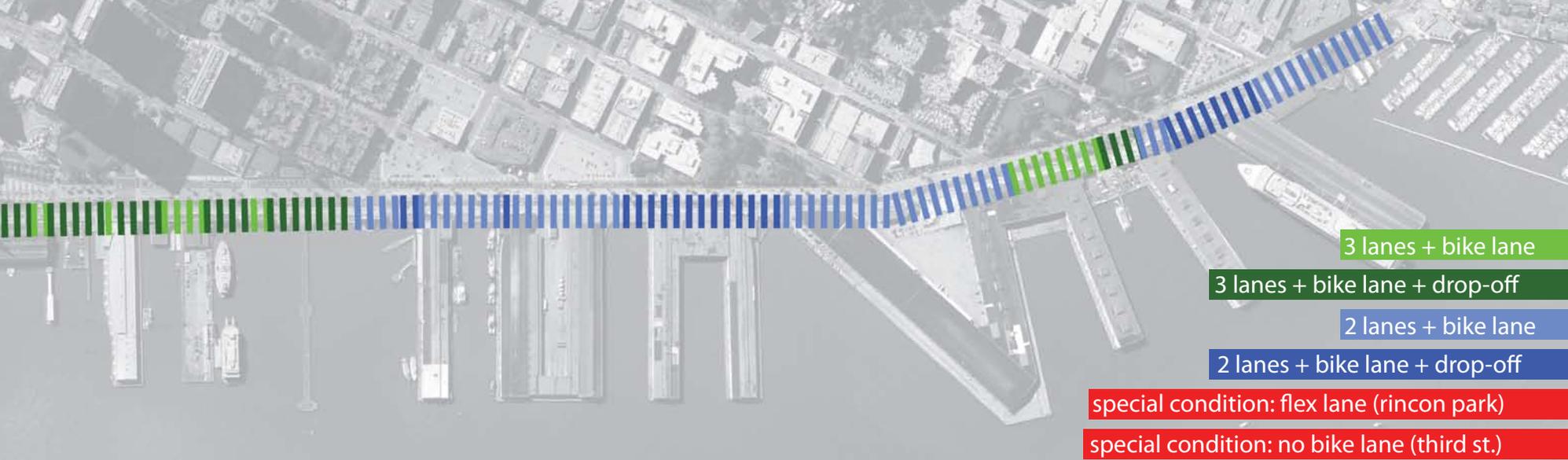
for bicyclists and pedestrians, the existing condition poses safety concerns with no clear sense of how to safely navigate through this facility.

emBIKEadero DESIGN TOOLKIT



envision a 15' bike path, wide enough for two bicyclists to bike side by side in the same direction, separated by a 4" grade change from pedestrian traffic and car traffic, extending 2.6 miles from Terry A. Francois Blvd. to North Point St.

this is the emBIKEadero separated bikeway

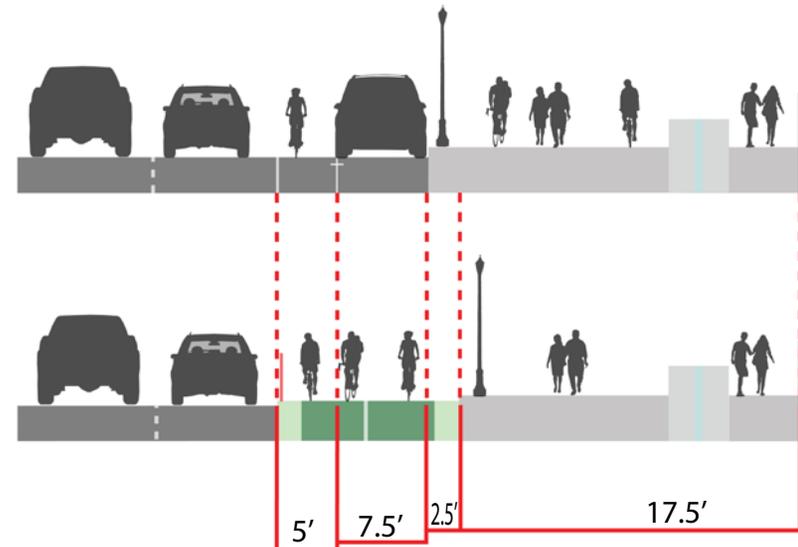


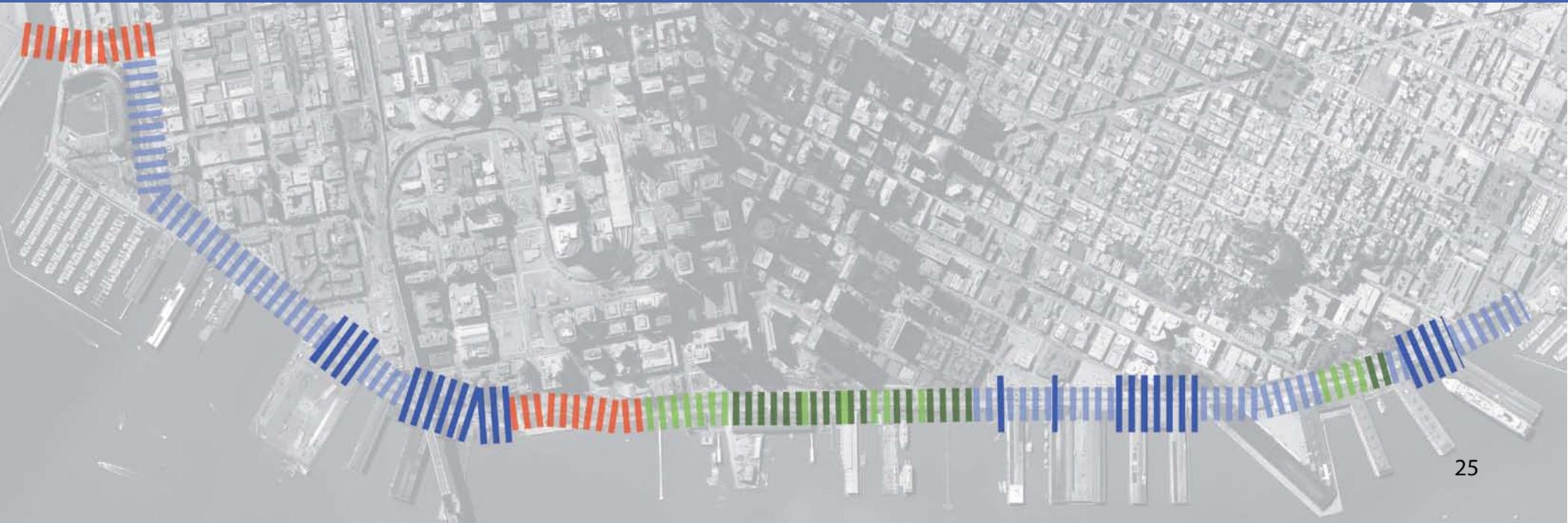
emBIKEadero MIDBLOCK DESIGN TOOLKIT condition 1: two lanes + bike lane + drop-off

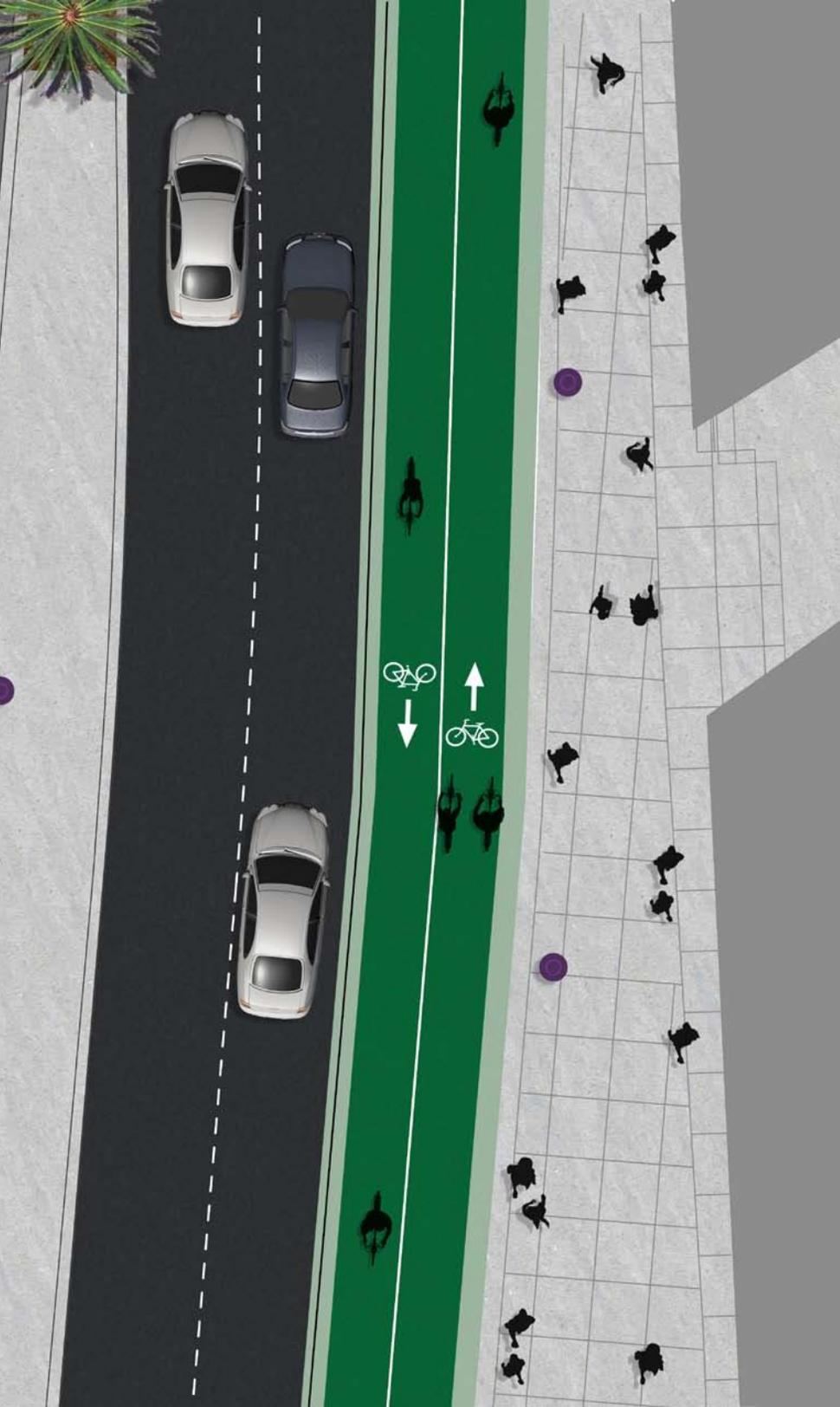
This condition occurs primarily on the northern and southern portion of the Embarcadero. Many of these areas with this lane configuration consist of smaller segments with pull-outs for parking and loading.

As shown in section, the existing lane configuration consists of a 5 foot bike lane and a 7.5 foot drop-off area. This creates at least 12.5 feet of space between the curb and the edge of the bike lane. The width of the promenade varies throughout this condition. Here, to get full 15 feet recommended for the path, the light posts must shift 3 feet. The extra 3 feet of room would be taken from the Promenade.

The drawing at top right portrays what the bicycle path might look like near Chestnut Street. The drop-off lane becomes the bulk of the of bike path, with the remaining width coming from the curb area.





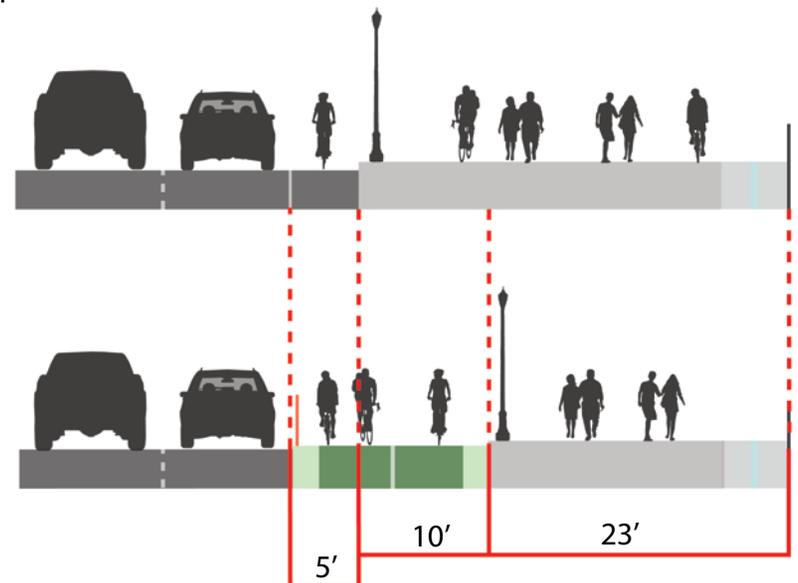


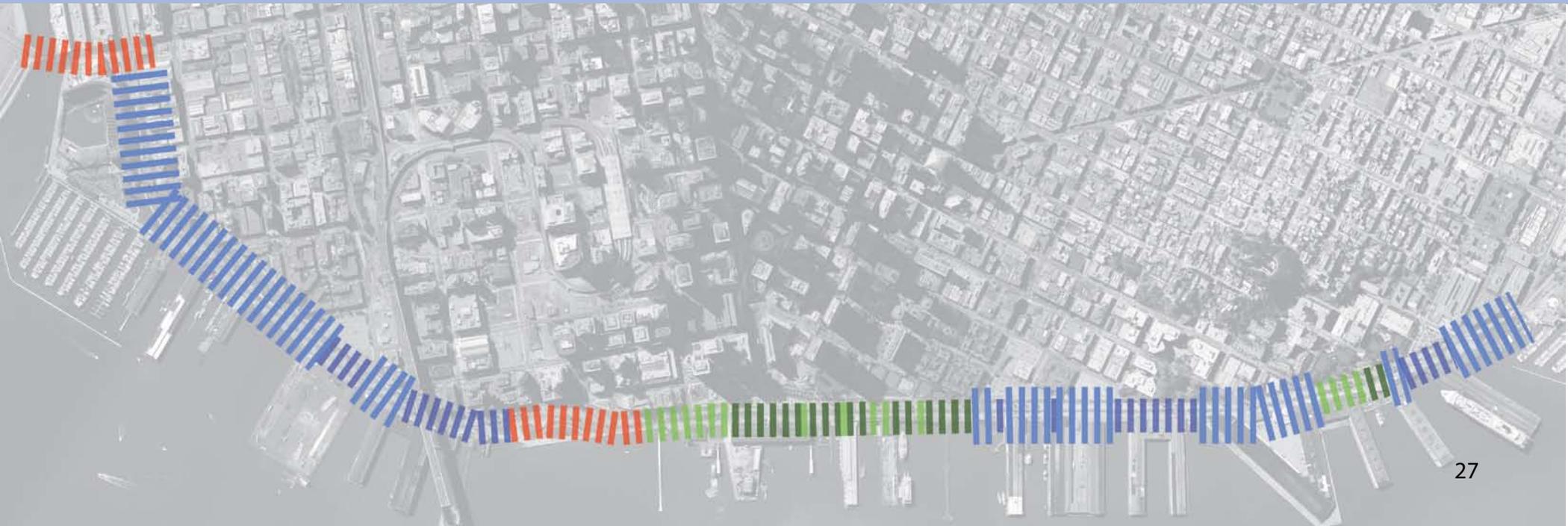
emBIKEadero MIDBLOCK DESIGN TOOLKIT condition 2: two lanes + bike lane

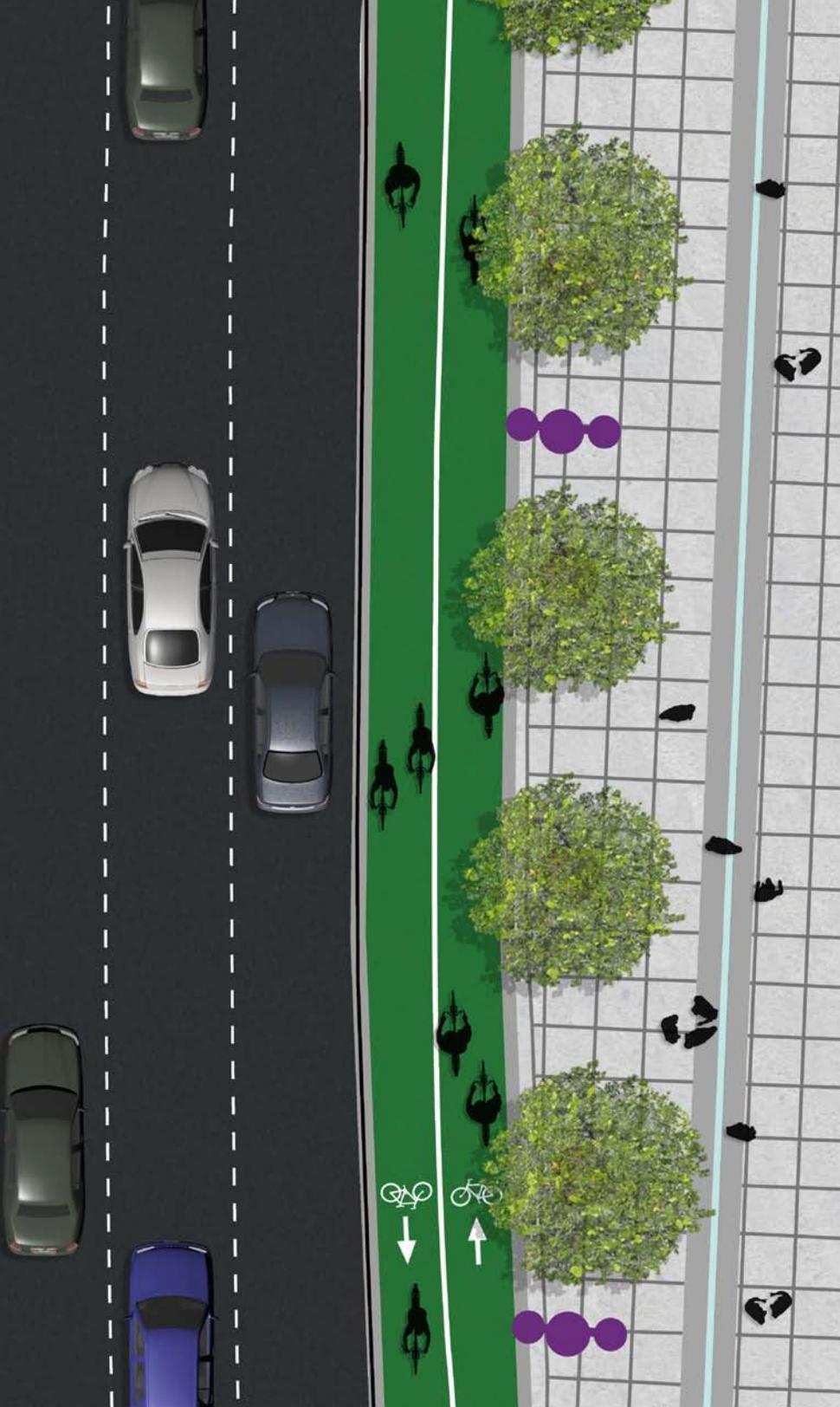
Condition 2 is the dominant condition in the southern portion of the Embarcadero and is almost as common along parts of the northern Embarcadero. The condition consists of two 10 foot travel lanes adjacent to one 5 foot bike lane.

This condition necessitates the shifting of the line of lamp posts that hug the Embarcadero. Lamps should be shifted to allow the full 15 feet of the path. The first 5 feet may be borrowed from the existing bike lane, with the other 10 feet borrowed from the promenade. In most locations, the promenade is able to absorb the 10-foot loss of space, such as at Pier 38, shown in plan. Just south of Pier 40 next to the park, shown at right, the promenade narrows to typical sidewalk length. As such the path will have to narrow down to 13 feet in width.

On the northern portion of the Embarcadero, where condition 2 alternates with condition 1 on a block-by-block basis, the lamp posts are set back from the roadway as far as they would be under condition 1. In these locations and if cost savings was critical, the bike path could be temporarily reduced to 13.5 feet in order to avoid the cost of shifting the lamp posts.



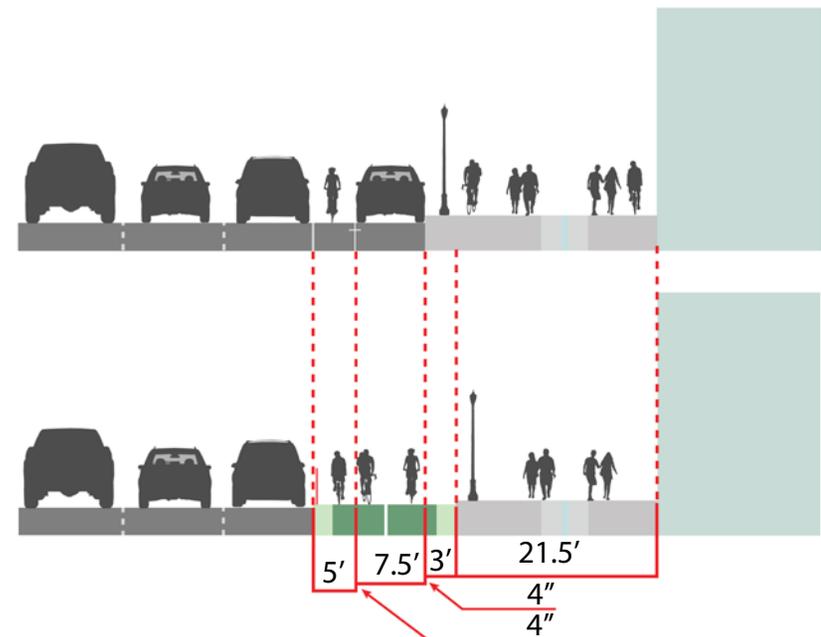


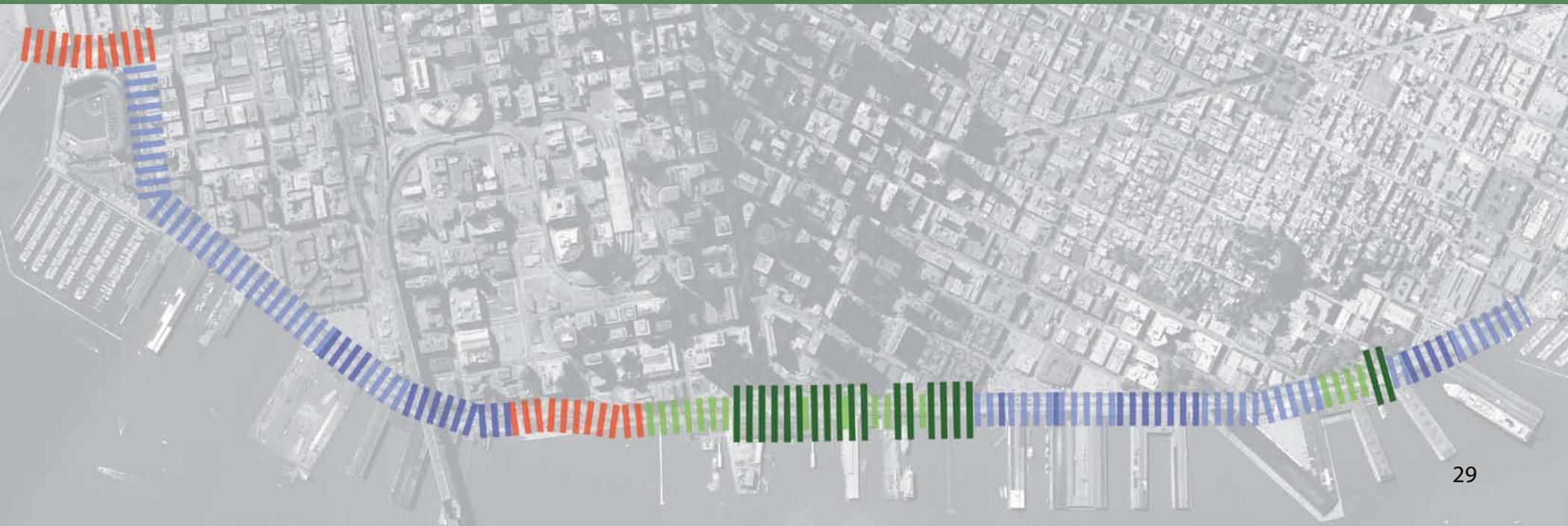
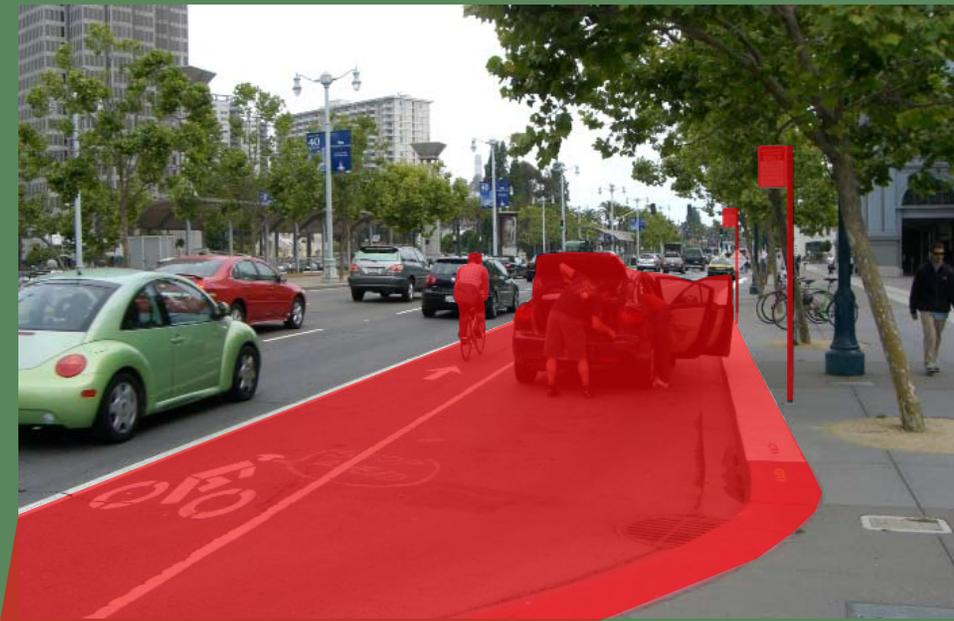


emBIKEadero MIDBLOCK DESIGN TOOLKIT condition 3: three lanes + bike lane + drop-off

Condition 3 occurs primarily in the stretch of the Embarcadero between the Ferry Building and Broadway, one of the heaviest trafficked areas of the Embarcadero by cars, bicyclists, and pedestrians alike. With a constant turnover of cars dropping off and trucks loading in front of the Ferry Building, this area is particularly precarious for cyclists.

Like condition 1, most of the width of the 15 foot path comes from the 5 feet of existing bike lane and 7.5 feet of parking lane. Especially in this area, making the path the full 15 feet width is critical with the large number of commuters, recreational cyclists, and tourists who frequent the area. It is critical that they have enough room to pass one another as well as to ride side-by-side. Shown at right, in front of the Ferry Building, the full 15 foot width can be achieved due to the wide loading zone area and the setback of the light posts.



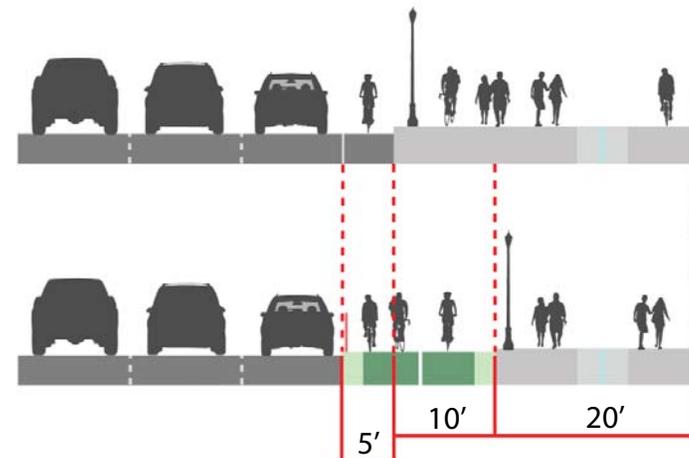


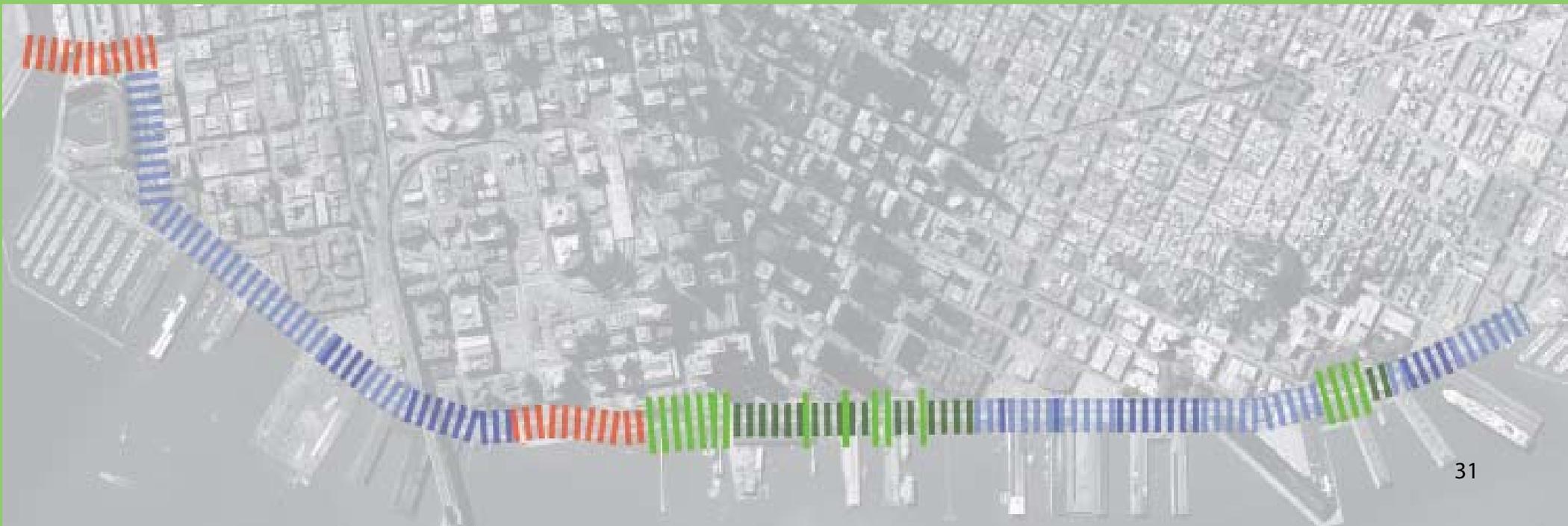
emBIKEadero MIDBLOCK DESIGN TOOLKIT condition 4: three lanes + bike lane

Condition 4 only occurs in small segments between the Ferry Building and Broadway and just south of the Ferry Building.

Without eliminating a lane of traffic, the lane configuration only allows 5 feet of space, taken from the bike lane. As a result, condition 4 demands that the line of lamp posts be moved back to accommodate the bike path. Shown in section, 10 feet will need to be taken from the promenade, as in the case in condition 2. However, because there is a third travel lane in this condition, closing the right most lane of traffic to cars would most likely be a far more economically efficient option than moving the string of lamp posts. As a next step, elimination of the third travel lane should be considered, especially in the long segment of condition 3, just north of Rincon Park.

On a segment-by-segment basis, depressing the Art Ribbon so that it is flush with the sidewalk should be examined in areas where widening of the Promenade is needed.

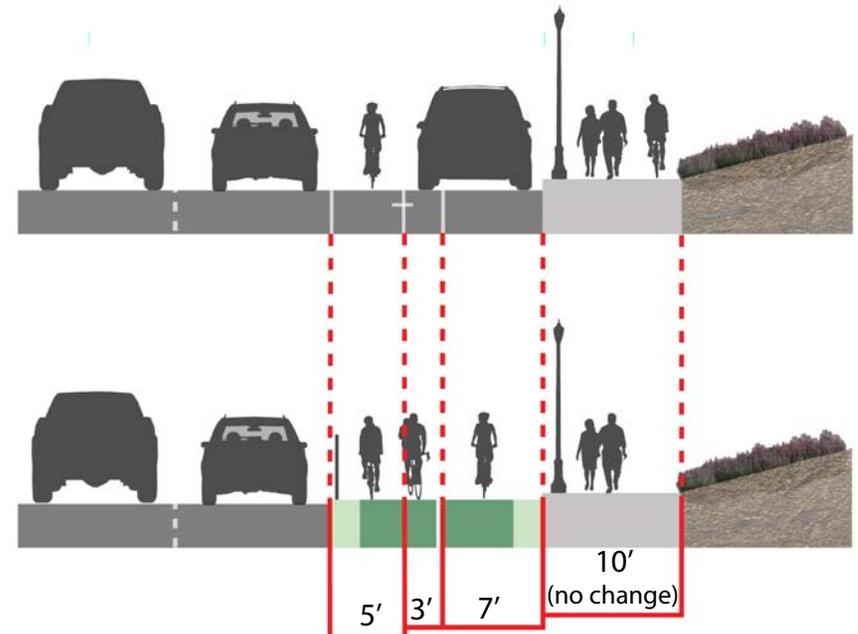


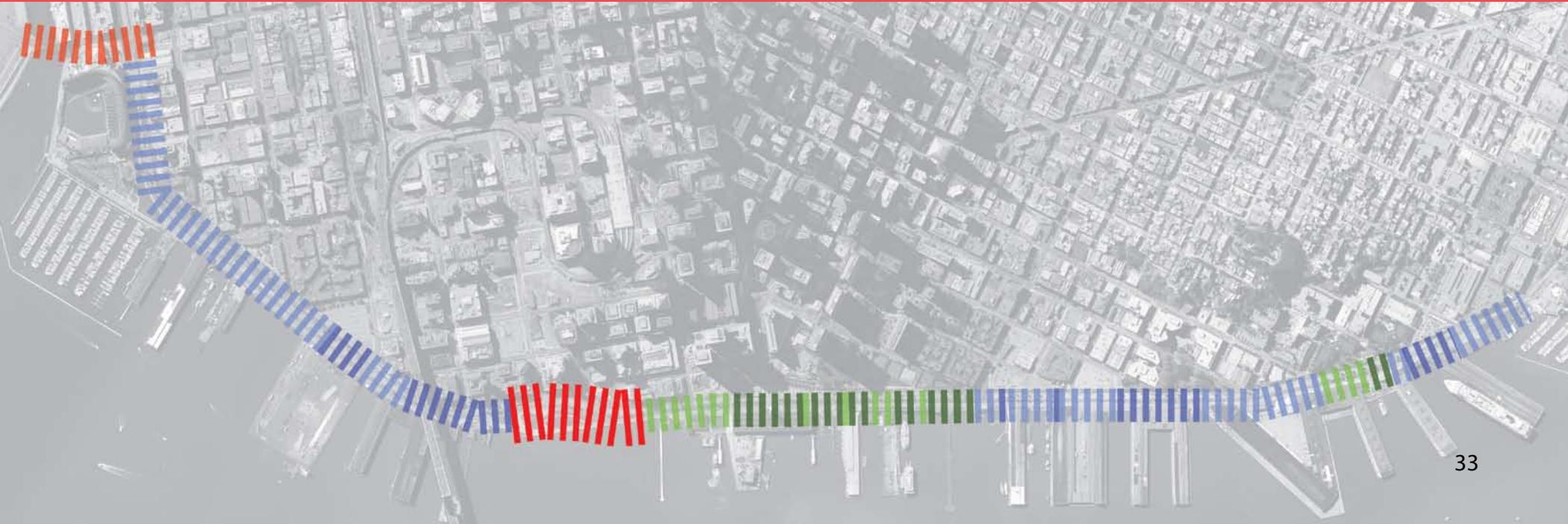
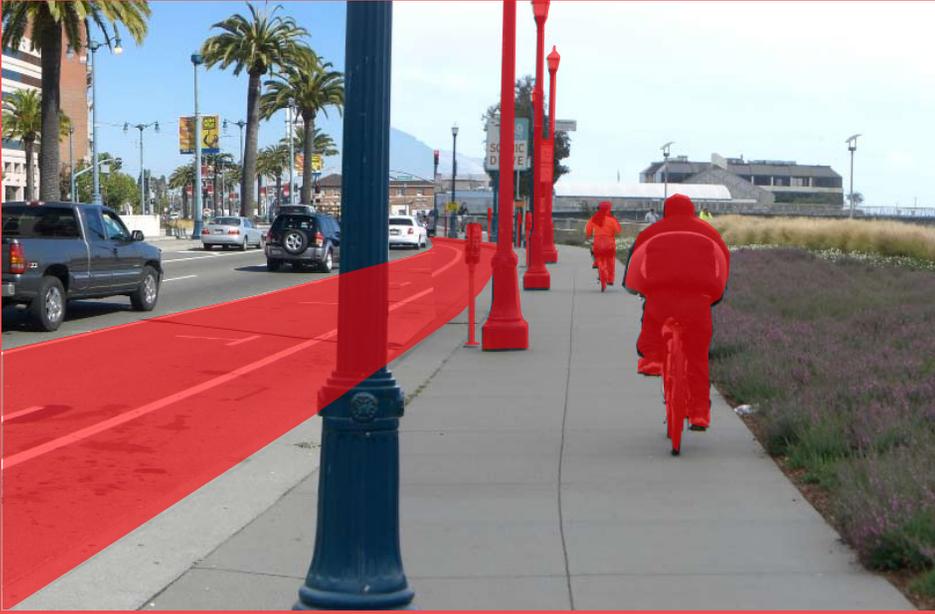


emBIKEadero MIDBLOCK DESIGN TOOLKIT special condition 1: flex lane/rincon park

Special condition 1 occurs in the lane configuration adjacent to Rincon Park. The configuration consists of two travel lanes and one “flex lane”, which serves as a third travel lane and a bike lane during peak commute hours and as parking stalls and a bike lane during the off-peak hours. Space for a bus stop is also provided.

The full 15 feet width can be borrowed from the existing flex lane, as shown below. As such, this segment will most likely be the cheapest segment to construct and will affect neither the pedestrian space nor the line of lamp posts.







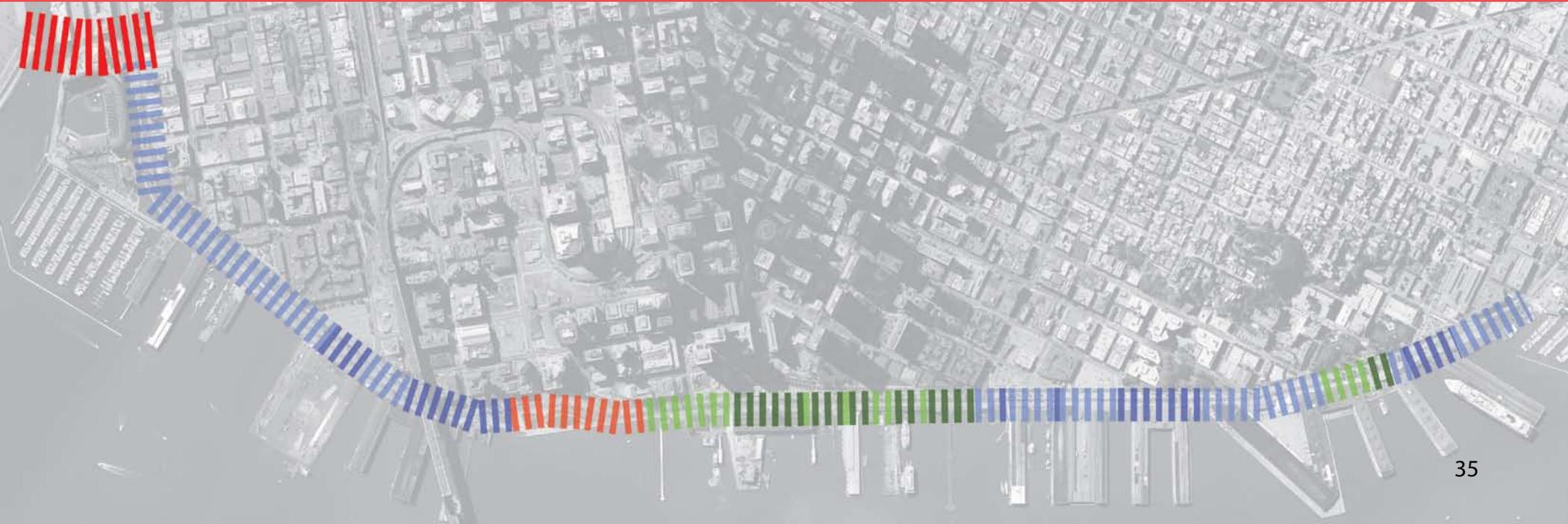
emBIKEadero MIDBLOCK DESIGN TOOLKIT

special condition 2: ballpark + third street bridge

Special condition 2 occurs on Third Street from the Third Street Bridge to Willie Mays Plaza. Here, there are no existing bicycle facilities. Bicyclists must cycle in the travel lane or, as some do, cross the bridge on the extremely narrow sidewalk. Once over the bridge, cyclists emerge onto a wide road also with no bike facilities.

As proposed, the right-most travel lane of the bridge would be given over to the bike path, as is already done during Giants home games. The loading zone on the north side of the bridge would be preserved. Following the loading zone typology as described in this document, the loading zone would shift out and the bike path would travel adjacent to it on the right side of the area. The bike path would then continue to Third and King in the right most travel lane, which is presently a right-turn lane. The bike path would then turn right onto King Street, borrowing space from the existing bike lane and the large sidewalk in front of the ballpark. The northbound travel lanes at Third and King consist of a turn pocket for left and through traffic, three through lanes, and a right turn lane. The proposed reconfiguration would eliminate one of the through travel lanes.

Once on King Street, the path should narrow down to 13 feet in order to provide adequate pedestrian space. The existing row of trees in front of the stadium will need to be removed in order to accommodate a bike path in this location, no matter what the width.



emBIKEadero INTERSECTION DESIGN TOOLKIT

loading zones

In the Embarcadero's existing state, many drop-off zones and some parking spaces are located on the waterside of the boulevard. These areas primarily provide space for passenger loading, delivery trucks, and valet parking. Delivery and drop-off uses will need to be accommodated by the new bike path design, though drop-off options on the city side of the Embarcadero should be made. Signage should also direct those interested in parking to nearby garages on the city side of the Embarcadero.

Loading should be encouraged in off-peak hours, especially early mornings in order to address most the delivery needs along the Embarcadero. Additionally, as is the case currently, many vehicles will continue to treat the curbside travel lane as a drop-off area, continuing to block traffic as they do today.

Although their accommodation will demand further study in the next phase of this project, several locations have been identified as able to accommodate a loading zone area. Depicted at right, a longer loading zone could be sited just south of the Ferry Building. This could accommodate both delivery trucks as well as the various public and private buses that pick up and drop-off passengers at the Ferry Building.

The design consists of three elements. The lane itself should be the width of the existing parking stalls on the Embarcadero, approximately, 7.5 feet. Adjacent to this is a 5 feet wide staging area, allowing an intermediate space for trucks drivers to unload goods and for people to get out of cars without being in the bike path.

The bike path railing should still run the length of the loading zone with breaks in the railing so that people can cross the



bike path at selected locations. Especially when loading zones may be longer, such as this one proposed by the Ferry Building, it is important to minimize the conflict points between bicyclists and pedestrians. Limiting the number of crossing points will make the crossing safer for both bicyclists and pedestrians. The breaks in the railing should be small when loading is intended for private vehicles or trucks, approximately, 6 feet in width. At bus stops, however, the openings should be slightly larger to accommodate more pedestrians. Signage should also be used to warn bicyclists and pedestrians of oncoming traffic.

emBIKEadero INTERSECTION DESIGN TOOLKIT driveways (non-signalized)

In its existing form, driveways are a constant feature throughout the length of the Embarcadero. These driveways were necessary features when the Port properties were more actively used for maritime purposes and, even up to today, as parking lots. A large number of driveways still remain though many lead to bulkheads that are uninhabited or have changed uses. Some of the driveways, however, are still used, such as the one at Pier 27, which houses a commercial seafood company. As Port properties become redeveloped, new driveway construction should be kept to a minimum and, ideally, no new driveways should be added. If absolutely necessary, driveways should follow the prototype explained here.

The prototype for treating the bike path through non-signalized driveways is shown at right. In order to accommodate the width of the driveway the bike path temporarily shifts its alignment, slowing down bicyclists as they approach the intersection. The railing of the bike path is broken along the width of the driveway such that, in combination with bollards, trucks and other vehicles entering the driveway are forced to turn at right-angles. This serves to maximize drivers' visibility of oncoming cyclists.

Bollards are placed in the white stripe dividing the lanes of bike traffic. Bollards should be set back from the driveway area to provide advanced warning to cyclists, giving them adequate time to take evasive action if there is a problem ahead.

As the bike path is located at an intermediate elevation between the street and the sidewalk, the driveway will bring motor vehicles at grade with the bike path. Shown above, a ramped curb is recommended to bring trucks from the bike



path grade to the promenade grade. This is recommended to avoid taking up more of the width of the promenade.

Signage should also be posted to help both motor vehicle drivers and cyclists to recognize the potential for conflict. At driveways with small traffic volumes, bicyclists should yield to oncoming motor vehicle traffic. At driveways with significant traffic volumes, bicycle signals should be considered to ensure the flow of motor vehicles and bicycles through the area.

Driveways with active uses should be accommodated in the above manner. Driveways that are no longer in use should be eliminated with the construction of the bike path.

emBIKEadero INTERSECTION DESIGN TOOLKIT

signalized intersections

At right is the proposed redesign for the intersection of the Embarcadero at Bryant Street. On the east side of the intersection is a driveway accessing the parking lot on Pier 30. This drawing serves as a prototype for how to treat the bike path through pedestrian crossings and motor vehicle crossings as well as how to design new bike crossings.

As with the driveway prototype, the path temporarily narrows at the intersection. Pedestrians are given priority at the intersection, indicated by a change in material. The change in material should be in accordance with the aesthetic of the Embarcadero waterfront. As shown, the crosswalk material suggested is the alternating dark and light colored, long granite pavers that are used in the plaza area between the end of Market Street and the Ferry Building (Appendix A). The pattern of the granite further reiterates the hierarchy of the intersection, drawing pedestrians through the space with the long slabs of granite oriented with their travel path while bicyclists, traveling perpendicular to the long linear slabs may be encouraged to slow down, traveling counter to the pattern of the paving.

At signalized intersections, bicycle signals should be introduced. At a four-way intersection, such as at Bryant/Embarcadero/Pier 20, bicycle signals should be timed so that a red phase coincides with green phase for cars crossing the Embarcadero from Bryant Street and Pier 20 and pedestrians crossing in the east-west direction.

At three-way intersections (not represented here), however, the bicycle signal for through cyclists should be red only when pedestrians are allowed to cross the Embarcadero. Thus at a three-way intersection such as Howard and the Embarcadero, bicyclists will be allowed through movement as cars turn off of Howard and onto

the Embarcadero. This serves to maximize the amount of continuous riding available to bicyclists in both directions while also ensuring pedestrian safety. Maximizing the amount of continuous riding may also aid enforcement efforts.

Bicycle crossing facilities should be implemented at each intersection along the bike path. Early efforts should focus on building crossing facilities at streets with existing and/or planned Class II and Class III planned facilities. Modeled after the blue bicycle crossing common to Copenhagen (Appendix A), the crossing lane should be painted green and may also have a dashed line painted on either side of it, as is done in Seattle. The crossings ramp to meet the grade of the bike path over the same distance as the curb cut.



- DESIGN COMPONENTS FOR SIGNALIZED INTERSECTIONS**
- 1. bollards in median
 - 2. narrowing and shifting of bike path
 - 3. demarcated pedestrian crossing
 - 4. driveway
 - 5. ramped curb
 - 6. bicycle signal
 - 7. eastbound bike crossing
 - 8. westbound bike crossing
 - 9. crosswalk curbcuts

emBIKEadero PARKING CONSIDERATIONS

back-in angled parking (BIAP)

Much of the space needed for the full width of the bike path is created by eliminating the existing pockets of parking and loading areas on the water-side of the Embarcadero. In total, 145 parking spaces would be eliminated and be absorbed into the new bike path under this proposal. Given the importance of parking revenue for the Port of San Francisco and the fact that people do, and will, continue to drive to the area, ways to replace the parking should be considered.

The Embarcadero, as a higher speed and high volume roadway, is not well suited to back-in angled parking (BIAP), which is primarily recommended on lower speed streets. It is widely used across the US as a way to increase the number of parking stalls available but also as a tool for traffic calming. It is often combined with a “road diet” of the street, a redesign of a once autocentric street, often with overly wide travel lanes, using that space to instead provide an improved biking and walking environment. In comparison to front-in angled parking, BIAP provides increased visibility for drivers as they pull out of a space, especially helping with visibility of bicyclists. Given that side streets such as Broadway or Washington will serve as feeders to the emBIKEadero bike path, “road dieting” those streets by narrowing travel lanes to 10 feet and consolidating parking stalls will help to traffic calm the area while replacing the parking loss on the Embarcadero.

BIAP on those streets would also provide the opportunity to employ other engineered traffic calming solutions, such as bulb-outs on street corners.

The diagram at right shows the streets examined for suitability for BIAP based on the width of the street. Many streets in South Beach already have perpendicular parking, but streets on the north portion of the Embarcadero, near Levi Plaza, have traditional parallel parking. Replacing that with BIAP and adding new BIAP parking where room permits would produce a net increase of parking, adding as much as 178 new parking spaces.

145 water-side parking spaces
need to be reconfigured to build the bike path



back-in angled parking on nearby side
streets would completely absorb the
parking loss



converting existing parallel parking to back-in angled parking on local side streets “road diets” those streets, making side streets safer for bicyclists + pedestrians



emBIKEadero CONCLUSION

With the growing number of bicyclists and pedestrians in San Francisco and a renewed interest in bicycling even by those who do not bike regularly, San Francisco has reached a critical crossroads in the story of its built environment. As an increasingly viable mode of transportation, the reality of cycling and walking as alternatives to private car use is increasingly prevalent in San Francisco and the Bay Area. Even among those who still own vehicles, a quick trip via bike to the grocery store or walking to work a few times a week makes an enormous difference on a variety of levels.

Changing one's travel behavior is a difficult process. It involves breaking routines, finding new means of doing what one already knows, and encouraging oneself to stick with it. San Francisco must make alternative modes of transportation as easy as possible. The emBIKEadero bike path does just that, giving pedestrians and cyclists their own spaces that best address their unique needs as user groups. The emBIKEadero path will be a north-south bike arterial, making bicycling in San Francisco simple and enjoyable. By creating a separated bikeway in one of the city's most visible and beautiful areas, San Francisco can help encourage the health of its citizens, improve the health of its environment, and continue to invite people to explore its waterfront on bicycle.



appendix a: design precedents



BIKE RAMP. Short ramps are used on the Hawthorne Bridge in Portland to bring bicyclists from the bike lane, at grade with cars, up to the shared-use path on the bridge. Similar short ramps are recommended to bring cyclists from side streets to the Embarcadero path.

credit: flickr.com/Mark Strosberg



BIKE CROSSINGS. Seattle uses the green bike facilities to bring cyclists through difficult intersections. The green lane indicate continuity of the bike space. Dashed white stripes are typically painted on both sides of the green lane.

credit: flickr.com/SPangborn



BIKE CROSSINGS. Copenhagen's "L" shaped crossings allow cyclists to make left-turns off of cycle tracks without merging into vehicular traffic. Cyclists follow the pedestrian signals, crossing the first street, stopping at the next corner until the signal changes, and then proceeding as through-moving traffic

credit: flickr.com/liv dahlin



FERRY BUILDING GRANITE PAVERS. Long granite pavers are used to create a rhythm of dark and light stripes. This pattern creates a suggested pedestrian route from the end of Market Street to the main entrance of the Ferry Building.



CONTRA FLOW BIKE PATH. At Crissy Field, the popular bike path leading to the Golden Gate Bridge has eastbound bicycle traffic moving next to westbound car traffic. The potential for conflict is in part mediated by the grade separation between bikes and cars, with the bikes at grade with the sidewalk.



BIKE SIGNALS. New York City's 9th Avenue bikeway uses bike signals to help control bicycle traffic. The red signal phase for bicycles allows cars traveling on 9th to make a protected left-turn on to side streets and allows cars on side streets to turn onto 9th Avenue.

credit: flickr.com Kylie Gradinger/BCGP



GREEN ASPHALT. The color of green paint used on bike lanes and bike boxes in Portland is currently slated to become the new national standard for bike facilities.

credit: flickr.com/intrepidation



THIRD STREET BRIDGE. During Embarcadero Sunday Streets, the northbound lanes of the bridge are shut down to car traffic.

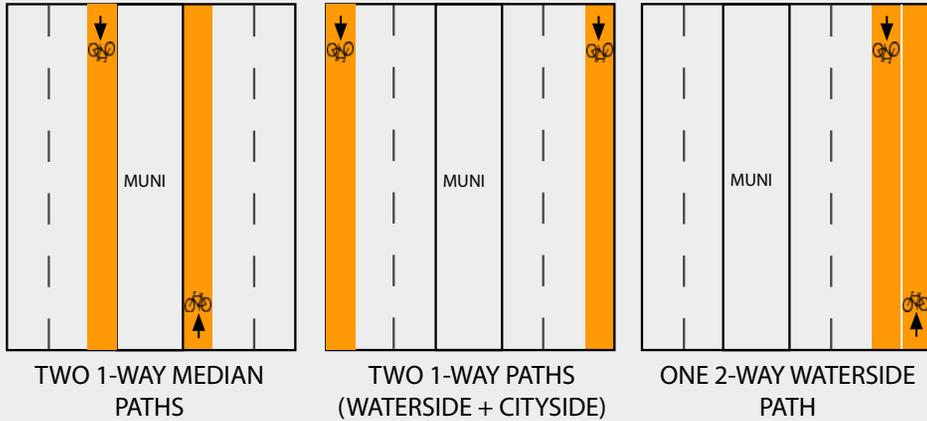
credit: flickr.com/luxomedia



THIRD STREET BRIDGE. The two northbound lanes of traffic (adjacent to the water) are closed to car traffic during the Giants' home games, allowing thousands of pedestrians to cross the Third Street bridge safely and effectively. Car traffic is rerouted to the remaining two lanes, providing travel in each direction.

appendix b: alternative proposals

proposals originally considered



Three project alternatives were originally studied, and the one 2-way waterside path option was chosen for further development. While the two 1-way median paths merit further study, the 2-way waterside in the recommended proposal.

two 1-way median bike paths



- pros
- + very safe option for cyclists
 - + no driveway/dooring/loading conflicts
 - + bikes ride in the direction of traffic

- cons
- may not look/feel safe to bicyclists
 - does not permit continuous riding
 - difficult to access mid-block destinations
 - not pleasant for riders
 - requires lane reconfiguration

two 1-way bike paths



pros

- + bikes ride in the direction of traffic
- + allow continuous riding in the northbound direction

cons

- does not allow continuous riding in southbound direction
- doubles the curb, parking, & drop-off changes
- encourages wrong-way riding by southbound cyclists

appendix c: references + acknowledgements

references: selected works consulted

- Caltrans. *Highway Design Manual Chapter 1000*. June 26, 2006.
- Jensen, Søren. "Bicycle Tracks and Lanes: A Before-After Study." TRB 87th Annual Meeting. Washington, DC (January 2008), 1-15.
- Reschovsky, Clara. *Journey to Work: 2000*. US Census Bureau (March 2004). *San Francisco Bicycle Plan* (1997).
http://www.sfgov.org/site/bac_index.asp?id=11525.
- Ridgway, Matthew and Mike Sallaberry. "Roadway Separated Bikeways in the US and Canada." Presented at Pro/Walk Pro Bike Conference 2008.
- San Francisco Municipal Transportation Authority. *2007 Citywide Bicycle Counts Report* (November 2007).
- San Francisco Municipal Transportation Authority. *Citizens' Guide to the Bicycle Plan*. undated.
- San Francisco Municipal Transportation Authority. *San Francisco Bicycle Plan* (June 2004).
- San Francisco Municipal Transportation Authority. *State of Cycling Report* (2008).
- San Francisco Municipal Transportation Authority. *Traffic Counts* (7/29/2008). http://www.sfmta.com/cms/rtraffic/documents/Volume_web.pdf
- Zeegers, Theo. "Width of Bicycle Paths." *Ketting 173* (October 2004), 4-6. <http://www.fietsberaad.nl/index.cfm?lang=en§ion=Kennisbank&mode=detail&repository=Width+of+bicycle+paths>

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